Appendix C08-01

Transportation Route for Heavy Equipment

AZERBAIJAN REPUBLIC

Azpromtechenergo LLC

Yashma TPP

HEAVY EQUIPMENT

TRANSPORTATION ROUTE

AY-TR001

2014

AZERBAIJAN REPUBLIC

Azpromtechenergo LLC

Yashma TPP

HEAVY EQUIPMENT

TRANSPORTATION ROUTE

AY-TR001

Director	**M.G.Behbudov**
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YASHMA COMBINED CYCLE POWER PLANT Project

LOGISTICS ANALYSYS and VARIOUS ROUTES SURVEY

Baku, Azerbaijan 2014

- The Purpose of this Submission

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  - To determine preliminary route possibilities related to the project
  - To determine transshipment ports capacities/ infrastructure
  - To examine existing port facilities in close proximity to the site
  - To examine temporary discharge berth or ports under construction
  - To analyze and advise sea / river/ canal route details
  - To investigate existing road infrastructure
  - To make recommendations for usage of Port facilities
  - To make recommendations on Road infrastructure

- CONTENT of this Submission
  - Transshipment ports/ facilities in Black/ Azov sea - Details
  - Volga-Don Canal System details and requirements
  - Ports of discharge in Baku/ Azerbaijan/ Details
  - Customs Requirements in Azerbaijan and Documentation
  - Routes from Discharge port to Job site / Survey & Details

• Transshipment Ports

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There are several ports in Turkey, Russia, Ukraine and Romania where transshipment can take place. General cargo can be transshipped at Georgian ports of Poti and Batumi for further inland transportation by Rail or Road transport to Sumgait City up to Job site. In this submission we would like to consider ports capable and experienced for handling of special project cargo where a lot of engineering solutions must be implemented. Below table demonstrates positive and negative aspects for operating at some of the ports in Black/ Azov sea for project cargo handling:

Name of the Port	Positive	Negative
Derince / Turkey	All year round, draft, good experience MPS rail connection is available through ferry to Ilichevsk	No own lifting capacities, has to be mobilized from 3rd party. Far distance from Volga-Don Canal entry
Trabzon/ Turkey	All year round, Draft up to 10.5 meters.	Small port, max length of ship can accept 150m. Lifting capacities has to be mobilized from 3rd party
Constantza/Romania	Huge port – up to 100 Mln tons turnover, Very good draft up to 19 m,	No big heavy lift projects experience. Far distance from Volga-Don Canal entry. For barge berthing draft is just 5 m.
Novorossiysk/ Russia	All year round, MPS rail access. Good draft to accept ocean ships.	Very congested, having 60 mln tons of cargo turnover not really interested in project cargo. No high lifting capacities
Poti/ Georgia	All year round, 2 x 100MT port mobile (Grove) cranes, MPS Rail way access	Very congested with general and containerized cargo, in 2014/ 2015 because of BP and Chevron projects will be hard to use for big projects
Ilichevsk/ Ukraine	All year round, good draft, Bogatyr-300MT Floating crane available, MPS rail way access	Port has not been refurbished for a long time.
Mariupol/ Ukraine	Very close to Volga-Don canal, very good experience in handling project cargo, 3 floating cranes available, high engineering capacity, MPS rail Way access	Dec-Feb winter months usage of Icebreakers required

• Transshipment Ports

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1. **Port of Derince** in Turkey (Kocaeli/ Izmit city). This port is Turkish state owned port with pretty big experience in project freight handling. Berth 5, 6 and 7 have been recently refurbished and can accept heavy cargo in accordance with international standards. There are 7 shore cranes upto 35 tons, 6 mobile cranes of upto 25 tons capacity, 30 short mast forklifts. Equipment for heavy lifts are ordered from 3rd party suppliers and there are mobile and crawler cranes available within 40 km radius with capacities up to 800 MT. Draft at the port vary 7-12 meters. Direct transshipment from ocean ships to river-sea ships or barges requires special permits from authorities due to high wave phase.
   TGP has an experience of usage of Derince port for a number of projects. For Janub 750MW Power Plant construction project in Azerbaijan port Derince was used for transshipment of heavy lifts – 8 GE turbines and generators at 212 and 174 MT each accordingly and 36 boiler units from 97 to 155 MT each



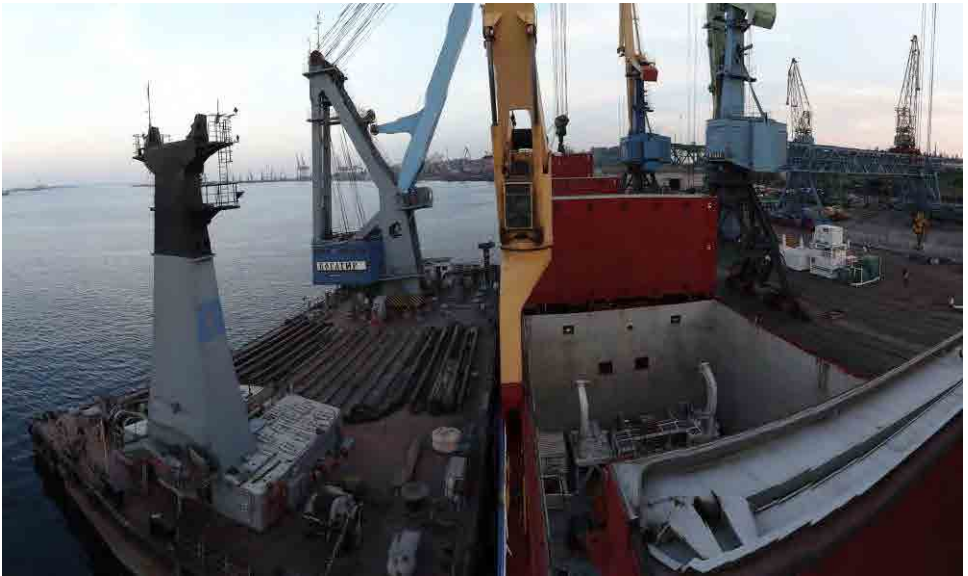


- Transshipment Ports

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2. **Port of Ilichevsk**/ Ukraine (Ilichevsk city). The Port receives vessels with any length and draught up to 13 m. Territory of the Port 346 hectares. Length of the Port berth line 5400 m. Warehouse area 54002 sq.m. Open storage area 743 094 sq. m.. There is a Floating Crane Bogatyr allocated to this port with lifting capacity up to 300 MT. TGP has recent experience of usage of this crane at Ilichevsk port during transshipment of 225 MT McDermott's SAT system from Ocean vessel to river-sea ship consigned to Baku, Azerbaijan.
Ilichevsk port is navigable all year round.





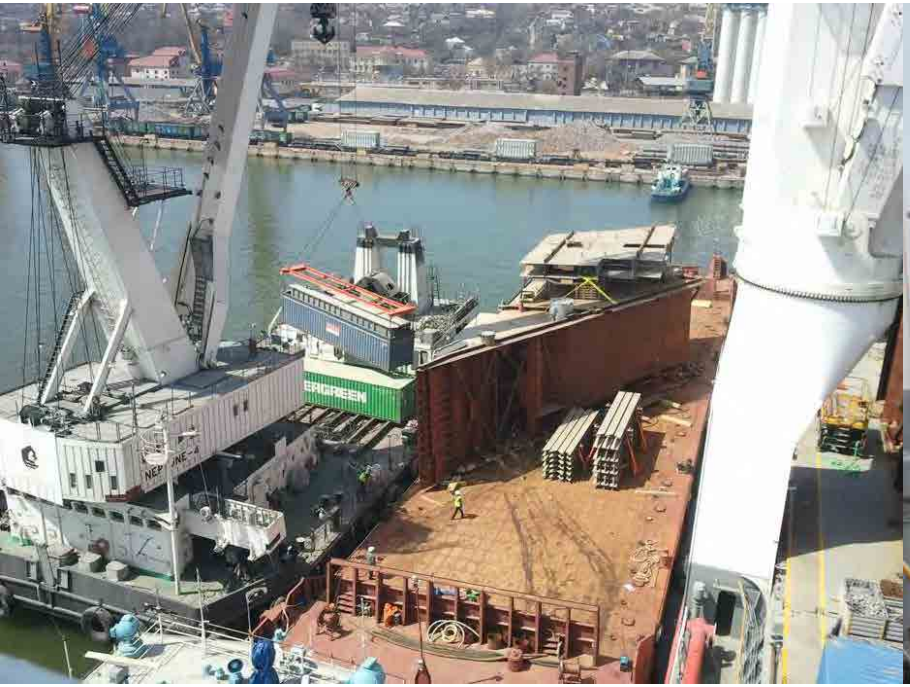


- Transshipment Ports

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3. **Port of Mariupol**/ Ukraine is on Azov sea – one of the most experiences in handling project cargo ports on Black/ Azov sea. The capacities of the Port give the possibility to handle more than 12 million tons of cargoes per year. The berths of the Port are capable to offer services for vessels with length up to 240 m. with draught up to 8 m. , port has 24 berths, total length of the berths 4200 meters. This port is navigable all year round - on winter period Icebreakers to be used. There are 3 floating cranes available at Mariupol port with capacities at 100, 140 and 150 MT. port of Mariupol is widely used for transshipment of project cargo towards to Caspian sea for projects in Azerbaijan, Kazakhstan, Turkmenistan , etc. There is ship building/ repair facilities next door to Mariupol port which gives good possibilities for engineering and technical solutions for the projects.





- Transshipment Ports

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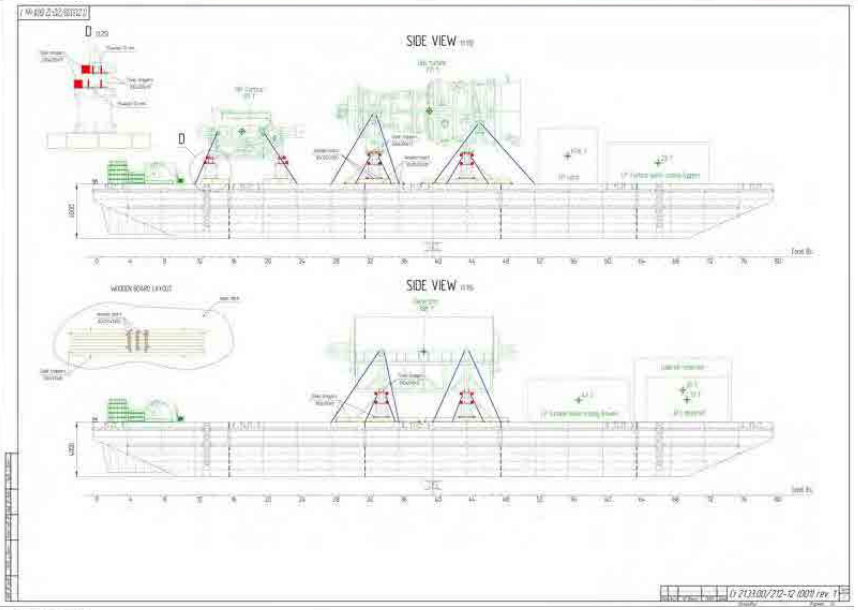
Trans Global Project Ltd. recent experience of usage Mariupol port was for Shimal 2 Combined Cycle Power Plant in Azerbaijan. In Partnership with ALE we have done transportation of MHI about 400 MT Turbine and 388 MT Generator and other HL equipment with transshipment from Ocean ship (BBC) to Wagenborg barge at Mariupol port and further to Caspian Sea up to Baku/ job site. Transshipment operation including barge preparation took 6 days in total. Sailing to Baku – 18 days.

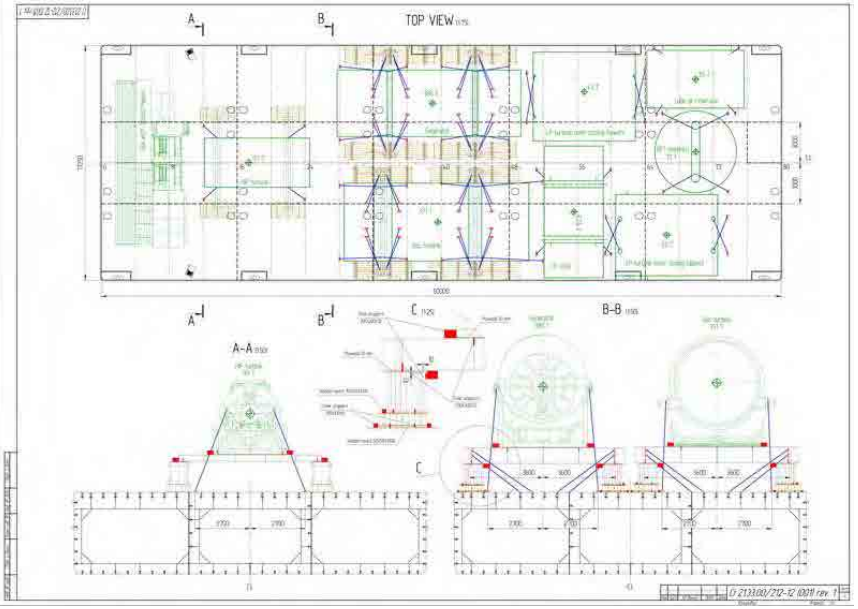


- Transshipment operations

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For transportation of OOG and Heavy lift items for the project from port of transshipment to the final port of discharge the loading, lashing-securing, ballast and stability projects for each barge and River-sea vessel has to be prepared in advance and approved by several authorities as well as tug information in case of barging. Needless to say HSE standards has to be implemented during preparation of the transport units, loading operations, lashing-securing of cargo on board and sailing. After completion of loading port authorities, surveyors, maritime authorities will inspect and approve loading and lashing in accordance with preliminary approved project documentation.



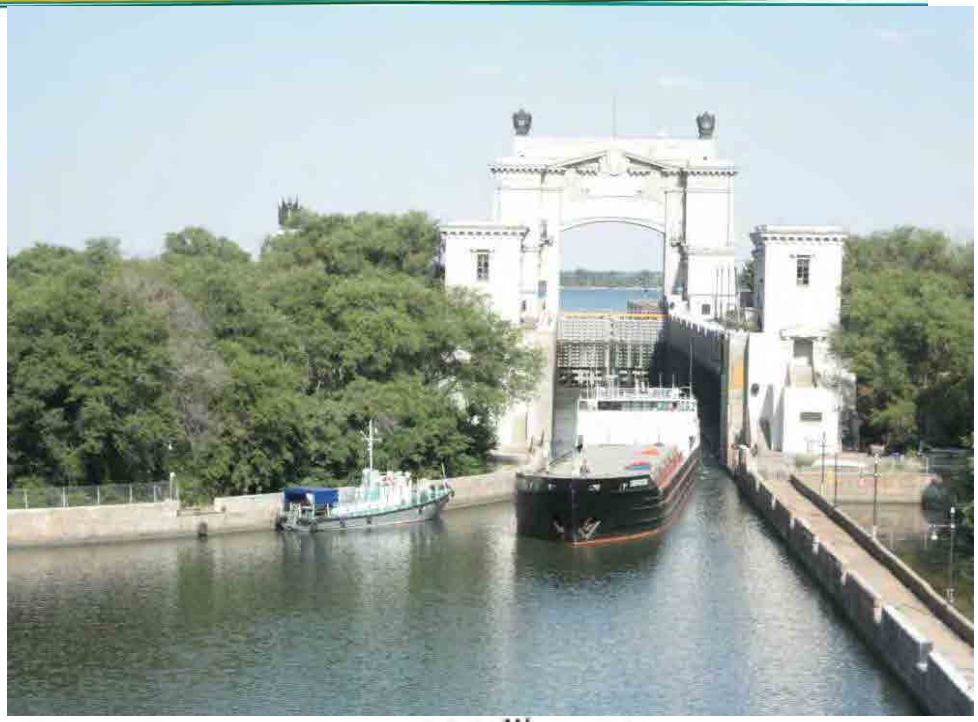
- Volga-Dona Canal System

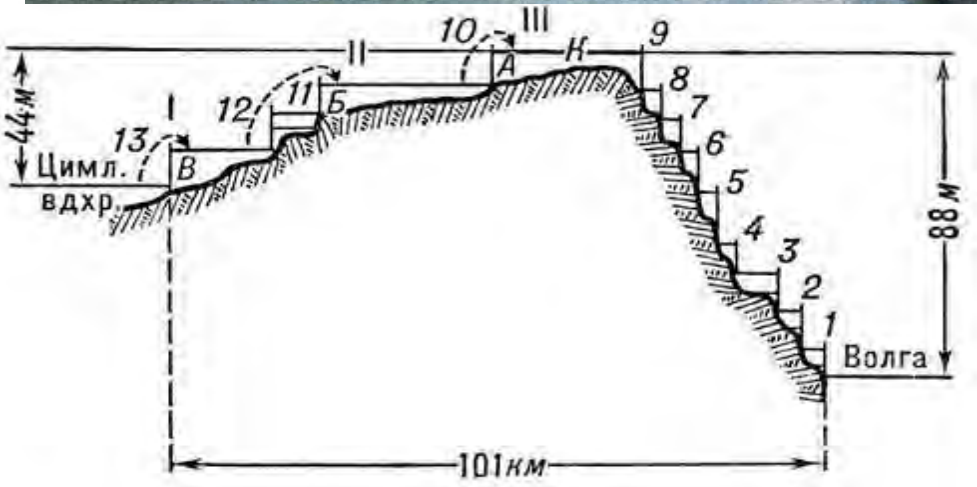
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This canal is season depending and navigation starts normally at the April and finishes at end November each year. Transit time approx. 2 weeks.

The canal starts at the Sarepta backwater on the Volga River (south of Volgograd; Lock No. 1 and the gateway arch are at 48° 31′10″N 44° 33′10″E) and ends in the Tsimlyansk Reservoir of the Don River at the town of Kalach-na-Donu. The canal has nine one-chamber canal locks on the Volga slope, which can raise ships 88 m, and four canal locks of the same kind on the Don slope, which can lower ships 44 m. The overall dimensions of the canal locks are smaller than of those on the Volga River, however they can pass ships of up to 5,000 tonnes cargo capacity. The smallest locks are 145 m long, 17.4 m wide and 3.4 - 3.6 m deep. Maximum allowed vessel size is 140 m long, 16.6 m wide and 3.5 m deep (so-called Volgo–Don Max Class).

In our recent experience for Shimal 2 project we moved through canal a barge with width 17.2 m with special permits from Canal authorities.





• ARRIVAL AZERBAIJAN

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- **CUSTOMS REQUIREMENTS**

Upon arrival River-Sea transport (Vessel or Barge) of the Azerbaijan National Waters these transport units must call at Baku International Sea trade Port for immigration and clearance. In special cases Baku port sends a pilot on board of the arrived transport unit to escort it to the place of discharge. After immigration, customs and sanitarian inspection complete all documents accompanying cargo is collected by Customs Authorities and delivered to Baku City Customs where Customs Agents must apply for clearance procedures and declaration. In special cases Customs issues a permit for responsible storage giving right to discharge transport units with no delay due to clearance procedures.

- **DOCUMENTATION for IMPORT to AZERBAIJAN REPUBLIC**

<u>The documents which must accompany cargo on the arrival to Azerbaijan Republic are:</u>

1. Bill of Lading
2. Original Commercial/ shipping Invoice
3. Certificate of Origin (Copy)
4. Fit-sanitarian Certificate (in case wooden packaging used)
5. DGR Declaration and MSDS form (In case of dangerous goods on board)

<u>The Documents must be presented to Customs Authorities in addition to the ones above:</u>

1. Certificate of Quality/ Conformity
2. Copy of export declarations (optional)
3. Permits from relevant authorities (may be required for some HS codes)
4. Copy of Contract between Consignee and supplier (once for the project)
5. Copy of TAX exemption/ other special paperwork (if required)

- BAKU Port/ DWJF & Sumgait

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In accordance with Decree of President of Azerbaijan Republic all ships entering Azerbaijan National waters have to call first at Baku International Sea Trade port. Since summer 2014 Baku International port will be removed to its newly constructed facilities at Alat (60Km southbound of Baku). After calling at Baku International port and fulfilling Customs formalities vessels proceed to final place of discharge. For this project 2 options can be considered – usage of SOCAR's Deep Water Jacket Factory facilities at Sahil and usage of Constructing berth at Sumgait city.

The advantage of using DWJF (SPS) facilities are obvious from the point of availability of lifting capacities up to 2500 MT floating crane-DB Azerbaijan as well as quality of berths built in accordance with requirements of international oil companies. This facility can also provide safe storage area for majority of cargo while in transit. The negative point of usage of SPS port is a far distance to the job site accompanying with a lot of obstacles enroute. Another difficulty on usage of SPS is maneuvering inside of SPS facilities with big pieces of cargo.

Sumgait Port/ berth construction is under process - Azenco JSC have started filling a part of sea by ground but this process takes time. There is no dedicated timing for readiness of this port at this stage.
Potentially construction of temporary berth nearby to site can be implemented and with approval of authorities, Sea Administration of Azerbaijan Republic, Ministry of Emergency situation, Ministry of Ecology this can be done in fairly short period of time

• Critical Items for transport by land

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Critical items to be transported for this projects are:

1. Gas Turbine – 14.1 m x 6.11 m x 6.11 m – Gross weight 397 MT
2. Generator – 15.2 m x 4.9 m x 5.6 m – Gross Weight 407 MT

Above is the list of items with very critical dimensions/ weights for inland transportation and the purpose of the route survey is to identify possibility of transport of these items on each particular route up to the job site in Azerbaijan.

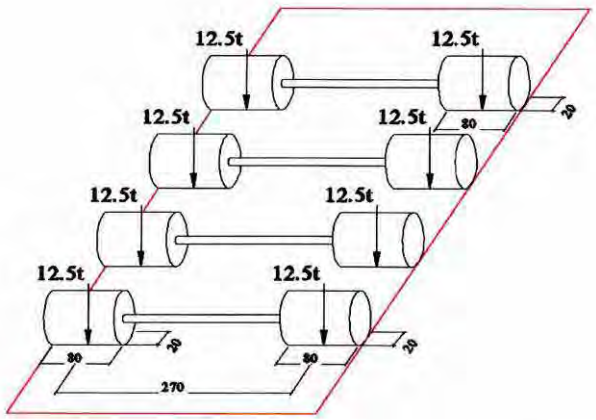
• Route Survey – Road Pressure limits

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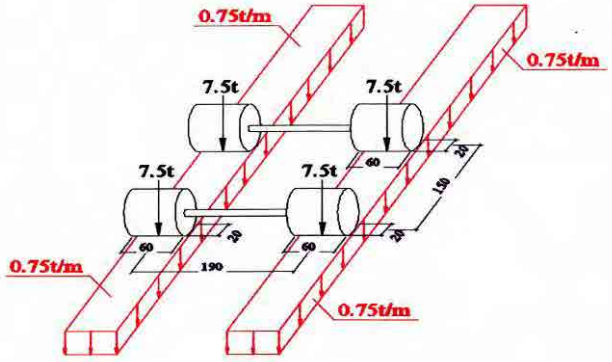
The Route from DWJF (SPS) goes via Salyan Highway, Newly constructed Road R6 and Sumgait bypass highway. All bridges on this route as per information from Azerkorpu (Bridge construction Company) are constructed within last 5 - 6 years with using NK-80, NK-100 and A-15 construction standards. In accordance with schemes presented at this page it is obvious that pressure at min 7,5 MT up to 12.5 MT per wheal set can be used for transporting heavy items. Therefore for transportation of heaviest cargo – Ammonia Converter at 440 MT we can use single line heavy duty trailer with 28-30 axel configuration or dual line trailer at 24 axel configuration.

NK-100 yükünün sxemi:



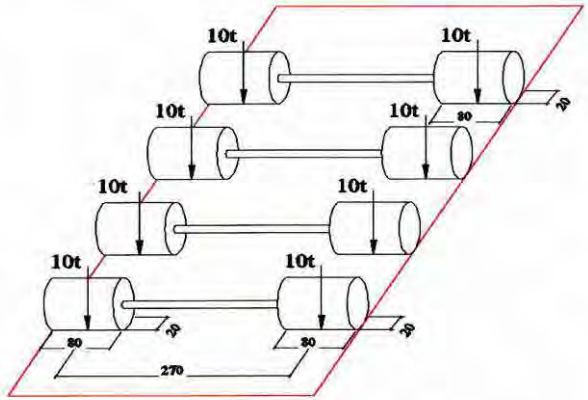
NK-100 avtomobilinin 1 oxuna düşən yük:	25,0t
NK-100 avtomobilinin 1 təkərinə düşən yük:	12,5t

A-15 yükünün sxemi:



A-15 avtomobilinin 1 oxuna düşən yük:	15,0t
A-15 avtomobilinin 1 təkərinə düşən yük:	7,5t
A-15 avtomobilinin təkərlərinin altında zolaq yükü:	0,75t/m

NK-80 yükünün sxemi:



NK-80 avtomobilinin 1 oxuna düşən yük:	20,0t
NK-80 avtomobilinin 1 təkərinə düşən yük:	10,0t

• Route Survey - DWJF to Sumgait Job site

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- Deep Water Jacket Factory – The berth in front of workshop 8 is ideal for discharge ops. DWJF – Ideal for discharge operations due to readiness of berth and discharge area in accordance with international standards but the route from DWJF to site is about 80km with number of obstacles enroute. Plenty of supporting equipment is available. Discharge operations must be approved by SOCAR/ Bosshelf JV.



Route Survey and Logistics Analyses

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In general total route from SPS to Job site is 73-75 km depending on bypass solutions. The suggested route starts at DWJF (SPS) facility Workshop 8 and using Gate South A exiting to side service road up to main highway M2. The concept is to use newly constructed R6 Road (2010 – 2013) from Karadag cement factory right turn towards to Qizildash settlement and further via Mushvigabad settlement to Sumgait bypass Highway.

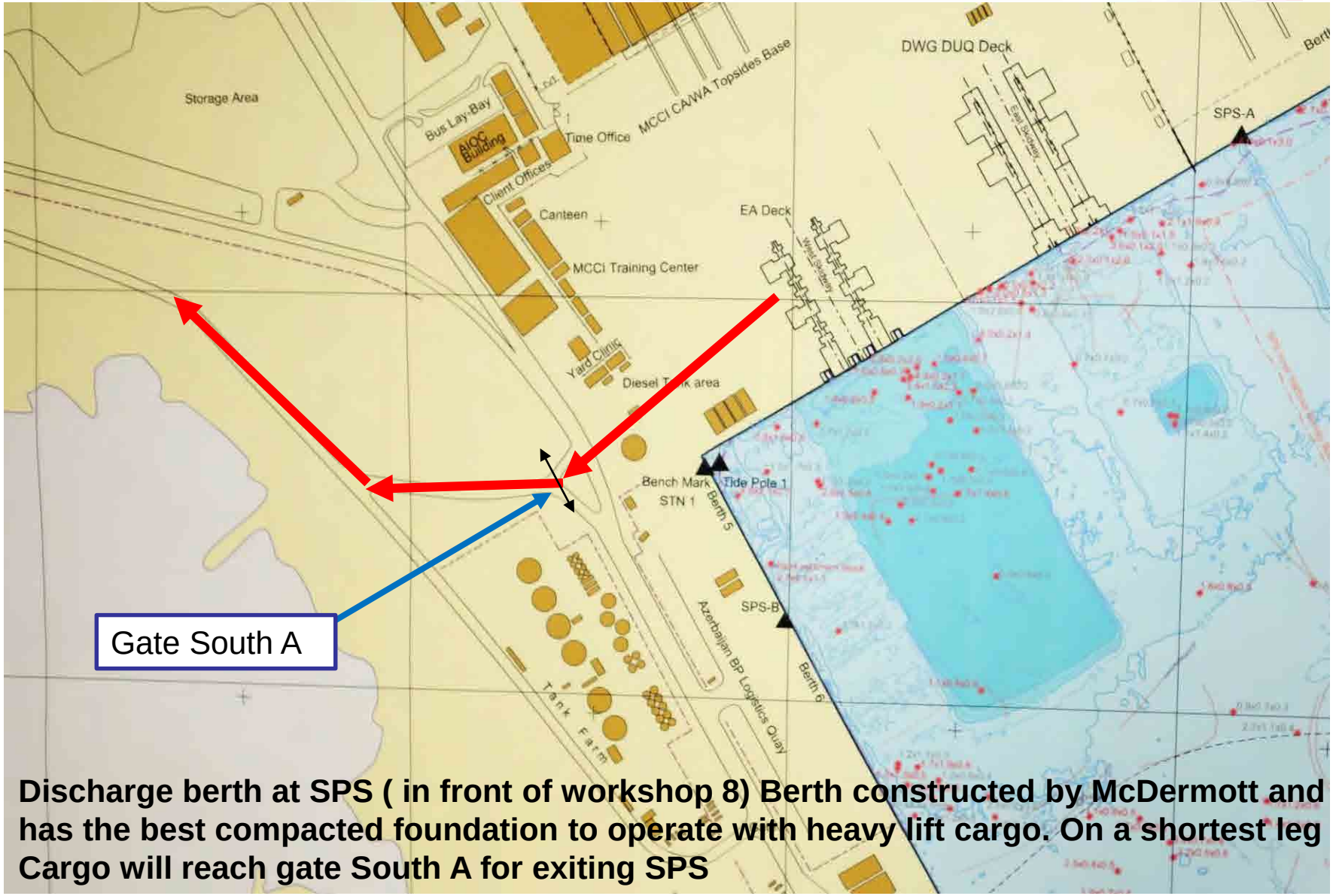


Route Survey and Logistics Analyses

Discharge berth at SOCAR Deep Water Jacket Factory

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Discharge berth at SPS (in front of workshop 8) Berth constructed by McDermott and has the best compacted foundation to operate with heavy lift cargo. On a shortest leg Cargo will reach gate South A for exiting SPS

Route Survey and Logistics Analyses

Discharge berth at SOCAR Deep Water Jacket Factory

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Discharge berth at SPS (in front of workshop 8) Berth constructed by McDermott and has the best compacted foundation at the territory of DWJF to operate with heavy lift cargo.





Exit from SPS Gate South A
Existing width 7 meters/ Stand on right and part of the wall can be dismounted tp be able to pass with cargo with width up to 9 meters

Route Survey and Logistics Analyses

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ACCESS ROUTE – Exit South A at SPS – 000 KM





000 - Route from SPS starts at Exit South A. The portion of the wall on right hand needs to be dismounted



Route Survey and Logistics Analyses

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- 900 m – small diameter gas pipe 06 – 08 m clearance – will be lifted on permanent basis
- 6 kv electric lines – 8 m clearance needs to be relocate underground
- 1.2 km – pipe rack (not in use) clearance 8m – needs to be comp-lately removed







Route Survey and Logistics Analyses

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- 1.4 km – road cross.

Route Survey and Logistics Analyses

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There are a lot of high voltage electric cables and lines enroute. 6 kv and 10 kv (3 phase lines – similar construction) is recommended to relocate underground.
Such lines are at:
0,8; 0,85; 2,7; 3,0; 3,4; 4,0; 4,8; 7,7; 7,75; 8,4; 8;45; 9,0; 11,6; 17,9; 23,1; 23,12; 34,8; 37,4; 41,8; 42; 42,5; 43,0; 43,8; 46,0; 47,9; 53,3; 54,4; 55,6; 63,3; 68,5. Km





5.58 km Right turn towards to Salyan highway. Before turn there are 2 columns of old gas pipeline with width clearance at 11,55m

Route Survey and Logistics Analyses

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- 6.0 Km – Exit to Salyan highway
- Road separations must be disassembled for road crossing to turn left on Salyan highway towards to south.
- For various cargo different radius of turn can be achieved at this point





Route Survey and Logistics Analyses

APTE TransGlobal

- There are several High voltage lines enroute at 35, 110, 220 KV with 3 or 6 x 3 phase lines. Passage under these lines with cargo higher than 5 meters (including trailer bed) will require complete switch off the lines by central dispatcher of Azerenergy and in case of high cargo simultaneous lifting of lines will be required:
- 35kv lines – 8,5; 11,3; 11,5; 15,0; 19,5; 45,1; 50,8; 51,0; 64,5; 67,8 km.
- 110kv lines – 11,4; 11,8; 12,8; 13,8; 27,8;39,0; 39,1; 42,7; 64,6 km
- 220 kv lines – 27,7; 38,2; 45,0km

(Engine on picture below is 300 MT – 6.35 height without trailer – Sangachal Power plant Construction Project- crossing 35kv lines)





Route Survey and Logistics Analyses

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9.8 km Road Information board. Needs to be bypassed from Right. At the moment thare is enough space to build bypass with width up to 10 meters

10.0 Right turn on the bridge towards to Qizildash Settlement



Route Survey and Logistics Analyses

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10.6 km Rail cross bridge - Building completed in 2013 (1)



10,7 km – road crossing bridge Building completed in 2013 (2)





11.6 km levelling bridge - Building completed in 2013 (3)



Route Survey and Logistics Analyses

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Conditions of bridges are good



13.6 km Bridge over rail line- Building completed in 2012



18.4 km Road and Rail cross bridge - Building completed in 2012



Route Survey and Logistics Analyses

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23.0 km bridge over ravine - Building completed in 2012



22,0 km Qizildash roundabout



Route Survey and Logistics Analyses

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- 40.4 km Road levelling bridge – construction completed 2013
- 40.8 km Mushvig settlement cross Shemakha road (bridge constructed 2012) - bypass over road bridge is possible

Route Survey and Logistics Analyses

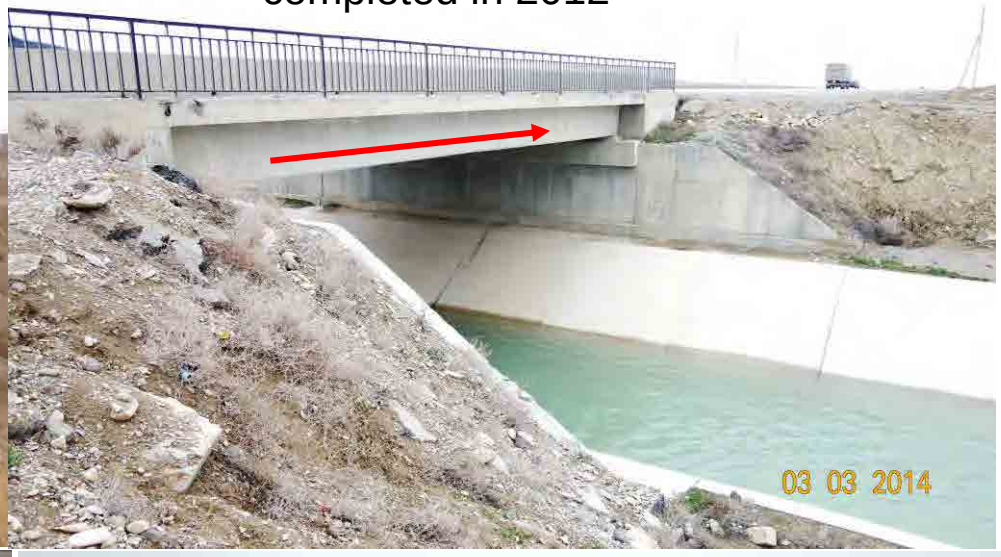
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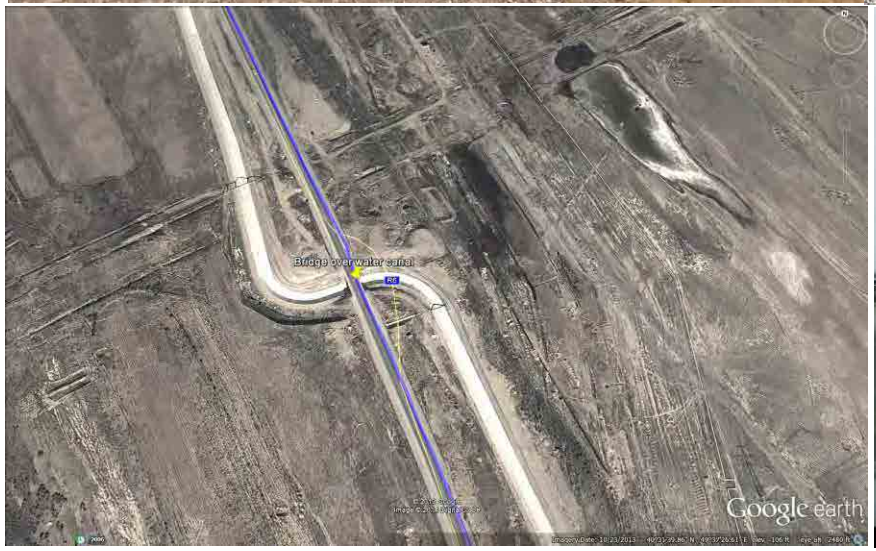
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42.3 km bridge over ravine/ road levelling - Building completed in 2012



47.8 km bridge over canal - Building completed in 2012





50,0 Sumgait Highway Entry – following on the bridge



Route Survey and Logistics Analyses

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50.3 km bridge over Road and rail lines - Building completed in 2012





51.0 Exit from the bridge – we take left turn (against traffic)

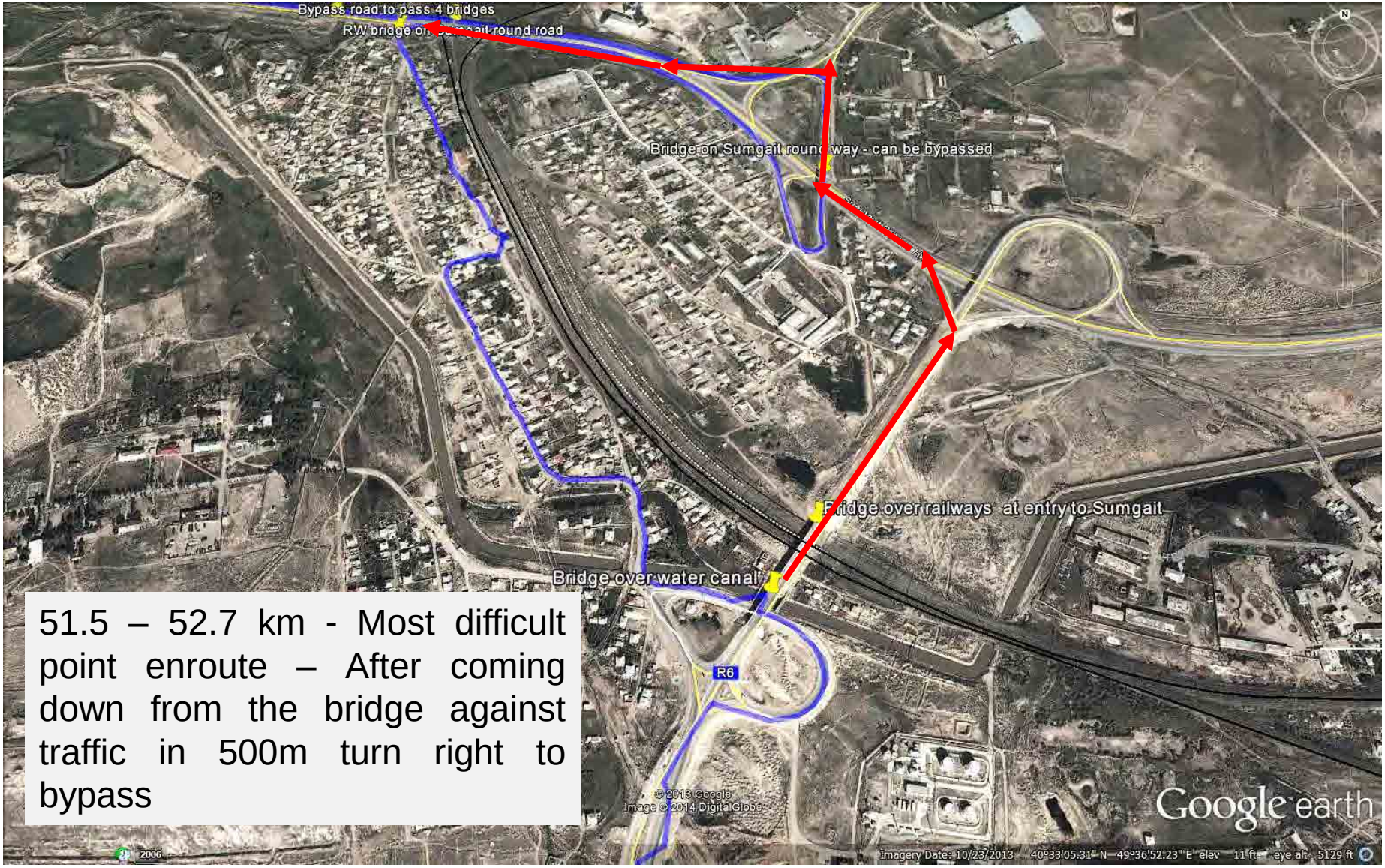




Route Survey and Logistics Analyses

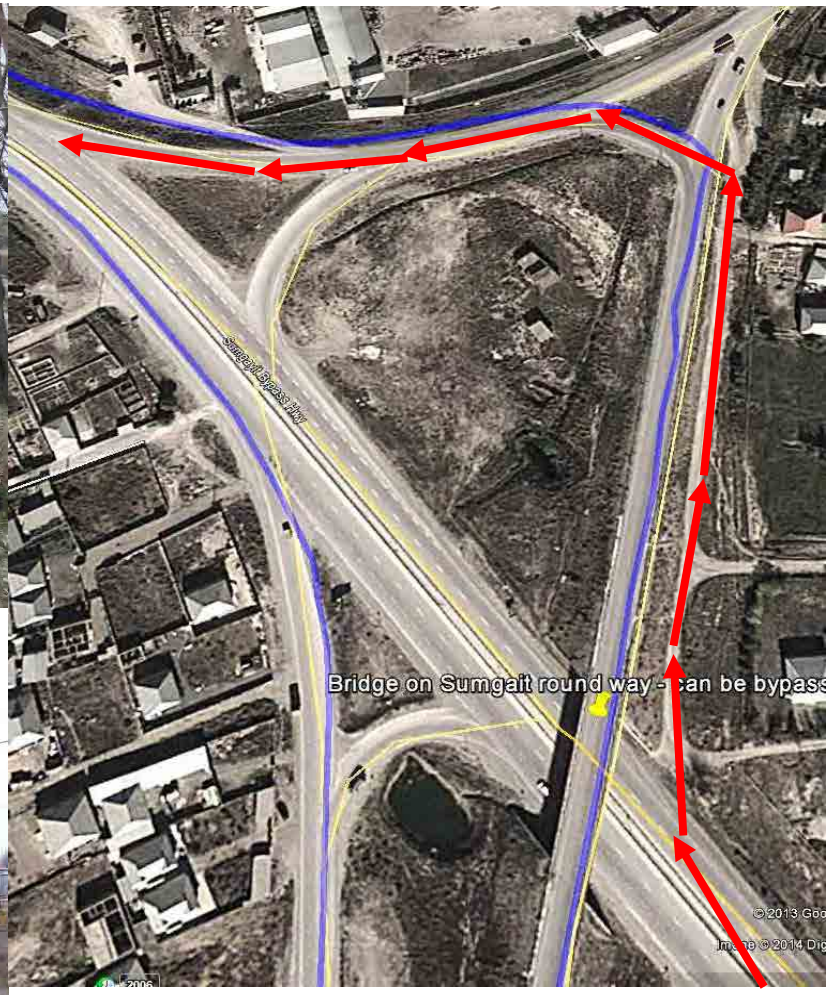
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51.5 – 52.7 km - Most difficult point enroute – After coming down from the bridge against traffic in 500m turn right to bypass







51,7-52,7 – Bypass (appr 300m) to avoid under bridge passage. Bypass can be build to serve high and wide cargo. Exit to Sumgait Highway

Route Survey and Logistics Analyses

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53.1 km bridge over rail line - Building completed construction in 2010



53.2 km Bridge over double rail lines – constructed 2010



53.4 km Bridge over road and little river– constructed 2010





Route Survey and Logistics Analyses

APTE TransGlobal

63.2km Bridge over Rail road. Built 2010



63,4 km. At this point 2 options can be used:

1. Straight forward movement over the bridge
2. Right turn towards Z.Tagiyev settlement for bypass the bridge.



Route Survey and Logistics Analyses

APTE TransGlobal

63.5 km Bridge over road.



63,4 km. At this point 2 options can be used:

1. Straight forward movement over the bridge
2. Right turn towards Z.Tagiyev settlement for bypass the bridge.

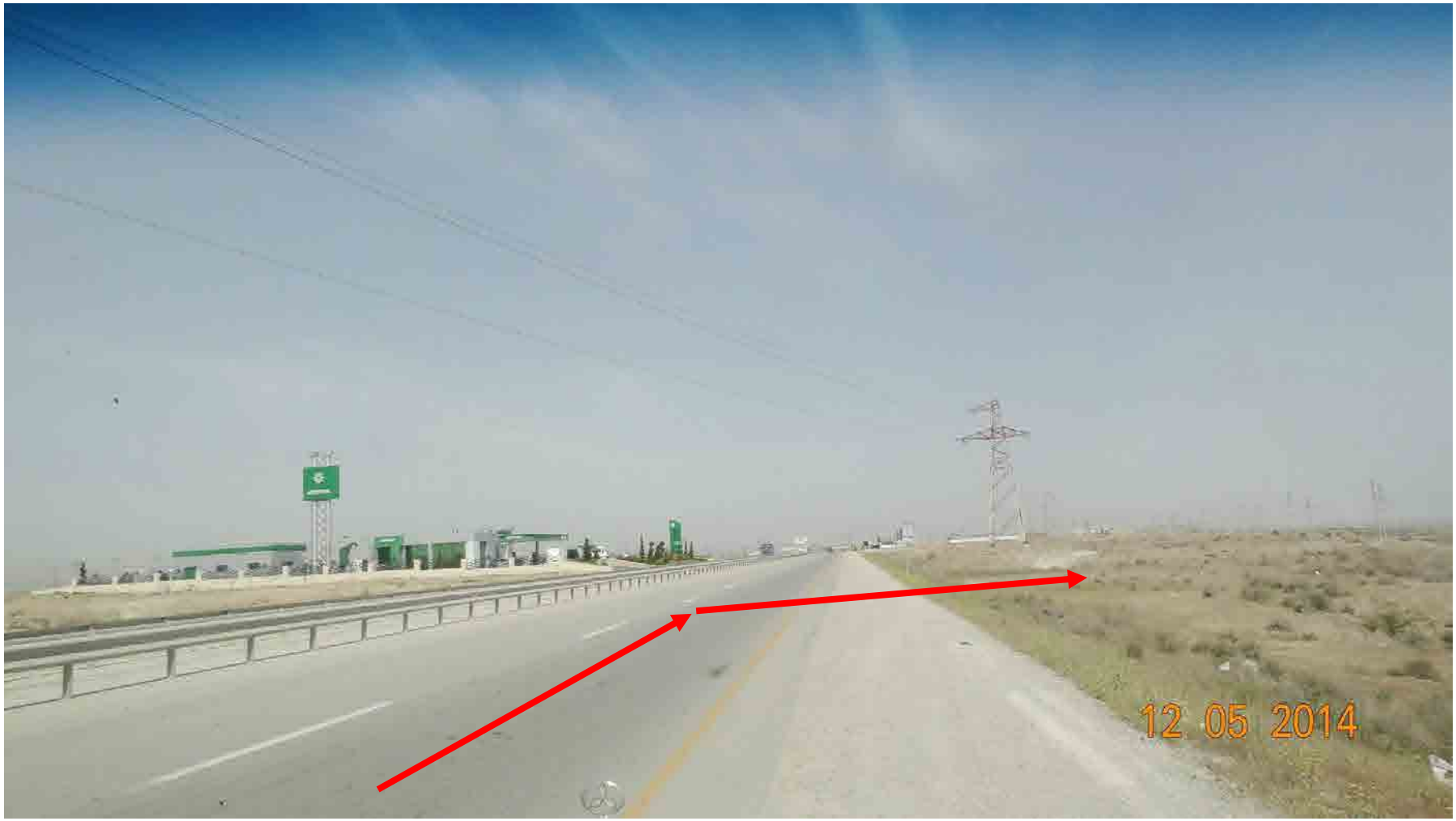


Route Survey and Logistics Analyses

APTE

TransGlobal

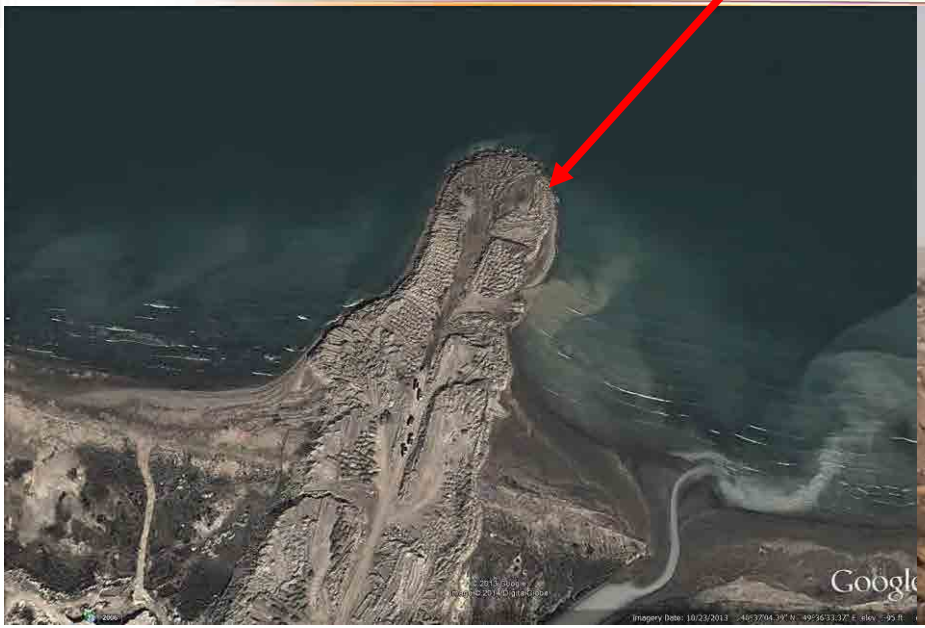
67 km. SITE- opposite Azpetrol Gas station –on the right:



- Route Survey – Temporary berth - Job site

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0.00 km Temporary jetty or Jetty under construction is not ready. In case of usage of temporary jetty route will start here. Right turn from jetty and in 50 meters left turn to bypass road

- Route Survey – Temporary berth - Job site

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1.4 km of sand road, strong enough but may require levelling by



- Route Survey – Temporary berth - Job site

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0,4 km Pipe – needs to be removed-not on use



0,9 km – 0.95 Pipe Racks with Gas and steam line – needs to be removed



1,1 km – 110 kv High Voltage line



1,4 km Enter highway towards Zeynalabdin



- Route Survey – Temporary berth - Job site

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2.1 km pedestrian crossing construction in front of STP – can be bypassed via parking



200 meters bypass via STP parking area





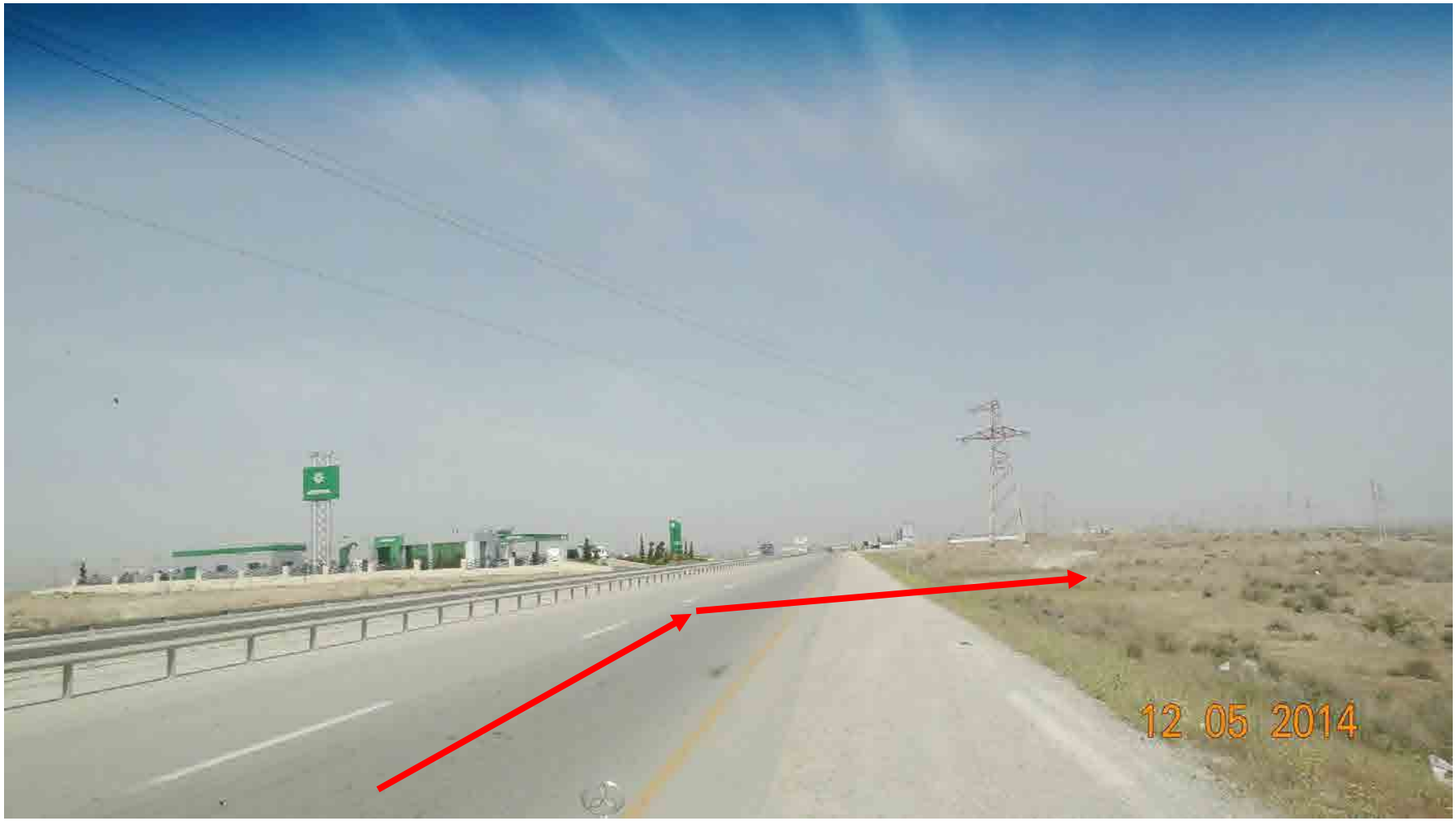
8.8 km right turn towards to Guba highway and reaching site in 1.5 km.

Enroute up to this point there are several 35,110 and 22 kv High voltage lines which needs to be switched off during transportation.

Route Survey and Logistics Analyses

APTE TransGlobal

67 km. SITE- opposite Azpetrol Gas station –on the right:



CONCLUSION

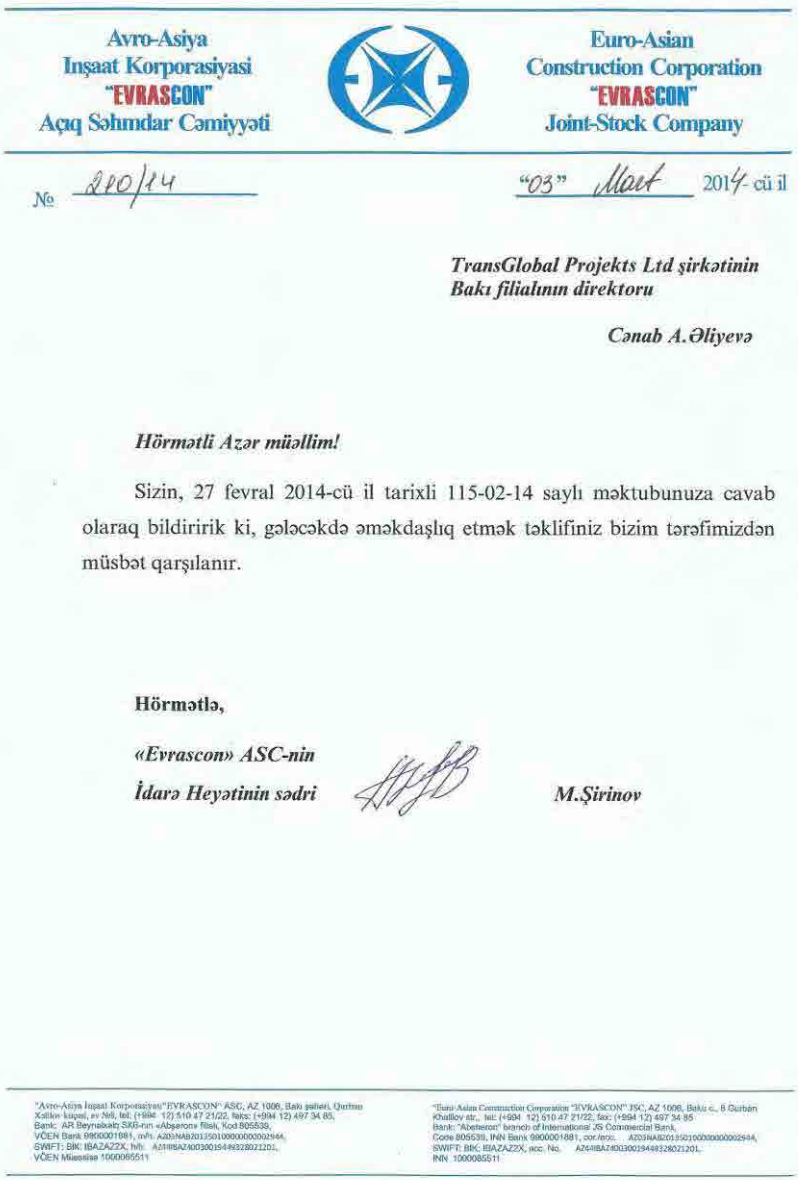
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- For transportation of OOG and Heavy cargo for this project both routes via SOCAR DWJF (SPS) facilities and the berth under construction at Sumgait .
- Construction of several bypasses needs to be considered for this transportation.
- Need to apply in advance to Azeravtoyolservice Department of Ministry of Transport of Azerbaijan Republic with drawings and details of all OOG and HL pieces of cargo for obtaining permits, approval of routes.
- Need to apply to Ministry of Internal affairs of Azerbaijan republic for arranging relevant police escorts and convoy
- Electric lines lifting, Cutting power, gas pipes lifting needs to be negotiated with relevant authorities in advance and coordination timing of operations.
- Information about dates of construction of bridges received from EURASCON (Former Azerkorpu) the Bridge construction company. This company confirmed readiness for cooperation (letter is attached) for construction of bypasses, supports, etc,
- There are several ongoing constructions and the route needs top be re-considered for the actual time of transportation.
- The route from possible temporary berth in Sumgait city will require some construction solutions including berth itself.

Supporting Documentation

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Avro-Asiya
İnşaat Korporasiyası
"EVRASCON"
Açıq Səhmdar Cəmiyyəti

Euro-Asian
Construction Corporation
"EVRASCON"
Joint-Stock Company

№ 210/14 "03" Mart 2014-cü il

TransGlobal Projekts Ltd şirkətinin
Bakı filialının direktoru

Cənab A.Əliyevə

Hörmətli Azər müəllim!

Sizin, 27 fevral 2014-cü il tarixli 115-02-14 saylı məktubunuza cavab olaraq bildiririk ki, gələcəkdə əməkdaşlıq etmək təklifiniz bizim tərəfimizdən müsbət qarşılanır.

Hörmətlə,

«Evrascon» ASC-nin
İdarə Heyətinin sədri *M.Şirinov*

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This letter is from Euro-Asian Construction Corporation EURASCON (Former Azerkorpu) the bridge construction company in support of TGP for the project.

Appendix C10-01

Terms of Reference (TOR)
of
Engineering Consultancy Services for
Yashma Gas Combined Cycle Power Plant Project

(Standard Bidding Documents under Japanese ODA Loans for Procurement of Plant basis)

Terms of Reference (TOR)
of
Engineering Consultancy Services for
Yashma Gas Combined Cycle Power Plant Project

Chapter 1. Background

A. Introduction

The Government of the Republic of Azerbaijan (hereinafter called "GOA") has applied a loan from Japan International Cooperation Agency (JICA) (hereinafter called "loan") to finance Yashma Gas Combined Cycle Power Plant Project (hereinafter called "the Project") and intends to apply part of the proceeds of this credit to payments under the Consulting Services for the supervision of implementation of the Project. Azerenerji JSC intends to employ a firm of consultants for the contract to manage and supervise the implementation of the Project, Yashma, Azerbaijan.

B. Project Information

a) Implementing Organization

The owner (will become "the Employer" of consultant) of the Project is Azerenerji Joint Stock Company (Azerenerji JSC).

b) Background Information

In the "State program for development of fuel and energy sector in Azerbaijan (2005-2015)" and "Look into the future development concept 2020" of the Republic of Azerbaijan (hereinafter referred to as "Azerbaijan"), major themes are the development of electric power sources and maintenance of associated equipment to ensure a stable electric power supply. In response Azerenerji JSC issues a development plan for an electric power plant that utilizes natural gas as essential fuel.

Azerbaijan's installed power capacity is 6,860 MW, with thermal power plants including gas-engine plants accounting for 5,881 MW and hydro power plants 979 MW in 2014. However, effective generation capacity remains around 5,000 MW due to the aging and deterioration of major power plants. Since maximum demand of electric power in 2013 was 3,720 MW, current power supply capacity is sufficient to meet Azerbaijan's power demand. That said, Azerenerji forecasts that power demand will grow at an annual rate of around 5% as a result of stable economic growth, with demand peaking at around 5,450MW in 2020. In order to cope with increasing power demand and realize the phased decommissioning plan of the Azerbaijan Power Station (2,400MW), which is a conventional dual fuel (gas and oil) fired power station constructed more than 30 years ago, the country needs to develop additional electric capacity of around 1,800MW between 2018 and 2020. Moreover, the Azerbaijan Power Station, which comprises a major share of power generation and is located about 250km west of the capital Baku, supplies power to Baku through long-distance transmission lines: power systems utilizing long-distance transmission lines are prone to transmission loss as well as blackouts.

Based on this recognition, development of additional capacity near the capital Baku area, improvement of power transmission lines and substations, and support for proper utilization of facilities are now viewed as legitimate and imperative goals to ensure a highly stable power supply.

c) Location of the project and information on the surrounding area

The planned project site is the Yashma, vicinage of Sumgayit city, approximately 45 km northwest of Baku, the capital of Azerbaijan. (Refer to "Annexes to the TOR" on page 19). The front of the site is facing the Caspian Sea. There is a national highway to the rear of the site (width approx. 350m and a length of 2,100m (71.5ha)). There is a 110 kV transmission line parallel to the national highway. Azerenerji JSC will relocate an 110kV transmission line to the outside of the site within site preparatory work. There are no residences on the site and no rivers pass through the territory. The Yashma CCPP is projected to require an area of approximately 30 ha in the site area.

d) Stage reached in the project preparation and summary of the findings of studies to date

"Preparatory Survey on Yashma Gas Combined Cycle Power Plant Project" as feasibility study for the Project has already been completed on August 2014 by Tokyo Electric Power Services Company Ltd in Co-operation with JICA, JAPAN.

C. Other Relevant Information

a) Technical Information

The capacity of the Plant will be 920 MW of electric power. It will be natural gas fired and consist of 460MW x 2 (Two) blocks, each of them has shingle shaft, which consists of one gas turbine(GT), one steam turbine(ST) and one generator including one heat recovery steam generator(HRSG). In this project the technical codes and standards to be followed will be JIS, IEC, ISO, ANSI, ASTM, DIN etc.

b) Relevant laws and regulations

This Project will be guided by Laws of the land (Azerbaijan).

D. Scope of the Project

a) Scope of Work Under This Project

Lot	Contents
Lot 1 : Power Plant Construction (EPC Contract)	(1) Construction of 460MW x 2 (two) blocks of natural gas fired combined cycle power plant and common facilities.
Lot 2 : Gas pipeline	(1) Fuel gas pipeline from branch point of the main gas pipe line into the site (and gas compressors, if necessary). (40-50km)
Lot 3 : Transmission Line and Substations	(1) Transmission lines from the site to sub-stations. (2) Sub-stations a・Yashma S/S Extension b・STP S/S Construction (Sumgayit) c・Sulu TePe S/S Construction
Consulting Services	● Refer to Chapter 3

b) Scope of Yen Loan

Scope of yen loan is construction of 460MW x 2 (two) blocks of natural gas fired combined cycle power plant and common facilities (Lot1).

The configuration of the block is shingle shaft and each block has one GT, one ST, one generator, one HRSG and their auxiliaries, which include all relevant equipment. The scope of the Yen Loan portion will be EPC contract.

c) Scope of Azerenerji JSC

The following equipment and facilities, etc. are proposed to be within the scope of Azerenerji JSC portion of the Project.

a) Fuel gas pipeline from branch point of the main gas pipe line into the site (Lot2) (and gas compressors, if necessary). (Before initial firing, which is assumed to July 2020)
b) Substations (Construction, Extension) relevant to Yashma CCPP Project (Lot3). (Before first power receiving, which is assumed to February 2020)
c) Transmission lines from the site to the substations (Lot3). (Before first power receiving, which is assumed to February 2020)

Chapter2. Objectives of Consulting Services

A. Outline of Consulting services

The consulting services shall be provided by an international consulting firm (hereinafter referred to as "the Consultant") in association with national consultants in compliance with Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012. The objective of the consulting services is to achieve the efficient and proper preparation and implementation of the Project through the following works:

a) Design and Engineering
b) Assist Azerenerji JSC in Pre-qualification(PQ) for Bidders
c) Assist Azerenerji JSC in the Bidding Procedures
d) Project management at all levels including periodic review of budget estimate and administration of project cash flows
e) Inspection, testing and delivery control during manufacturing
f) Construction Supervision including Commissioning and Acceptance Test
g) Assist Azerenerji JSC in assuring the safety during the construction work of the Project
h) Ensure the quality of transfer of knowledge and technology from Manufacturer to Azerenerji JSC Personnel
i) Assist Azerenerji JSC in Operation and Maintenance
j) Assist Azerenerji JSC regarding environmental and social aspects

Chapter 3. Scope of Consulting Services

A. Design and Engineering

The Consultant shall be responsible for :

a) Preparation of design calculations, basic plans, drawings, specification and schedules for Bidders and contract documents. The design shall include calculations to determine size or capacity requirements; single line diagram with control and protection scheme; layout and arrangement of components, layout of plant area, selection of equipment and materials including those related to environmental issues; models of testing equipment and materials and specialized research.
b) Review and update above mentioned documents based on Azerenerji JSC and JICA's comments.

B. Assist Azerenerji JSC in Pre-qualification(PQ) for Bidders

The Consultant shall undertake the followings;

a) Define technical and financial requirements, capacity and/or experience for PQ criteria taking into consideration technical feature of the Project.
b) Prepare PQ documents in accordance with the latest version of Standard Prequalification Documents under Japanese ODA Loans.
c) Assist (name of Executing Agency) in PQ announcement, addendum/corrigendum, and clarifications to the applicants' queries.
a) Evaluate PQ applications in accordance with the criteria set forth in PQ documents and
b) Prepare a PQ evaluation report for approval of the PQ evaluation committee.

C. Assist Azerenerji JSC in the Bidding Procedures

The consultant shall undertake the followings;

a) Prepare bidding documents in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement of Works together with all relevant specifications, drawings and other documents.
b) Prepare bidding documents which includes the clauses to have Contractor comply with the requirement of the Environmental Management Plan (EMP) and JICA Guidelines for environmental and social considerations (April 2010) (JICA Environmental Guidelines).
c) Assist (name of Executing Agency) in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries
d) Evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP have been prepared in harmony each other and will meet such requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents.
e) Prepare a bid evaluation report for approval of the bid evaluation committee.
f) Assist (name of Executing Agency) in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting and.
g) Prepare a draft and final contract agreement

D. Project management at all levels including periodic review of budget estimate and administration of project cash flows

The consultant shall establish a project management system acceptable to Azerenerji JSC, which will be used to monitor, track and pin point problems.
The work involved will include the following:

a) Establish the basic overall project construction schedule, budget and cash disbursement schedule for both foreign and local portions.
b) Establish and implement a project management system and procedures to monitor and control the cost and time schedule to enable timely corrective measures.
c) Support, co-coordinate, supervise, make decisions and issue instructions to Azerenerji JSC for all design and engineering related to the construction activities from the view point of achieving engineering standards, quality assurance and safety on project
d) Set up a quality reporting system of project progress and status to Azerenerji JSC.
e) Manage claims by and against the Contractor properly and reasonably within a feasible time scale, considering the best interests of Azerenerji JSC.
f) Anticipate and identify potential difficulties or conflicts and their effect on the implementation schedule and recommend and agree on steps to be taken by the Contractor or by Azerenerji JSC to overcome difficulties and avoid delays.
g) Prepare and/or evaluate recommendations to Azerenerji JSC regarding any proposals of change, technical amendments and change in the scope of work, the appropriateness of their pricing and if agreed to by Azerenerji JSC, the timely issuance to the Contractor of charged order, as per the conditions of the supply and installation contract.

E. Inspection, testing and delivery control during manufacturing

The Consultant - with the participation of Azerenerji JSC - shall undertake the

implementation of the followings;

a) Check and approve proposal on quality assurance, quality control plan and delivery schedule prepared by the Contractor.
b) Regularly review production and delivery schedules submitted by the Contractor.
c) Check and approve factory testing procedures and factory test results submitted by the Contractor.
d) Monitor manufacturing progress by testing regular inspections to ensure compliance to contract documents.
e) Witness factory test of major equipment and preparation of corresponding certificates (test items witnessed are to be agreed between Azerenerji JSC and the Contractor).
f) Check and review inspection report of each factory testing submitted by the Contractor.

F. Construction Supervision including Commissioning and Acceptance Test

The Consultant shall perform his duties during the contract implementation period of the contracts to be executed by the Employer and the Contractor. Standard Bidding Documents under Japanese ODA Loans for Procurement of Plant will be applied to this Project. In this context, the Consultant shall;

a) Act as the Project Manager to execute construction supervision and contract administration services in accordance with the power and authority to be delegated by the Employer.
b) Provide assistance to the Employer concerning variations and claims which are to be ordered/issued at the initiative of the Employer. Advise the Employer on resolution of any dispute with the Contractor.
c) Issue instructions, approvals and notices as appropriate.
d) Provide recommendation to the Employer for acceptance of the Contractor's performance security, advance payment security and required insurances.
e) Assess adequacy of all inputs such as materials, labor and equipment provided by the Contractor.
f) Check and approve the Contractor's method of work, including site organization, program of performance, quality assurance system, safety plan and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected.
g) Regularly monitor physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected by the Contractor.
h) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions.
i) Review and approve the Contractor's design for the works to be constructed, and review and approve as required the Employer's Requirements, working drawings, shop drawings and drawings for temporary works;
j) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated.
k) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract.
l) Organize, as necessary, management meetings with the Contractor to review the arrangements for future work. Prepare and deliver minutes of such meetings to the Employer and the Contractor.
m) Supervise the works so that all the contractual requirements are met by the Contractor,

including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractor is duly assigned at the project site.

n) Supervise field tests, sampling and laboratory test to be carried out by the Contractor.
o) Inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the Employer's Requirements.
p) Verify payment applications submitted by the Contractor and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract.
q) Coordinate the works among different contractors employed for the Project.
r) Modify the Employer's Requirements as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any).
s) Carry out timely reporting to the Employer for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied.
t) Inspect, verify and approve or disapprove claims issued by the parties to the contract (i.e. the Employer and Contractor).
u) Supervise Pre-commissioning carried out by the Contractor, check and approve the Contractor's Pre-commissioning report, and issue the Completion Certificate as specified in the contract
v) Supervise Commissioning and Guarantee Test carried out by the Contractor, check and approve the Contractor's report on the Commissioning and Guarantee Test, and issue the Operational Acceptance Certificate as specified in the Contract.
w) Provide periodic and/or continuous inspection services during defect liability period and if any defects are noted, instruct the Contractor to rectify.
x) Check and certify as-built drawings prepared by the Contractor.
y) Check and certify the operation and maintenance manual prepared by the Contractor.

G. Assist Azerenerji JSC in assuring the safety during the construction work of the Project.

The consultant shall undertake the followings;

a) When preparing or reviewing bidding documents for procurement of works and those for procurement of supply and installation of plant, the consultants shall make sure that the requirements stipulated in 1) below will fully be met.
   1) Bidding documents for procurement of works and those for procurement of supply and installation of plant require that:
   (i) The safety requirements in accordance with the laws and regulations in the country of the Borrower and relevant international standards (including guidelines of international organization), if any, shall be clearly stipulated in the contract.
   (ii) Bidders shall furnish a safety plan to meet the safety requirements stipulated in the bidding documents.
   (iii) The personnel for key positions to be proposed by bidders shall include an accident prevention officer.
b) The consultants shall review the safety plans submitted by the bidders.
c) During the supervision of the construction work, the consultants shall confirm that an accident prevention officer proposed by the contractor is duly assigned at the project site and that the construction work is carried out according to the safety requirements stipulated in the contract. If consultants recognize any questions regarding the safety measures including the ones mentioned above, the consultants shall require the

contractors to take appropriate remedies.

H. Ensure the quality of transfer of knowledge and technology from Manufacturer to Azerenerji JSC Personnel

The Consultant shall undertake the followings;

a) Define the Manufacturer's responsibility to develop, arrange and implement an adequate on-the-job training program, both during construction period for Azerenerji JSC's operation and maintenance (O&M) staff assigned to operate and undertake maintenance of the plant.
   Ensure that the Manufacturer shall provide O&M training during the construction period of, including the assembly of the structure of the power plant equipment which cannot be checked during operation, and test operation, where Azerenerji JSC's O&M staff should be able to observe and record the Manufacturer's off-site maintenance activities.
b) Incorporate the Manufacturer's responsibility for the above mentioned on-the-job training for Azerenerji JSC `s operation/maintenance staff into the Bid Documents.
c) Ensure the quality of training and knowledge transfer provided from the Manufacturer to Azerenerji JSC`s O&M staff during the construction period.
   If necessary, take corrective action to actualize the training and knowledge transfer outcome, where Azerenerji JSC become able to independently implement quality operation and maintenance activities. The training will be provided by the Manufacturer. Corrective action may include programming training of power plant staff in coordination with the Manufacturer.
d) Support Azerenerji JSC O&M staff to acquire quality assurance skills to assess the quality of O&M training and to identify training-needs.
e) Encourage and ensure Azerenerji JSC staff to acquire such skills as reading design drawings and circuit diagrams, listen to the Contractor regarding near-miss experiences and learn safety management from the Contractor's implementation scheme, learn maintenance skills from the Manufacturer and record such construction and maintenance experiences by video recording and through documentation.

I. Assist Azerenerji JSC in Operation and Maintenance

The Consultant shall undertake the followings;

a) Strategic Planning
   1) Assist Azerenerji JSC to develop the Operation and Maintenance Strategy, including the plant performance target and plant Operation and Maintenance policy whereby Azerenerji JSC O&M staff are to become able to conduct O&M activities in a sustainable and independent manner.
   2) Assist Azerenerji JSC in developing the procedures to make the breakdown targets from Key Performance Indicators for each department/division of the plant and employees.
   3) Assist Azerenerji JSC to establish and implement PDCA.
b) Good Practice
   1) Assist Azerenerji JSC to develop and implement a system for recording data on plant efficiency and performance, including daily operation, daily inspection, periodical inspection, maintenance records and accident records.
   2) Assist Azerenerji JSC to establish and implement maintenance schedules and

procedures.

3) Assist Azerenerji JSC to acquire knowledge and skills of monitoring and checking during operation, such as actualizing equipment functions, maintaining heat efficiency, reducing equipment wear, reducing creep and fatigue degradation of hot parts, by utilizing computer-based simulator and OJT through daily operation.
4) Assist Azerenerji JSC to establish and implement a trouble-management scheme, including trip cause analysis and recurrence prevention.
5) Assist Azerenerji JSC to establish and implement a safety management scheme, including ex-ante and ex-post safety activities.
6) Assist Azerenerji JSC to prepare inventory records (assets listing) of nameplates, summary list of equipment facilities "as-built" drawings for electro-mechanical equipment
7) Assist Azerenerji JSC to acquire knowledge and skills to conduct non-destructive inspection.
8) Assist Azerenerji JSC to develop basic design of IT-enabled Operation and Management System which includes the plant budgeting database and parts management system for system detailed design to be taken up at a later stage.
9) Guidance and coordination of the preparation of the Contractor's operation and maintenance manuals, which includes negotiation with the Contractor in the provision of their operation/maintenance manuals before the commissioning process so that Azerenerji JSC can customize the manuals with regard to operation/maintenance before the commissioning.

J. Assist Azerenerji JSC regarding environmental and social aspects

The consultant shall undertake the followings;

a) Review of Relevant Plan
   1) Review Environmental Impact Assessment (EIA), Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) including health, safety and social aspects attached to the minutes of discussion of JICA's appraisal mission conducted in XX, 201X, and revise/update EMP and EMoP, if necessary.
b) Assist for the Implementation of EMP and EMoP
   1) Assist Azerenerji JSC in complying with conditions set on approval of EIA report and the requirements under EMP, EMOP and Azerbaijan regulations and the JICA guidelines, and in preparation of environmental plan
   2) Prepare the Pre-qualification Documents and Bid Documents which includes the clauses to have Contractor comply with the requirement of the EMP and EMoP, the conditions set on EIA approval and JICA Environmental Guidelines.
   3) Assist Azerenerji JSC in supervising the contractor's work along with EMP and EMoP, the Bid Documents and Azerbaijan regulations and the JICA guidelines.
   4) Assist Azerenerji JSC in supervising the additional environmental study conducted by the contractor, if any
c) Provision of Information to JICA
      1) Assist Azerenerji JSC in providing environmental and social relevant information on the Project as JICA may reasonably request.
d) Environmental Monitoring
      1) Monitor the compliance of the Project with conditions stated in the Approval letter of the EIA, and make recommendations on environmental mitigation measures to Azerenerji JSC and contractors if necessary.

2) Assist Azerenerji JSC in preparation of environmental monitoring report during construction, which is to be submitted to JICA as a part of Quarterly Progress Report, by filling in the monitoring form.

Chapter 4. Expected Time Schedule

The total duration of consulting services will be sixty nine (69) months followed by twelve (12) months of defects liability period. The implementation schedule expected is as shown in Table.4-1.

Table 4-1 Expected Time Schedule

1)	Pre-Construction stage	:	22 Months
2)	Construction stage	:	47 Months
3)	Warranty period	:	12 Months
4)	Foreign Consultant	:	360-Man- Months
5)	Local Consultant	:	180-Man- Months
6)	Local Staff	:	177-Man- Months

Chapter 5. Staffing (Expertise Requirement)

Thirteen (13) of foreign consultants and four (4) of local consultants will be engaged, over 81 month' duration of consulting services, for a total of 360 man-months for foreign consultants and 180 man-months for local consultants. Total consulting input is 540 man-months.

1) Foreign Consultant
   1. Project Manager (Team leader: M or E)
   2. Mechanical Engineer (Gas / Steam Turbine)
   3. Mechanical Engineer (HRSG)
   4. Mechanical Engineer (BOP)
   5. Electrical Engineer
   6. Control and Instrument Engineer
   7. Architectural Engineer
   8. Civil Engineer (Civil Work)
   9. Civil Engineer (Land Reclamation)
   10. Operation & Maintenance Expert
   11. Environment and Social Expert
   12. Economist
   13. Contract Expert

2) Local Consultant – Full time
   1. Mechanical Inspector
   2. Electrical / I & C Inspector
   3. Architectural Inspector
   4. Civil Inspector

3) Local Staff

A. Qualification of key Team Members

The qualification of key Team Members is shown in Table 5-1.

Table 5-1 : Qualification of key Team Members

Designation	Qualification
Project Manager	Education: · Graduate in Mechanical/Electrical Engineering Experience: · Experience in power plant project : 20 years or more · Experience for International development projects under International donor such as JICA, WB and ADB : 5 years or more. · Experience in CC Power Plant project. · At least one experience of leading a consultants' team as the Team Leader or the Deputy Team Leader.
Mechanical Engineer (Gas / Steam Turbine)	Education: · Graduate in Mechanical Engineering Experience: · Experience in power plant project : 15 years or more · Experience for International development projects : 5 years or more. · Experience of working as a Mechanical Engineer in CC Power Plant project in the field of Gas/Steam Turbine system.
Mechanical Engineer (HRSG)	Education: • Graduate in Mechanical Engineering Experience: • Experience in power plant project : 15 years or more • Experience for International development projects : 3 years or more. • Experience of working as a Mechanical Engineer in power plant project in the field of HRSG system.
Mechanical Engineer (BOP)	Education: • Graduate in Mechanical/Electrical Engineering Experience: • Experience in power plant project : 10 years or more • Experience for International development projects. • Experience of working as a Mechanical/Electrical Engineer in power plant project.
Electrical Engineer	Education: • Graduate in Electrical Engineering Experience: • Experience in power plant project : 15 years or more

	• Experience for International development projects : 3 years or more. • Experience of working as an Electrical Engineer in power plant project in the field of Electrical system.
Control and Instrument Engineer	Education: • Graduate in Electrical/Mechanical Engineering Experience: • Experience in power plant project : 15 years or more • Experience for International development projects : 3 years or more. • Experience of working as an Electrical/Mechanical Engineer in CC Power Plant project in the field of Control and Instrument system.
Architectural Engineer	Education: • Graduate in Architecture Experience: • Experience for International development projects. • Experience as Professional Architecture.
Civil Engineer (Civil Work)	Education: • Graduate in Civil Engineering Experience: • Experience in power plant project : 10 years or more • Experience for International development projects. • Experience of working as a Civil Engineer in power plant project.
Operation & Maintenance Expert	Education: • Graduate in Mechanical/Electrical Engineering Experience: • Experience in power plant project : 5 years or more • Experience for International development projects. • Experience of working as an operation and maintenance expert in the field of CC power plant project.

Consultant may propose other experts and supporting staffs required to accomplish the tasks outlined in the TOR. It is the Consultant's responsibility to select the optimum team and to propose the professionals which he believes best meets the needs of Azerenerji JSC.

B. Scope of works for the respective personnel

Detailed information on the major tasks and duties each member of the detailed engineering design team and the construction supervision team shall perform is provided as follows:

Foreign Consultant		
No	Position	Major Tasks and Duties
A-1	Project Manager (Team leader: M or E)	As project manager and representative of the consultant; 1) Overall in TOR
A-2	Mechanical Engineer (Gas /Steam Turbine)	As a gas/steam turbine authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-3	Mechanical Engineer (HRSG)	As a HRSG and Boiler authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-4	Mechanical Engineer (BOP)	As a Plant Engineering authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-5	Electrical Engineer	As an electrical authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-6	Control and Instrument Engineer	As an instrumentation and control authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M

		7) Technical Transfer 8) Preparation of Reports
A-7	Architectural Engineer	As a architecture authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-8	Civil Engineer (Civil Work)	As a civil authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-9	Civil Engineer (Land Reclamation)	As a civil authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-10	Operation & Maintenance Expert	As a operation and maintenance expert; 1) Inspection and Testing during Manufacturing 2) Commissioning Acceptance Tests 3) Assistance in O&M 4) Technical Transfer 5) Preparation of Reports
A-11	Environment and Social Expert	As an environmental and social expert; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-12	Economist	As a financial expert; 1) Preparation of Pre-qualification Documents and Draft Bidding Documents including ・ Check and Review of Bid Documents ・ Evaluation (Pre-qualification & Price) 2) Supervising and Control Disbursement of Construction Budget

		3) Preparation of reports such as a part of monthly and quarterly report
A-13	Contract Expert	As a contract expert; 1) Administrating contractual documents and related activities 2) Preparation of Pre-qualification Documents and Draft Bidding Documents including ・ Check and Review of Bid Documents ・ Evaluation (Pre-qualification & Price) ・ Assistance for Contract Negotiation 3) Preparation of reports such as a part of monthly and quarterly report
Local Consultant		
No	Position	Major Tasks and Duties
B-1	Mechanical Inspector	As a mechanical engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports
B-2	Electrical / I & C Inspector	As an electrical/ I & C engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports
B-3	Architectural Inspector	As an architectural engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports
B-4	Civil Inspector	As a civil engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports

Chapter 6. Reporting

Within the scope of consulting services, the Consultant shall prepare and submit following reports and documents to Azerenerji JSC.

Type of Report		Date of Submission
1	Inception report (including schedule)	Within 6 weeks after the commencement of the services
2	Engineering report (including basic design report)	After completion of basic design
3	Construction schedule	Within PQ issue
4	Draft of pre-qualification documents	Before 1 month of PQ issue
5	Draft of bid documents	Before 1 month of Bid announce
6	Draft of evaluation criteria and method of pre-qualification	Before 1 month of PQ issue
7	Draft of evaluation report of pre-qualification	After evaluation of Pre-qualification
8	Draft of evaluation criteria and method of international competitive biddings	Before 1 month of Bid announce
9	Draft of evaluation report of international competitive biddings	After evaluation of biddings
10	Quarterly progress report	Within 15th days of the first month of the following quarter
11	Project completion report	Within 6 months after the Project completion

Chapter 7. Obligations of the Executing Agency

A. Undertaking by Azerenerji JSC

In order for the Consultant to carry out consulting services smoothly, Azerenerji JSC shall provide the followings to the Consultant without any cost.

a) All available documents, drawings, maps, statistics, data and information related to the Project including topography map/survey and site soil investigation/boring data.
b) Full time counterparts of Azerenerji JSC project team to participate in the Consultant's activities.
c) Assistance for acquisition of all necessary permits, recommendation and authorization for construction works and operation of the plant.
d) Water, natural gas and electric power during construction including commissioning and guarantee and reliability tests.

e) Checking Environmental Impact Assessment (EIA) Report with operation data after commissioning.
f) Periodic provision of operation and maintenance record data and information during the
g) Defect Liability Period of one (1) year to the Contractor and the Consultant for evaluation of operation and maintenance conditions.
h) Working office in Baku during pre-construction phase and in Yashma CCPP Project site during construction phase.

Annexes to the TOR

Location and Site Map is provided as annexure of TOR.



Source: Google earth

Figure 1 Location of Yashma Project Site



Source: Google earth

Figure 2 Area of Yashma Project Site

Appendix C10-02

Terms of Reference (TOR)
of
Engineering Consultancy Services for
Yashma Gas Combined Cycle Power Plant Project

(FIDIC Conditions of Contract for Plant and Design Build (Yellow Book) basis)

Terms of Reference (TOR)
of
Engineering Consultancy Services for
Yashma Gas Combined Cycle Power Plant Project

Chapter 1. Background

A. Introduction

The Government of the Republic of Azerbaijan (hereinafter called "GOA") has applied a loan from Japan International Cooperation Agency (JICA) (hereinafter called "loan") to finance Yashma Gas Combined Cycle Power Plant Project (hereinafter called "the Project") and intends to apply part of the proceeds of this credit to payments under the Consulting Services for the supervision of implementation of the Project. Azerenerji JSC intends to employ a firm of consultants for the contract to manage and supervise the implementation of the Project, Yashma, Azerbaijan.

B. Project Information

a) Implementing Organization

The owner (will become "the Employer" of consultant) of the Project is Azerenerji Joint Stock Company (Azerenerji JSC).

b) Background Information

In the "State program for development of fuel and energy sector in Azerbaijan (2005-2015)" and "Look into the future development concept 2020" of the Republic of Azerbaijan (hereinafter referred to as "Azerbaijan"), major themes are the development of electric power sources and maintenance of associated equipment to ensure a stable electric power supply. In response Azerenerji JSC issues a development plan for an electric power plant that utilizes natural gas as essential fuel.

Azerbaijan's installed power capacity is 6,860 MW, with thermal power plants including gas-engine plants accounting for 5,881 MW and hydro power plants 979 MW in 2014. However, effective generation capacity remains around 5,000 MW due to the aging and deterioration of major power plants. Since maximum demand of electric power in 2013 was 3,720 MW, current power supply capacity is sufficient to meet Azerbaijan's power demand. That said, Azerenerji forecasts that power demand will grow at an annual rate of around 5% as a result of stable economic growth, with demand peaking at around 5,450MW in 2020. In order to cope with increasing power demand and realize the phased decommissioning plan of the Azerbaijan Power Station (2,400MW), which is a conventional dual fuel (gas and oil) fired power station constructed more than 30 years ago, the country needs to develop additional electric capacity of around 1,800MW between 2018 and 2020. Moreover, the Azerbaijan Power Station, which comprises a major share of power generation and is located about 250km west of the capital Baku, supplies power to Baku through long-distance transmission lines: power systems utilizing long-distance transmission lines are prone to transmission loss as well as blackouts.

Based on this recognition, development of additional capacity near the capital Baku area, improvement of power transmission lines and substations, and support for proper utilization of facilities are now viewed as legitimate and imperative goals to ensure a highly stable power supply.

c) Location of the project and information on the surrounding area

The planned project site is the Yashma, vicinage of Sumgayit city, approximately 45 km northwest of Baku, the capital of Azerbaijan. (Refer to "Annexes to the TOR" on page 19). The front of the site is facing the Caspian Sea. There is a national highway to the rear of the site (width approx. 350m and a length of 2,100m (71.5ha)). There is a 110 kV transmission line parallel to the national highway. Azerenerji JSC will relocate an 110kV transmission line to the outside of the site within site preparatory work. There are no residences on the site and no rivers pass through the territory. The Yashma CCPP is projected to require an area of approximately 30 ha in the site area.

d) Stage reached in the project preparation and summary of the findings of studies to date

"Preparatory Survey on Yashma Gas Combined Cycle Power Plant Project" as feasibility study for the Project has already been completed on August 2014 by Tokyo Electric Power Services Company Ltd in Co-operation with JICA, JAPAN.

C. Other Relevant Information

a) Technical Information

The capacity of the Plant will be 920 MW of electric power. It will be natural gas fired and consist of 460MW x 2 (Two) blocks, each of them has shingle shaft, which consists of one gas turbine(GT), one steam turbine(ST) and one generator including one heat recovery steam generator(HRSG). In this project the technical codes and standards to be followed will be JIS, IEC, ISO, ANSI, ASTM, DIN etc.

b) Relevant laws and regulations

This Project will be guided by Laws of the land (Azerbaijan).

D. Scope of the Project

a) Scope of Work Under This Project

Lot	Contents
Lot 1 : Power Plant Construction (EPC Contract)	(1) Construction of 460MW x 2 (two) blocks of natural gas fired combined cycle power plant and common facilities.
Lot 2 : Gas pipeline	(1) Fuel gas pipeline from branch point of the main gas pipe line into the site (and gas compressors, if necessary). (40-50km)
Lot 3 : Transmission Line and Substations	(1) Transmission lines from the site to sub-stations. (2) Sub-stations a・Yashma S/S Extension b・STP S/S Construction (Sumgayit) c・Sulu TePe S/S Construction
Consulting Services	● Refer to Chapter 3

b) Scope of Yen Loan

Scope of yen loan is construction of 460MW x 2 (two) blocks of natural gas fired combined cycle power plant and common facilities (Lot1).

The configuration of the block is shingle shaft and each block has one GT, one ST, one generator, one HRSG and their auxiliaries, which include all relevant equipment. The scope of the Yen Loan portion will be EPC contract.

c) Scope of Azerenerji JSC

The following equipment and facilities, etc. are proposed to be within the scope of Azerenerji JSC portion of the Project.

a) Fuel gas pipeline from branch point of the main gas pipe line into the site (Lot2) (and gas compressors, if necessary). (Before initial firing, which is assumed to July 2020)
b) Substations (Construction, Extension) relevant to Yashma CCPP Project (Lot3). (Before first power receiving, which is assumed to February 2020)
c) Transmission lines from the site to the substations (Lot3). (Before first power receiving, which is assumed to February 2020)

Chapter2. Objectives of Consulting Services

A. Outline of Consulting services

The consulting services shall be provided by an international consulting firm (hereinafter referred to as "the Consultant") in association with national consultants in compliance with Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012. The objective of the consulting services is to achieve the efficient and proper preparation and implementation of the Project through the following works:

a) Design and Engineering
b) Assist Azerenerji JSC in Pre-qualification(PQ) for Bidders
c) Assist Azerenerji JSC in the Bidding Procedures
d) Project management at all levels including periodic review of budget estimate and administration of project cash flows
e) Inspection, testing and delivery control during manufacturing
f) Construction Supervision including Commissioning and Acceptance Test
g) Assist Azerenerji JSC in assuring the safety during the construction work of the Project
h) Ensure the quality of transfer of knowledge and technology from Manufacturer to Azerenerji JSC Personnel
i) Assist Azerenerji JSC in Operation and Maintenance
j) Assist Azerenerji JSC regarding environmental and social aspects

Chapter 3. Scope of Consulting Services

A. Design and Engineering

The Consultant shall be responsible for :

a) Preparation of design calculations, basic plans, drawings, specification and schedules for Bidders and contract documents. The design shall include calculations to determine size or capacity requirements; single line diagram with control and protection scheme; layout and arrangement of components, layout of plant area, selection of equipment and materials including those related to environmental issues; models of testing equipment and materials and specialized research.
b) Review and update above mentioned documents based on Azerenerji JSC and JICA's comments.

B. Assist Azerenerji JSC in Pre-qualification(PQ) for Bidders

The Consultant shall undertake the followings;

a) Define technical and financial requirements, capacity and/or experience for PQ criteria taking into consideration technical feature of the Project.
b) Prepare PQ documents in accordance with the latest version of Standard Prequalification Documents under Japanese ODA Loans.
c) Assist (name of Executing Agency) in PQ announcement, addendum/corrigendum, and clarifications to the applicants' queries.
a) Evaluate PQ applications in accordance with the criteria set forth in PQ documents and
b) Prepare a PQ evaluation report for approval of the PQ evaluation committee.

C. Assist Azerenerji JSC in the Bidding Procedures

The consultant shall undertake the followings;

a) Prepare bidding documents in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement of Works together with all relevant specifications, drawings and other documents.
b) Prepare bidding documents which includes the clauses to have Contractor comply with the requirement of the Environmental Management Plan (EMP) and JICA Guidelines for environmental and social considerations (April 2010) (JICA Environmental Guidelines).
c) Assist (name of Executing Agency) in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries
d) Evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP have been prepared in harmony each other and will meet such requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents.
e) Prepare a bid evaluation report for approval of the bid evaluation committee.
f) Assist (name of Executing Agency) in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting and.
g) Prepare a draft and final contract agreement

D. Project management at all levels including periodic review of budget estimate and administration of project cash flows

The consultant shall establish a project management system acceptable to Azerenerji JSC, which will be used to monitor, track and pin point problems.
The work involved will include the following:

a) Establish the basic overall project construction schedule, budget and cash disbursement schedule for both foreign and local portions.
b) Establish and implement a project management system and procedures to monitor and control the cost and time schedule to enable timely corrective measures.
c) Support, co-coordinate, supervise, make decisions and issue instructions to Azerenerji JSC for all design and engineering related to the construction activities from the view point of achieving engineering standards, quality assurance and safety on project
d) Set up a quality reporting system of project progress and status to Azerenerji JSC.
e) Manage claims by and against the Contractor properly and reasonably within a feasible time scale, considering the best interests of Azerenerji JSC.
f) Anticipate and identify potential difficulties or conflicts and their effect on the implementation schedule and recommend and agree on steps to be taken by the Contractor or by Azerenerji JSC to overcome difficulties and avoid delays.
g) Prepare and/or evaluate recommendations to Azerenerji JSC regarding any proposals of change, technical amendments and change in the scope of work, the appropriateness of their pricing and if agreed to by Azerenerji JSC, the timely issuance to the Contractor of charged order, as per the conditions of the supply and installation contract.

E. Inspection, testing and delivery control during manufacturing

The Consultant - with the participation of Azerenerji JSC - shall undertake the

implementation of the followings;

a) Check and approve proposal on quality assurance, quality control plan and delivery schedule prepared by the Contractor.
b) Regularly review production and delivery schedules submitted by the Contractor.
c) Check and approve factory testing procedures and factory test results submitted by the Contractor.
d) Monitor manufacturing progress by testing regular inspections to ensure compliance to contract documents.
e) Witness factory test of major equipment and preparation of corresponding certificates (test items witnessed are to be agreed between Azerenerji JSC and the Contractor).
f) Check and review inspection report of each factory testing submitted by the Contractor.

F. Construction Supervision including Commissioning and Acceptance Test

The Consultant shall perform his duties during the contract implementation period of the contracts to be executed by the Employer and the Contractor. FIDIC Conditions of Contract for Plant and Design Build (Yellow Book) will be used in this Project. In this context, the Consultant shall

a) Act as the Engineer to execute construction supervision and contract administration services in accordance with the power and authority to be delegated by the Employer.
b) Provide assistance to the Employer concerning variations and claims which are to be ordered/issued at the initiative of the Employer. Advise the Employer on resolution of any dispute with the Contractor.
c) Issue instructions, approvals and notices as appropriate.
d) Provide recommendation to the Employer for acceptance of the Contractor's performance security, advance payment security and required insurance.
e) Provide commencement order to the Contractor.
f) Assess adequacy of all inputs such as materials, labor and equipment provided by the Contractor.
g) Check and approve the Contractor's method of work, including site organization, program of performance, quality assurance system, safety plan and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected.
h) Regularly monitor physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected by the Contractor.
i) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions.
j) Review and approve the Contractor's design for the works to be constructed, and review and approve as required the Employer's Requirements, working drawings, shop drawings and drawings for temporary works.
k) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated.
l) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract.
m) Organize, as necessary, management meetings with the Contractor to review the arrangements for future work. Prepare and deliver minutes of such meetings to the Employer and the Contractor.
n) Supervise the works so that all the contractual requirements are met by the Contractor, including those in relation to i) quality of the works, ii) safety and iii) protection of the

environment. Confirm that an accident prevention officer proposed by the Contractor is duly assigned at the project site.

o) Supervise field tests, sampling and laboratory test to be carried out by the Contractor.
p) Inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the Employer's Requirements.
q) Verify statements submitted by the Contractor and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract.
r) Coordinate the works among different contractors employed for the Project.
s) Modify the Employer's Requirements as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any).
t) Carry out timely reporting to the Employer for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied.
u) Inspect, verify and fairly determine claims issued by the parties to the contract (i.e. the Employer and Contractor) in accordance with the contract.
v) Supervise the Test on Completion carried out by the Contractor and assist the Employer in carrying out the Test after Completion, if applicable.
w) Perform the inspection of the works and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the contract.
x) Provide periodic and/or continuous inspection services during defects notification period and if any defects are noted, instruct the Contractor to rectify.
y) Check and certify as-built drawings prepared by the Contractor.
z) Check and certify the operation and maintenance manual prepared by the Contractor.

G. Assist Azerenerji JSC in assuring the safety during the construction work of the Project.

The consultant shall undertake the followings;

a) When preparing or reviewing bidding documents for procurement of works and those for procurement of supply and installation of plant, the consultants shall make sure that the requirements stipulated in 1) below will fully be met.
   1) Bidding documents for procurement of works and those for procurement of supply and installation of plant require that:
   (i) The safety requirements in accordance with the laws and regulations in the country of the Borrower and relevant international standards (including guidelines of international organization), if any, shall be clearly stipulated in the contract.
   (ii) Bidders shall furnish a safety plan to meet the safety requirements stipulated in the bidding documents.
   (iii) The personnel for key positions to be proposed by bidders shall include an accident prevention officer.
b) The consultants shall review the safety plans submitted by the bidders.
c) During the supervision of the construction work, the consultants shall confirm that an accident prevention officer proposed by the contractor is duly assigned at the project site and that the construction work is carried out according to the safety requirements stipulated in the contract. If consultants recognize any questions regarding the safety measures including the ones mentioned above, the consultants shall require the contractors to take appropriate remedies.

H. Ensure the quality of transfer of knowledge and technology from Manufacturer to Azerenerji JSC Personnel

The Consultant shall undertake the followings;

a) Define the Manufacturer's responsibility to develop, arrange and implement an adequate on-the-job training program, both during construction period for Azerenerji JSC's operation and maintenance (O&M) staff assigned to operate and undertake maintenance of the plant.
   Ensure that the Manufacturer shall provide O&M training during the construction period of, including the assembly of the structure of the power plant equipment which cannot be checked during operation, and test operation, where Azerenerji JSC's O&M staff should be able to observe and record the Manufacturer's off-site maintenance activities.
b) Incorporate the Manufacturer's responsibility for the above mentioned on-the-job training for Azerenerji JSC `s operation/maintenance staff into the Bid Documents.
c) Ensure the quality of training and knowledge transfer provided from the Manufacturer to Azerenerji JSC`s O&M staff during the construction period.
   If necessary, take corrective action to actualize the training and knowledge transfer outcome, where Azerenerji JSC become able to independently implement quality operation and maintenance activities. The training will be provided by the Manufacturer. Corrective action may include programming training of power plant staff in coordination with the Manufacturer.
d) Support Azerenerji JSC O&M staff to acquire quality assurance skills to assess the quality of O&M training and to identify training-needs.
e) Encourage and ensure Azerenerji JSC staff to acquire such skills as reading design drawings and circuit diagrams, listen to the Contractor regarding near-miss experiences and learn safety management from the Contractor's implementation scheme, learn maintenance skills from the Manufacturer and record such construction and maintenance experiences by video recording and through documentation.

I. Assist Azerenerji JSC in Operation and Maintenance

The Consultant shall undertake the followings;

a) Strategic Planning
   1) Assist Azerenerji JSC to develop the Operation and Maintenance Strategy, including the plant performance target and plant Operation and Maintenance policy whereby Azerenerji JSC O&M staff are to become able to conduct O&M activities in a sustainable and independent manner.
   2) Assist Azerenerji JSC in developing the procedures to make the breakdown targets from Key Performance Indicators for each department/division of the plant and employees.
   3) Assist Azerenerji JSC to establish and implement PDCA.
b) Good Practice
   1) Assist Azerenerji JSC to develop and implement a system for recording data on plant efficiency and performance, including daily operation, daily inspection, periodical inspection, maintenance records and accident records.
   2) Assist Azerenerji JSC to establish and implement maintenance schedules and procedures.
   3) Assist Azerenerji JSC to acquire knowledge and skills of monitoring and checking during operation, such as actualizing equipment functions, maintaining heat efficiency, reducing equipment wear, reducing creep and fatigue degradation of hot parts, by

utilizing computer-based simulator and OJT through daily operation.

4) Assist Azerenerji JSC to establish and implement a trouble-management scheme, including trip cause analysis and recurrence prevention.
5) Assist Azerenerji JSC to establish and implement a safety management scheme, including ex-ante and ex-post safety activities.
6) Assist Azerenerji JSC to prepare inventory records (assets listing) of nameplates, summary list of equipment facilities "as-built" drawings for electro-mechanical equipment
7) Assist Azerenerji JSC to acquire knowledge and skills to conduct non-destructive inspection.
8) Assist Azerenerji JSC to develop basic design of IT-enabled Operation and Management System which includes the plant budgeting database and parts management system for system detailed design to be taken up at a later stage.
9) Guidance and coordination of the preparation of the Contractor's operation and maintenance manuals, which includes negotiation with the Contractor in the provision of their operation/maintenance manuals before the commissioning process so that Azerenerji JSC can customize the manuals with regard to operation/maintenance before the commissioning.

J. Assist Azerenerji JSC regarding environmental and social aspects

The consultant shall undertake the followings;

a) Review of Relevant Plan
   1) Review Environmental Impact Assessment (EIA), Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) including health, safety and social aspects attached to the minutes of discussion of JICA's appraisal mission conducted in XX, 201X, and revise/update EMP and EMoP, if necessary.
b) Assist for the Implementation of EMP and EMoP
   1) Assist Azerenerji JSC in complying with conditions set on approval of EIA report and the requirements under EMP, EMOP and Azerbaijan regulations and the JICA guidelines, and in preparation of environmental plan
   2) Prepare the Pre-qualification Documents and Bid Documents which includes the clauses to have Contractor comply with the requirement of the EMP and EMoP, the conditions set on EIA approval and JICA Environmental Guidelines.
   3) Assist Azerenerji JSC in supervising the contractor's work along with EMP and EMoP, the Bid Documents and Azerbaijan regulations and the JICA guidelines.
   4) Assist Azerenerji JSC in supervising the additional environmental study conducted by the contractor, if any
c) Provision of Information to JICA
      1) Assist Azerenerji JSC in providing environmental and social relevant information on the Project as JICA may reasonably request.
d) Environmental Monitoring
      1) Monitor the compliance of the Project with conditions stated in the Approval letter of the EIA, and make recommendations on environmental mitigation measures to Azerenerji JSC and contractors if necessary.
      2) Assist Azerenerji JSC in preparation of environmental monitoring report during construction, which is to be submitted to JICA as a part of Quarterly Progress Report, by filling in the monitoring form.

Chapter 4. Expected Time Schedule

The total duration of consulting services will be sixty nine (69) months followed by twelve (12) months of defects liability period. The implementation schedule expected is as shown in Table.4-1.

Table 4-1 Expected Time Schedule

1)	Pre-Construction stage	:	22 Months
2)	Construction stage	:	47 Months
3)	Warranty period	:	12 Months
4)	Foreign Consultant	:	360-Man- Months
5)	Local Consultant	:	180-Man- Months
6)	Local Staff	:	177-Man- Months

Chapter 5. Staffing (Expertise Requirement)

Thirteen (13) of foreign consultants and four (4) of local consultants will be engaged, over 81 month' duration of consulting services, for a total of 360 man-months for foreign consultants and 180 man-months for local consultants. Total consulting input is 540 man-months.

1) Foreign Consultant
   1. Project Manager (Team leader: M or E)
   2. Mechanical Engineer (Gas / Steam Turbine)
   3. Mechanical Engineer (HRSG)
   4. Mechanical Engineer (BOP)
   5. Electrical Engineer
   6. Control and Instrument Engineer
   7. Architectural Engineer
   8. Civil Engineer (Civil Work)
   9. Civil Engineer (Land Reclamation)
   10. Operation & Maintenance Expert
   11. Environment and Social Expert
   12. Economist
   13. Contract Expert

2) Local Consultant – Full time
   1. Mechanical Inspector
   2. Electrical / I & C Inspector
   3. Architectural Inspector
   4. Civil Inspector

3) Local Staff

A. Qualification of key Team Members

The qualification of key Team Members is shown in Table 5-1.

Table 5-1 : Qualification of key Team Members

Designation	Qualification
Project Manager	Education: · Graduate in Mechanical/Electrical Engineering Experience: · Experience in power plant project : 20 years or more · Experience for International development projects under International donor such as JICA, WB and ADB : 5 years or more. · Experience in CC Power Plant project. · At least one experience of leading a consultants' team as the Team Leader or the Deputy Team Leader.
Mechanical Engineer (Gas / Steam Turbine)	Education: · Graduate in Mechanical Engineering Experience: · Experience in power plant project : 15 years or more · Experience for International development projects : 5 years or more. · Experience of working as a Mechanical Engineer in CC Power Plant project in the field of Gas/Steam Turbine system.
Mechanical Engineer (HRSG)	Education: • Graduate in Mechanical Engineering Experience: • Experience in power plant project : 15 years or more • Experience for International development projects : 3 years or more. • Experience of working as a Mechanical Engineer in power plant project in the field of HRSG system.
Mechanical Engineer (BOP)	Education: • Graduate in Mechanical/Electrical Engineering Experience: • Experience in power plant project : 10 years or more • Experience for International development projects. • Experience of working as a Mechanical/Electrical Engineer in power plant project.
Electrical Engineer	Education: • Graduate in Electrical Engineering Experience: • Experience in power plant project : 15 years or more

	• Experience for International development projects : 3 years or more. • Experience of working as an Electrical Engineer in power plant project in the field of Electrical system.
Control and Instrument Engineer	Education: • Graduate in Electrical/Mechanical Engineering Experience: • Experience in power plant project : 15 years or more • Experience for International development projects : 3 years or more. • Experience of working as an Electrical/Mechanical Engineer in CC Power Plant project in the field of Control and Instrument system.
Architectural Engineer	Education: • Graduate in Architecture Experience: • Experience for International development projects. • Experience as Professional Architecture.
Civil Engineer (Civil Work)	Education: • Graduate in Civil Engineering Experience: • Experience in power plant project : 10 years or more • Experience for International development projects. • Experience of working as a Civil Engineer in power plant project.
Operation & Maintenance Expert	Education: • Graduate in Mechanical/Electrical Engineering Experience: • Experience in power plant project : 5 years or more • Experience for International development projects. • Experience of working as an operation and maintenance expert in the field of CC power plant project.

Consultant may propose other experts and supporting staffs required to accomplish the tasks outlined in the TOR. It is the Consultant's responsibility to select the optimum team and to propose the professionals which he believes best meets the needs of Azerenerji JSC.

B. Scope of works for the respective personnel

Detailed information on the major tasks and duties each member of the detailed engineering design team and the construction supervision team shall perform is provided as follows:

Foreign Consultant		
No	Position	Major Tasks and Duties
A-1	Project Manager (Team leader: M or E)	As project manager and representative of the consultant; 1) Overall in TOR
A-2	Mechanical Engineer (Gas /Steam Turbine)	As a gas/steam turbine authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-3	Mechanical Engineer (HRSG)	As a HRSG and Boiler authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-4	Mechanical Engineer (BOP)	As a Plant Engineering authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-5	Electrical Engineer	As an electrical authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-6	Control and Instrument Engineer	As an instrumentation and control authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M

		7) Technical Transfer 8) Preparation of Reports
A-7	Architectural Engineer	As a architecture authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-8	Civil Engineer (Civil Work)	As a civil authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-9	Civil Engineer (Land Reclamation)	As a civil authority; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-10	Operation & Maintenance Expert	As a operation and maintenance expert; 1) Inspection and Testing during Manufacturing 2) Commissioning Acceptance Tests 3) Assistance in O&M 4) Technical Transfer 5) Preparation of Reports
A-11	Environment and Social Expert	As an environmental and social expert; 1) Design and Engineering 2) Assistance in PQ and ICB 3) Inspection and Testing during Manufacturing 4) Construction supervision 5) Commissioning Acceptance Tests 6) Assistance in O&M 7) Technical Transfer 8) Preparation of Reports
A-12	Economist	As a financial expert; 1) Preparation of Pre-qualification Documents and Draft Bidding Documents including ・ Check and Review of Bid Documents ・ Evaluation (Pre-qualification & Price) 2) Supervising and Control Disbursement of Construction Budget

		3) Preparation of reports such as a part of monthly and quarterly report
A-13	Contract Expert	As a contract expert; 1) Administrating contractual documents and related activities 2) Preparation of Pre-qualification Documents and Draft Bidding Documents including ・ Check and Review of Bid Documents ・ Evaluation (Pre-qualification & Price) ・ Assistance for Contract Negotiation 3) Preparation of reports such as a part of monthly and quarterly report
Local Consultant		
No	Position	Major Tasks and Duties
B-1	Mechanical Inspector	As a mechanical engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports
B-2	Electrical / I & C Inspector	As an electrical/ I & C engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports
B-3	Architectural Inspector	As an architectural engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports
B-4	Civil Inspector	As a civil engineering authority; 1) Inspection and Testing during Manufacturing 2) Construction supervision 3) Commissioning Acceptance Tests 4) Preparation of Reports

Chapter 6. Reporting

Within the scope of consulting services, the Consultant shall prepare and submit following reports and documents to Azerenerji JSC.

Type of Report		Date of Submission
1	Inception report (including schedule)	Within 6 weeks after the commencement of the services
2	Engineering report (including basic design report)	After completion of basic design
3	Construction schedule	Within PQ issue
4	Draft of pre-qualification documents	Before 1 month of PQ issue
5	Draft of bid documents	Before 1 month of Bid announce
6	Draft of evaluation criteria and method of pre-qualification	Before 1 month of PQ issue
7	Draft of evaluation report of pre-qualification	After evaluation of Pre-qualification
8	Draft of evaluation criteria and method of international competitive biddings	Before 1 month of Bid announce
9	Draft of evaluation report of international competitive biddings	After evaluation of biddings
10	Quarterly progress report	Within 15th days of the first month of the following quarter
11	Project completion report	Within 6 months after the Project completion

Chapter 7. Obligations of the Executing Agency

A. Undertaking by Azerenerji JSC

In order for the Consultant to carry out consulting services smoothly, Azerenerji JSC shall provide the followings to the Consultant without any cost.

a) All available documents, drawings, maps, statistics, data and information related to the Project including topography map/survey and site soil investigation/boring data.
b) Full time counterparts of Azerenerji JSC project team to participate in the Consultant's activities.
c) Assistance for acquisition of all necessary permits, recommendation and authorization for construction works and operation of the plant.
d) Water, natural gas and electric power during construction including commissioning and guarantee and reliability tests.

e) Checking Environmental Impact Assessment (EIA) Report with operation data after commissioning.
f) Periodic provision of operation and maintenance record data and information during the
g) Defect Liability Period of one (1) year to the Contractor and the Consultant for evaluation of operation and maintenance conditions.
h) Working office in Baku during pre-construction phase and in Yashma CCPP Project site during construction phase.

Annexes to the TOR

Location and Site Map is provided as annexure of TOR.



Source: Google earth

Figure 1 Location of Yashma Project Site



Source: Google earth

Figure 2 Area of Yashma Project Site

Appendix C13-01

1st Public Meeting Protocol (including Attendance List)

1st Public Meeting Protocol

Public meeting Protocol

Azerbaijan, **Baku**
11.04.2014

Location:
Azerbaijan, Sumgait city

Place: Sumgait Power Plant, Conference room

Public meeting topic: First Stakeholder Meeting on Yashma Combined Cycle Gas Turbine Power Plant Construction Project

Public meeting participants:
There were 46 participants including community members from Sumgait and Z. Tagiyev settlement, local press, Azerbaijani consultants and specialists from Sumgait Power Plant. Azerenerji announced the organization of the stakeholder meeting by local newspaper and direct contact to stakeholders.

Working organ of the public meeting:
Chairperson: Director of Sumgait Power Plant

Presentation:

Director of Sumgait Power Plant Mr. Mahir Kheyirkhabarov

Opening of public meeting and welcoming guests. Presentation of participants. Determination of discussion topics and order of discussions.

Informing participants about the importance of planned Yashma Combined Cycle Gas Turbine Power Plant Construction Project in context of dynamic economic development of Azerbaijan, realizing state programs in energy sector signed by Prezident of Azerbaijan Mr. Ilham Aliyev.

Team Leader of JICA study team Opening remarks.

JİCA Study Team member for Yashma project

Informing about Guidelines for Environmental and Social Considerations Environmental and Social Consideration of Japan International Cooperation Agency (JICA) (hereinafter, JICA guidelines), goal and duration of JICA project in Yashma, effectiveness of ecological friendly technologies of new Power Plant, Gas Pipeline and Transmission Line. Currently planned capacity of power plant is 900-950 MW. The plant will consist of two blocks and use natural gas as a fuel. According to the result of initial research the technologies which will be used in construction work will not greatly impact on the environment. The water which will be used at plant will be taken from Caspian Sea. Water is taken from the depths of the sea for cooling system. JICA needs to confirm the project satisfy the conditions of Azerbaijan and JICA concerning environmental and social impacts. JICA is interested to know about environment impacts and results of impacts to the environment. The final report will be provided to Ministry of Nature Resources of Azerbaijan and after approval it will be uploaded to JICA website for public disclosure.

The presentation includes initial research materials on project description of power plant, transmission lines and substations, gas pipeline map, collected data by local consultants on marine environment, atmosphere, noise and vibration, fauna and flora, study of data on species listed in Azerbaijani Red book and IUCN listed species, Social Environment: land use, land traffic, sanitation, population & demography, education, public infrastructure, employment, income and expenditure, tourist site, cultural and heritage properties, minorities. In order to identify environmental impacts, the past database must be reviewed and field research will be conducted. Different modeling results will be prepared and presented to community in the next stakeholder meeting.

After the first public meeting, field researches will start.

Air quality research as well as noise measurement will be conducted throughout 24 hours in 2 places – Power Plant area and in nearest living area.

JICA study team will prepare EİA report based on the data collection work and field survey.

Questions and answers:

Questions from the local participants, representative of the industrial city of Sumgait and Z.Tagiev settlement .

Director of Sumgait Power Plant:

- They have always lived here. They have informaton about environmental impact of the power plant . I hope that this meeting was interesting for them .

Question 1.

- "Could you tell about wastes , pollutions during construction activities? May I know about level of emissions?"
- "As the Power Plant will use natural gas as a fuel CO, CO_2, NOx etc. emissions are expected. All local and international standarts will bemet."

Question 2.

- "We wish you success and welcome to project staff. This is third project in Sumgayit which we know. Is that possible to use sea water in cooling system effectively and protect sea from negative impacts."

"Intake water system is the same as in Shimal Power Plant and the water which will be taken from the depth of the sea will be discharged back to the sea without any negative impact. We will notify you about the results of the research in the second stakeholder meeting.

Question 3.

-Do you intend to plant trees around the new station ?

-"There is a plan to install tree-planting area in the project site. The tree-planting area was installed at various existing power plants. "

Question 4.

- Is there such large-scale of the same type plant in other countries?
- “Currently, Indonesia and Malaysia build bigger and stronger plants . Malaysia built in two blocks of 700 MW . ”

Question 5.

-How to handle the cooling system of the power plant in operation? Where is the water will be taken from?

- “The cooling system water will be taken from the depth of the sea. After the process of mineralization and other treatment we will use it in colling system. ”

Question 6.

- Are you plan to conduct monitoring of emissions to the environment ?
- “Yes. Both water and air .”
- It was very interesting to participate in your stakeholder meeting.

Wish you good luck in your future work!.

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Appendix C13-02

2nd Public Meeting Protocol (including Attendance List)

2nd Public Meeting Protocol

Public meeting Protocol

Azerbaijan, **Baku**
04.07.2014

Location:
Azerbaijan, Sumgait city

Place: Sumgait Power Plant, Conference room

Public meeting topic: First Stakeholder Meeting on Yashma Combined Cycle Gas Turbine Power Plant Construction Project

Public meeting participants:
There were 51 participants including community members from Sumgait and Z. Tagiyev settlement, local press, Azerbaijani consultants and specialists from Sumgait Power Plant. Azerenerji announced the organization of the stakeholder meeting by local newspaper and direct contact to stakeholders..

Working organ of the public meeting:
Chairperson: Director of Sumgait Power Plant

Presentation:

Director of Sumgayit Power Plant

Opening of the public meeting and welcoming guests. Presenting the participants. Introducing the discussion topics and their sequence. Informing participants about the purpose of the Second Public Meeting on the planned Yashma Combined Cycle Gas Turbine Power Plant Construction Project.

JİCA Study Team member for Yashma project

-Presentation on Environmental Impact Assessments of Yashma Power Plant Project.

−Explanation about Guidelines for Environmental and Social Considerations of Japan International

Cooperation Agency (JICA), goal and duration of the JICA project in Yashma, effectiveness of ecological friendly technologies of the new Thermal Power Plant, Gas Pipeline and Transmission Line. The current planned capacity of the power plant is 900-950 megawatts. The station will consist of two blocks. The natural gas will be used as a fuel.

The technologies which will be used in the construction work won't cause any negative impacts on the environment. The water to be used for the cooling system at the plant will be taken from depth of the Caspian Sea. JICA explained the requirements to fulfill the conditions of Azerbaijan and JICA concerning environmental and social impacts. JICA is interested to identify and recognize the environment impacts.

The project's energy efficient technologies, water treatment systems, quality of air, noise, temperature of water were explained. The project will be realized in the manner that will meet all ecological standards and protect the nature from negative impacts.

The works will be conducted mainly during the daytime for protection of the local population from noise in the evening and night time. The local people will be employed in the temporary works.

Biodiversity Specialist of the project

Mentioned in his presentation about 19 plant species in the power plant area, 24 species in the transmission lines area and 30 species on the gas pipeline route. According to his information, there are no species, birds or fishes included in IUCN Red Book or the Red Book of Azerbaijan found in the territory of power plant, transmission line or gas pipelines. Only two species, Mediterranean tortoise and Red Falcon bird were mentioned as vulnerable in the Red Book of Azerbaijan.

During the public meeting environmental experts answered questions from Sumgayit city and Z.Tagiyev settlement community members.

Questions and answers:

Question 1.

"We are concerned about dust and noise caused during the construction activities. How often will monitoring will be conductedprovided during the construction period? Do you consider providing online monitoring?

"We plan to conductedprovide monitoring in the period of maximum construction activityselected areas. It`s more effective. Contractors will conduct provide monitoring in on the selected period byareas, also online or other systematic monitoring equipment"

Question 2.

"How do you monitor the change of water temperature in the Caspian sea?"

" We will install equipment to measure water temperature of thermal effluent. Water temperature will be measured around the site as well."

Question 3.

Do you have a special device for cooling the generator?

"Yes. We have all modern devices for proper use of the generator."

Question 4.

What kind of green activities are planned near the power station?

"On the south side of the Power Station many trees will be planted and other environment protection activities will be conducted."

Conclusion

Specialists from Sumgayit Power Station, community member from Jorat settlement, community members from Z.Tagiyev settlement were satisfied with the answers on their questions.

Representatives from Sumgayit, Zeynallabdin Taghiyev settlement, settlement of Nasosniy, Jorat settlement of Sumgayit, as well as from Sumgayit Power Plant, Azerkimya, Azerboru, SOCAR

companies, also teachers, journalists from newspaper "Azerbaijan ishiqlari", housekeepers from Z.Tagiyev settlement were glad to meet with representatives from JICA Study Team, ECONote and together with the director of Sumgayit Power Plant wished good luck to JICA and TEPSCO teams during the project.

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Appendix C13-03

Environmental Impact Assessment Report for
Yashma Gas Combined Cycle Power Plant Project
in the Azerbaijan

Final Report of Environmental Impact Assessment (EIA)

for

Construction of Yashma Gas Combined Cycle Power Plant

And Associated Facilities

August 2014

Submitted by:
Tokyo Electric Power Services Co., LTD
(Japan International Cooperation Agency Study Team)
Date: August 2014
Team leader: Sachio Kosaka

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Chapter 5: Existing Environment: Socio-Economic

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Chapter 7: Analysis of Alternative

Chapter 8: Environmental Management Plan and Monitoring Plan

Chapter 9: Public Consultation

Chapter 10: Conclusions and Recommendations

Abbreviations Used

Abbreviations	Words
CCPP	Combined Cycle Power Plant
EIA	Environmental Impact Assessment
F/S	Feasibility Study
GT	Gas Turbine
HRSG	Heat Recovery Steam Generator
IFC	International Finance Corporation
JICA	Japan International Cooperation Agency
JSCA	Azerenerji Joint Stock Company
MW	Mega Watt
NOx	Nitrogen Oxide
NG	Natural Gas
NGO	Non-Governmental Organization
O&M	Operation and Maintenance
ODA	Official Development Assistance
SOx	Sulfur Oxide
ST	Steam Turbine
TOR	Terms of Reference
WB	World Bank

Units

Prefixes

μ	:	micro- = 10^{-6}
m	:	milli- = 10^{-3}
c	:	centi- = 10^{-2}
k	:	kilo- = 10^{3}
M	:	mega- = 10^{6}
G	:	giga- = 10^{9}

Units of Length

m	:	meter
cm	:	centimeter
km	:	kilometer

Units of Area

cm^2	:	square centimeter
m^2	:	square meter
km^2	:	square kilometer
ha	:	hectare

Units of Density and Concentration

kg/m^3	:	kilogram per cubic meter
t/m^3	:	ton per cubic meter
mg/1	:	milligram per liter
mg/m^3N	:	milligram per normal cubic meter
mg/m^3	:	milligram per cubic meter
ppm	:	parts per million
$\mu g/ m^3$	:	microgram per cubic meter

Units of Energy

kcal	:	kilocalorie
Mcal	:	megacalorie
MJ	:	mega joule
TJ	:	tera joule
kWh	:	kilowatt-hour
MWh	:	megawatt-hour
GWh	:	gigawatt-hour

Units of Heating Value

kcal/kg	:	kilocalorie per kilogram
kJ/kg	:	kilojoule per kilogram

Units of Temperature

°C	:	degree Celsius or Centigrade

Units of Electricity

W	:	watt
kW	:	kilowatt
A	:	ampere
kA	:	kiloampere
V	:	volt
kV	:	kilovolt
kHz	:	kilohertz

Units of Time

s	:	second
min	:	minute

h	:	hour
d	:	day
y	:	year

Units of Flow

t/h	:	ton per hour
t/d	:	ton per day
t/y	:	ton per year
cm/s	:	centimeter per second
m/s	:	meter per second
m^3/s	:	cubic meter per second
m^3/h	:	cubic meter per hour
m^3/d	:	cubic meter per day
m^3N/s	:	cubic meter per second at normal condition
m^3N/h	:	cubic meter per hour at normal condition
g/s	:	gram per second
g/h	:	gram per hour
g/d	:	gram per day
kg/s	:	kilogram per second
kg/h	:	kilogram per hour
kg/d	:	kilogram per day

Units of Sound Power Level

dB	:	decibel

EIA

Chapter 1

Chapter 1

Introduction

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Annex 1-7 IFC/WB Environmental, Health, and Safety General Guidelines, 2007

1. Introduction

1.1 Background

In the “State program for development of fuel and energy sector in Azerbaijan (2005-2015)” and “Look into the future development concept 2020” of the Republic of Azerbaijan (hereinafter referred to as “Azerbaijan”), major themes are the development of electric power sources and maintenance of associated equipment to ensure a stable electric power supply. In response we issue a development plan for an electric power plant that utilizes natural gas as essential fuel.

Azerbaijan’s installed power capacity is presently 6,049MW, with thermal power plants accounting for 5,101MW and hydro power plants 948MW in 2012. However, effective generation capacity remains around 5,000MW due to the aging and deterioration of major power plants. Since maximum demand of electric power in 2012 was 3,624MW, current power supply capacity is sufficient to meet Azerbaijan’s power demand.

That said, Azerenerji forecasts that power demand will grow at an annual rate of around 5% as a result of stable economic growth, with demand peaking at around 5,450MW in 2020.
In order to cope with increasing power demand and realize the phased decommissioning plan of the Azerbaijan Power Station (2,400MW), which is a conventional oil-fired power station constructed more than 30 years ago, the country needs to develop additional electric capacity of around 1,800MW between 2018 and 2020.

Moreover, the Azerbaijan Power Station, which comprises a major share of power generation and is located about 250km west of the capital Baku, supplies power to Baku through long-distance transmission lines: Power systems utilizing long-distance transmission lines are prone to transmission loss as well as blackouts.

Based on this recognition, development of additional capacity near the capital Baku area, improvement of power transmission lines and substations and support for proper utilization of facilities are now viewed as legitimate and imperative goals to ensure a highly stable power supply.

The purpose of the survey is to carry out studies necessary for judging whether the project is viable as an ODA project in accordance with the minutes of meetings agreed upon between Azerenerji Joint Stock Company (JSCA) and Japan International Cooperation Agency (JICA) on June 2013.

JICA has contracted Tokyo Electric Power Service CO., LTD. (TEPSCO) in order to conduct F/S regarding selected ’Yashma Gas Combined Cycle Power Plant (Yashma CCPP) project ‘ for the purpose of improving capability of electric supply in Azerbaijan.

1.2 Demand-Supply Situation

The supply demand balance until 2020 is shown in Table 1.2-1.
Electric power export is considered in this plan. Prior to 2006, power imports by Azerenerji JSC exceeded exports. Azerenerji JSC had been trying to cut imports due to security reasons, and the import/export balance changed to an export surplus from 2007 onwards. An inter-connection in the power trade to Turkey via Georgia was made from 2013 onwards. Therefore, Azerenerji JSC is now able to export surplus electricity to the power market.

The target reserve margin rate (RMR) was reviewed by the JICA study team in 2013 as follows.

2012-2016: about 30%
2018-2022: about 25%

In the development plan, the RMR in 2020 is 22.5%, lower than the target RMR of 25%. The RMR of the other years appear acceptable in Azerenerji JSC's plan, and therefore this plan seems preferable from the view point of the supply/demand balance.

Installation of the Yashma thermal power station, which has a capacity of 920MW, is planned to be completed in 2018. Under a scenario whereby development of the Yashma project is shifted to 2019, the reserve margin for 2018 is 21.8%. This is lower than the target RMR of 25%, even when 600MW is not retired but shifted to 2019. Therefore, development of the Yashma thermal power plant in 2018 is important in maintaining a stable power supply.

Table 1.2-1 Supply Demand Balance of Azerbaijan's Power System

	Item		unit	2013	2014	2015	2016	2017	2018	2019	2020
I	Peak demand		MW	3,720	3,850	4,100	4,350	4,600	4,850	5,100	5,360
	Increase over the previous year		%	2.6	3.5	6.5	6.1	5.7	5.4	5.2	5.1
II	Installed capacity - total:		MW	6,895	6,493	6,928	7,028	7,028	7,348	7,848	7,548
	THERMAL	Existing Thermal PP		5,101	5,921	5,436	5,821	5,821	5,821	6,141	6,491
		Retirement TPP			▲ 900				▲ 600		▲ 600
		Newly installed TPP		820	415	385			920	350	300
		Installed capacity - TPP Total:	MW	5,921	5,436	5,821	5,821	5,821	6,141	6,491	6,191
	HYDRO	Existing HydroPP		963	969	1,007	1,007	1,057	1,057	1,057	1,157
		Newly installed HPPs		6	38		50			100	
		Installed capacity - HPP Total:	MW	969	1,007	1,007	1,057	1,057	1,057	1,157	1,157
	Renewable Power Plants (wind, solar) Total		MW	5	50	100	150	150	150	200	200
III	Available Capacity			5,065	5,583	5,958	6,328	6,328	6,608	7,218	6,948
IV	Restrictions		MW	▲ 1,830	▲ 910	▲ 970	▲ 700	▲ 700	▲ 740	▲ 630	▲ 600
V	Import-export balance		MW	▲ 180	▲ 380	▲ 380	▲ 380	▲ 380	▲ 380	▲ 380	▲ 380
VI	Demand / Supply Balance Surplus (+) / Deficit (-)		MW	1,165	1,353	1,478	1,598	1,348	1,378	1,738	1,208
VII	Reserve margin		%	31.3%	35.1%	36.0%	36.7%	29.3%	28.4%	34.1%	22.5%

Source: JSCA

1.3 Project Outline

1.3.1 Power plant

Table 1.3-1 shows the Project Overview for Yashma Gas Combined Cycle Power Plant (Yashma CCPP).

Table 1.3-1 Project Overview for Yashma CCPP

Items	Contents
Owner	Azerenerji Joint Stock Company (JSCA)
Name	Yashma Power Plant
Site	Sumgayit city in Azerbaijan (45km northwest of Baku)
Area	71.5 ha
Type	Combined Cycle Power Plant
Capacity	Two single shafts, total capacity 900 to 950 MW
Fuel	Natural Gas
Expected Taking Over #1 #2	 2020 2021



Source: Google earth

Figure 1.3-1 Location of Yashma Project Site

1.3.2 Transmission line and substation

Transmission lines and substation plans for the Yashma CCPP Project are shown in Tables 1.3-2 and 1.3-3. All projects for the Yashma CCPP are set to be completed by 2018.

Table 1.3-2 New Transmission Lines for Yashma CCPP

Voltage (kV)	Section of Transmission Line	No. of Circuit	Length (km)	Planned Completion Year
330	Yashma E/S - Yashma S/S	1	8.4	2018
	Yashma E/S - Sule TePe S/S	1	37.4	2018
220	Yashma E/S - Absheron S/S-Sanaya Qovsagi S/S	2	4.6	2018
	Yashma E/S - Absheron S/S-Boyuk Sor S/S	2	23.5	2018
	Yashma E/S - Sumgayit S/S	2	17.3	2018

S/S: Substation
E/S: Power Station

(Source: JSCA)

Table 1.3-3 New Substations for Yashma CCPP

Voltage (kV)	Name of Substation	Capacity (MVA)	Planned Completion Year
330	Yashma S/S Extension	1x200,2x240	2018
330	Sule TePe S/S	1x400, 2x250	2018
220	Sumgayit S/S	2x125	2018

S/S: Substation

(Source: JSCA)

1.3.3 Gas pipeline

According to earlier information from Azerenerji JSC, there exists one (1) gas pipeline 300m southeast from the Yashma site. Though this pipeline is available for the Yashma power plant, based on new information from SOCAR the pipeline's supply pressure and volume are not sufficient for the Yashma power plant project: the pipeline's supply pressure is approx. 5 bar and it is normally used for residential consumers but the Yashma project requires a minimum pressure level of 20-30 bar at the project site boundary.

Azerenerji JSC submitted the official letter to SOCAR regarding the Yashma project. Required Gas volume is 200,000m^3/hour for the Yashma project as described in the official letter. Azerenerji JSC and the study team had meetings with SOCAR on the possibility of gas supply, and SOCAR, Azerenerji JSC and the study team conducted joint site surveys and discussions regarding some candidate sites. The candidate side Khizi is recommended as a construction site for a new gas pipeline.

1.4 Regulation and guideline regarding project activity

1.4.1 Environmental Impact Assessment

(1) Overview of the environmental administration

The Ministry of Ecology and Natural Resources (MENR) has primary responsibility for environmental regulation. The MENR's statutes were adopted by presidential decree in 2001, making this body responsible for:

• Development of draft environmental legislation for submission to the Azerbaijan Parliament (Milli Mejlis);
• Implementation of environmental policy;
• Enforcement of standards and requirements for environmental protection;
• Suspension or termination of activities not meeting set standards;
• Advising on environmental issues;
• Expert review and approval of environmental documentation, including EIA and
• Implementation of the requirements set out in international conventions ratified by the Azerbaijan Republic (within its competence).

Ministries related to the environmental administration includes, besides MENR, Ministry of Emergency Situations (MES)), and Ministry of Health, Ministry of Fuel and Energy. MENR controls the environmental impact assessment procedure as well as the environmental standard and environmental mitigation measures. Working safety and sanitation is controlled by MES and the Ministry of Health, and fuel supply is controlled by MFE.

(2) Environmental laws

Environmental laws in Azerbaijan include:

- ✓ 1991 The Land Code of the Azerbaijan Republic
- ✓ 1995 Azerbaijan Constitution
- ✓ 1996 Law of Azerbaijan on Pesticide and Agricultural Chemicals
- ✓ 1997 The Water Code of the Azerbaijan Republic
- ✓ 1997 Law of the Azerbaijan Republic on Radiation Safety of the Population
- ✓ 1998 Law of the Azerbaijan Republic on Fishing
- ✓ 1998 Law of the Azerbaijan Republic on Hydro‐Meteorology
- ✓ 1998 Law of the Azerbaijan Republic On Industrial and Domestic Wastes
- ✓ 1998 Law Of Azerbaijan Republic On State Land Cadaster, Monitoring Of Lands And Land Structuring
- ✓ 1998 Law of the Azerbaijan Republic on Subsurface
- ✓ 1998 The Forest Code of Azerbaijan Republic
- ✓ 1999 Law of the Azerbaijan Republic on Protection of the Environment
- ✓ 1999 Law of the Azerbaijan Republic on Ecological Safety
- ✓ 1999 Law of the Azerbaijan Republic on Fauna
- ✓ 1999 Law of the Azerbaijan Republic on Water Supply and Wastewater
- ✓ 1999 Law of the Azerbaijan Republic on Fertility of Lands
- ✓ 1999 The Law of the Republic of Azerbaijan on Amelioration and Irrigation
- ✓ 2000 Law of the Azerbaijan Republic on Specially Protected Natural Territories and Objects
- ✓ 2001 Law of the Azerbaijan Republic on Protection of Atmospheric Air
- ✓ 2002 Law of Azerbaijan Republic on Obtaining of Environmental Information
- ✓ 2002 The Law of the Republic of Azerbaijan on Ecological Insurance
- ✓ 2006 Law of the Republic of Azerbaijan on Phytosanitary Control

The fundamental environmental framework in Azerbaijan is regulated in Law of the Azerbaijan Republic on Protection of the Environment and Law of the Azerbaijan Republic on Ecological Safety which are established in 1999.
In addition, there are several decrees and acts to complete those environmental laws.

Azerbaijan accedes to, ratifies and signs the principal international agreements, conventions and protocols concerning environmental protection and conservation of natural resources including:

- ✓ European Convention for the Protection of Animals during International Transport
- ✓ Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971
- ✓ Convention concerning the protection of the world cultural and natural heritage
- ✓ Convention on international trade in endangered species of wild fauna and flora
- ✓ Convention on the conservation of migratory species of wild animals
- ✓ Convention on biological diversity
- ✓ Convention on the Law of the Non-navigational Uses of International Watercourses
- ✓ Convention on the conservation of European wildlife and natural habitats (Bern Convention)
- ✓ Convention on environmental impact assessment in a transboundary context
- ✓ Convention on the protection and use of transboundary watercourses and international lakes
- ✓ Convention on access to information, public participation in decision making and access to justice in environmental matters
- ✓ Kyoto protocol to the united nations framework convention on climate change
- ✓ Framework Convention for the Protection of the Marine Environment of the Caspian Sea
- ✓ Vienna Convention for the Protection of the Ozone Layer (1985)
- ✓ Plant protection convention
- ✓ Basel convention on the control of transboundary movements of hazardous wastes and their disposal(1989)
- ✓ 1979 Convention on long range transboundary air pollution
- ✓ Stockholm convention on persistent organic pollutants
- ✓ Convention on the transboundary effects of industrial accidents
- ✓ International convention for the prevention of pollution from ships, 1973

In compliance with Article 42 of the Environmental Protection Law, the MENR is a governmental authority, responsible for EIA process.
Recommended guidance on the EIA process in Azerbaijan is provided in the Handbook for the Environmental Impact Assessment Process in Azerbaijan.

A summary of the guidance provided in the handbook is given in the following table1.4-1. The approval of an EIA by the MENR establishes the compliance framework, including the environmental and social standards that an organization should adhere to.

Table 1.4-1 Summary of the Handbook for EIA Process in Azerbaijan

Screening	The developer is required to submit an Application (containing basic information on the proposal) to MENR to determine whether an EIA is required
Scoping	Recommend for a Scoping Meeting to be attended by the developer, experts and concerned members of the public, and aimed at reaching a consensus on the scope of the EIA
Project Description	Full description of technological process and analysis of what is being proposed in terms of planning, pre-feasibility, construction and operation.
Environmental Studies	Recommend to describe fully the baseline environmental at the site and elsewhere, if likely to be affected by the proposal. The environment must be described in terms of its various components – physical, ecological and social.
Consideration of Alternatives	No requirement to discuss project alternatives and their potential impacts (including the so-called “do-nothing” alternative), except for the description of alternative technologies.
Impact Assessment and mitigation	Recommend to identify all impacts (direct and indirect, onsite and offsite, acute and chronic, one-off and cumulative, transient and irreversible). Each impact must be evaluated according to its significance and severity and mitigation measures provided to avoid, reduce or compensate for these impacts.
Public participation	Recommend to inform the affected public about the planned activities twice: first when the application is submitted to the MENR for the preliminary assessment and again during the EIA process. The developer is expected to involve the affected public in discussions on the proposal.
Monitoring	The developer is responsible for continuous compliance with the conditions of the EIA approval through a monitoring program. The MENR undertakes inspections of the implementation of activities in order to verify the accuracy and reliability of the developer’s monitoring data. The developer is responsible for notifying the MENR and taking necessary measures in case the monitoring reveals inconsistencies with the conditions of the EIA approval.

Main purpose of EIA process:

- Rehabilitation of natural systems disturbed as a result of previous economic activity;
- Prevention of environmental degradation;
- Environmental-economic balance of future economic development;

- Development of suitable living conditions for people;
- Reduction of environmental hazard level of intended activity.

Whether an EIA is required for the project is determined by MENR based on the document submitted by the project proponent describing the project facility overview. The facility for which MENR decided to require the EIA procedure will, after the EIA approval by MENR, receive approval for construction and operation.

The criteria for determining the necessity of EIA procedure are basically compliant to the World Bank guidelines. In Azerbaijan, however, EIA approval is always required for the construction and operation of a thermal power plant.

Stage I: initiator (applicant) of an activity should apply to the MENR and inform it about the main project solution and potential negative environmental impacts.
After reviewing the application, MENR advises the applicant on importance and scope of the EIA process. In rare cases, an applicant can immediately be licensed for commencement of works.
Stage II: An EIA document prepared by an applicant is reviewed by an expert and a Summary document is released. That document includes proposals and remarks made by the public. A summary document can generally be licensed by the MENR or rejected by stating any grounds for this.
Review period of an EIA document should be a maximum of 3 months.
Regulations provide requirements for the contents of EIA and the summary document. The applicant receives mandatory requirements with the permit. The main purpose of the above requirements is to ensure concrete definition of environmental impacts and strengthening of control (i.e. management monitoring is considered to be necessary). The requirements also specify environmental monitoring parameters.
Figure 1.4-1 describes the flowchart of the Recommended EIA procedure at the Handbook of EIA in Azerbaijan.

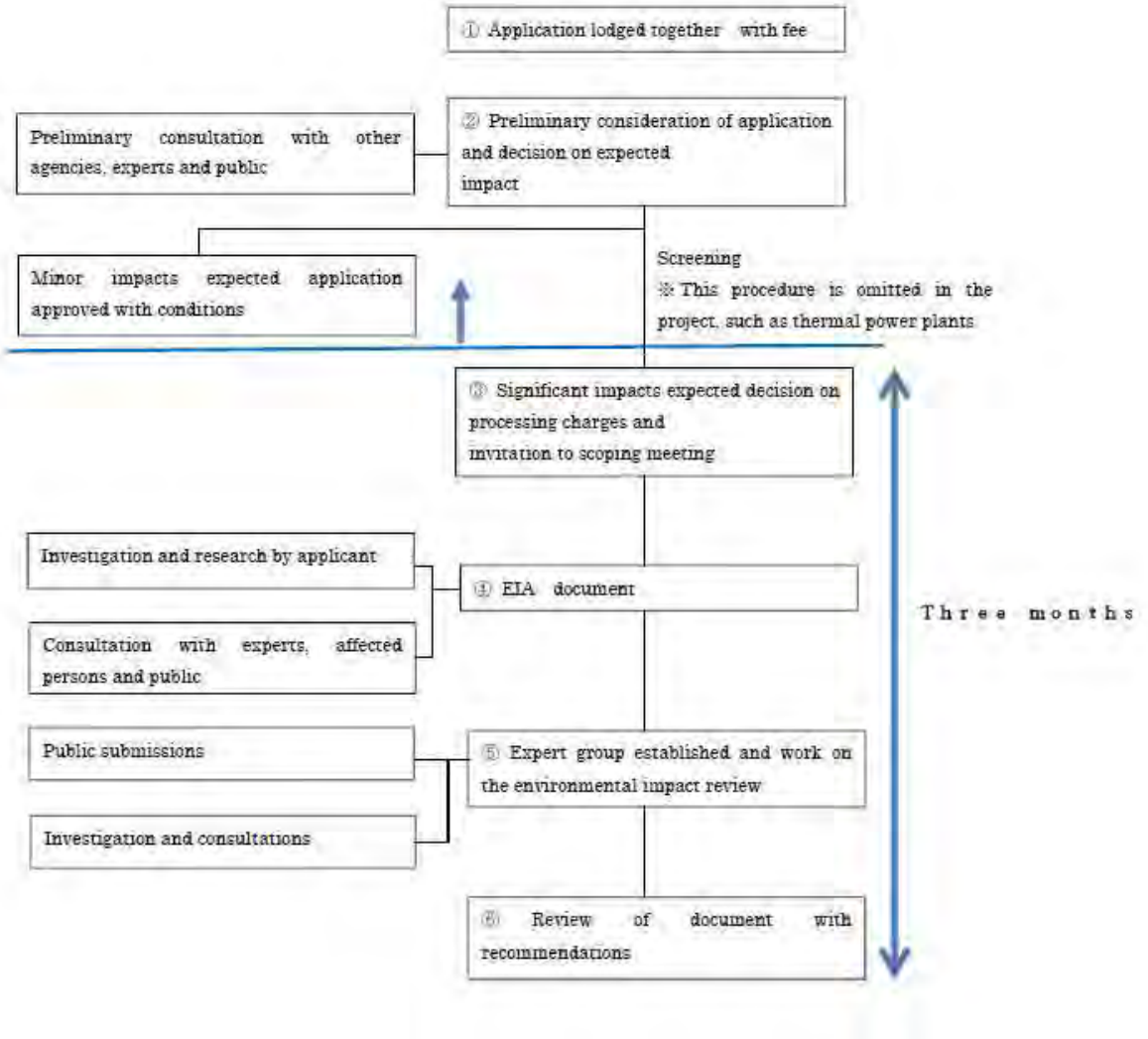


Figure 1.4-1 EIA Recommended Process

The power plant sector is classified as a sensitive sector under the JICA guideline for Environmental and Social Consideration. The project which is likely to have a significant adverse impact on the environmental and society is classified as category A. The project considered as category A requires an Environmental Assessment Report for the construction and operation of the project with recommendations for appropriate mitigation and management measures.
It is also necessary that the report for this project will be approved in Azerbaijan at least four months before Japan decides to give an yen loan to this project.
JICA guidelines and the check lists for power plant and transmission line are showed in Annex-1-1 to 1-3.

1.4.2 Environmental Management

In Azerbaijan, the public participation is regulated in Art. 6.1.7 and 7.1.6 of Law of the Azerbaijan Republic on Protection of the Environment. The law stipulates that the public shall be informed of the project summary and the conceivable environmental impact, their response shall be taken into account, and their participation to the project procedure shall be promoted.

The project proponent shall describe the contents and the fact of the project and provide it to the local people by means of media. The project proponent shall also prepare five copies of the EIA to make it accessible by the local people.

The EIA handbook states that the summary and the environmental impact of the project shall be appropriately publicized to the public in the course of EIA implementation process and their opinion shall be given due consideration in the EIA report. It also states that the public consultation meeting is, although not obligatory, a very efficient means in this view.

Azerenerji adopts the policy of holding a public consultation meeting in the course of EIA process during construction of a power plant. They have conducted public meeting in their projects during EIA operation period, construction period, and the project operation period as necessary.
In this project, Azerenerji conducted public consultation in April 2014 in the scoping phase and in July 2014 in the EIA draft final period, in compliance with The Guidelines for Environmental and Social Considerations of JICA (2010).
Additionally, this EIA report partially refers to the IFC/WB EHS Guidelines; the guideline for power plants, transmission lines, and gas pipelines and the general one. IFC/WB develops them as international technological standards for environmental management. These guideline are shown in Annex 1-4 to 1-7.

1.5 Outline of Methodology

The major activities to be carried out as part of the environmental assessment may be summarized as follows:

- Review of relevant literature on policy, legal and administrative framework focusing on environmental quality and discharge standards, health and safety issues, protection of sensitive areas and endangered species, land use controls, etc.
- Carrying out an environment baseline survey covering areas in and around the project site
- Identification of major project activities, both during the construction and operational phases of the project
- Identification and prediction of environmental impacts of project activities on the surrounding environment, including cumulative impacts of the proposed power plant and the existing and ongoing projects / industries on selected environmental attributes.
- Identification of the most significant environmental and social impacts and suggestion of mitigation measures to reduce or eliminate negative impacts and to enhance positive impacts
- Arrangement of public consultation meetings to consult with potentially affected people.
- Development of Environmental Management Plans (EMPs) for both the construction and operational phases of the project
- Analysis of alternatives to the proposed project site, technology, design, and operation.

A study team was constituted comprising specialists on various aspects for conducting the environmental assessment of the project. The list of team members is following;.
JICA study team consisting of environmental and social experts has been engaged to conduct EIA study for the project.
Local staffs of ECONote LLC and Azpromtechenergo LLC are also engaged to help the team for some of the field data collection and for arrangement of stake holder meetings.

1.6 Report Structure

This report presents the Environmental Impact Assessment (EA) of Yashma CCPP to be constructed with financial assistance from Japan.

The EIA, including a social impact assessment, has been carried out following the Handbook for the Environmental Impact Assessment Process in Azerbaijan(1996) and JICA guideline for environmental and social considerations(2009）.

The EIA report has been prepared and presented following the structure.

Chapter 1 (Introduction) presents the background and a brief outline of the proposed power plant project. It provides a brief description of the policy and legal framework with regard to the environmental aspects of the project in the context of Azerbaijan, where the regulatory requirement of conducting an environmental assessment of the proposed project has been discussed. The Chapter provides a brief description of the area covered by the present study and the methodology followed for environmental assessment of the proposed project.

Chapter 2 (Description of Project) provides a description of the different aspects of the proposed project, including project location, site development and construction activities, equipment and processes to be employed, electricity generation and transmission, gas transmission, water management, waste and emission management, firefighting, and operation and maintenance.

Chapter 3 (Existing Environment-Physical and Chemical) provides a description of the existing physical and chemical environment of the study area. The elements of the physical environment around the project site that have been described here include climate, topography, geology, hydrology, air quality, noise level, and water quality.

Chapter 4 (Existing Environment-Ecological) describes the existing ecological environment, including the terrestrial and aquatic ecosystem around the project site, and the presence of rare and endangered species.

Chapter 5 (Existing socio-economic) describe the land use and utilities, demographic characteristics, education, employment and economics around the project site.

Chapter 6 (Potential Environmental Impacts and Mitigation Measures) describes the potential environmental impacts of the proposed project and the mitigation measures to reduce or eliminate adverse impacts, along with measures to enhance positive impacts. For this purpose, the project activities has been divided into two phases - construction phase and operation phase with Maintenance- and the major environmental impacts of the project activities during each phase have been identified. This Chapter then provides an evaluation of these potential environmental impacts and presents the suggested measures to reduce or eliminate adverse impacts and enhance positive impacts. An economic assessment of the impacts has also been presented at the end of the Chapter.

Chapter 7 (Analysis of Alternatives) provides an analysis of alternatives with respect to project location, technology options, cooling systems, and also a "no project" scenario.

Chapter 8 (Environmental Management Plan and Monitoring) presents the environmental management and monitoring plan for the proposed project, both during construction and operation phases. Among other issues, it addresses the detailed monitoring plan (including monitoring parameters, monitoring schedule and requirements).

Chapter 9 (Public Consultations) presents the findings of various consultations carried out as part of the environmental assessment, including consultation with statutory and non-statutory bodies and public consultations.

Chapter10 (Conclusions and Recommendations) presents the conclusions and recommendations of this environmental assessment study.

EIA ANNEX 1-1

Guidelines for Environmental and Social Considerations

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GUIDELINES FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

(Translation of Japanese Version)

April 2010

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List of Acronyms

EIA	Environmental Impact Assessment
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
MOFA	Ministry of Foreign Affairs
OECD	Organization for Economic Cooperation and Development
TOR	Terms of Reference

Preface

Owing to the recent increase of public interest in environmental issues, Principle 17 of the Rio Declaration on Environment and Development proclaims that an environmental impact assessment (EIA), as a national instrument, shall be undertaken for proposed activities that are likely to have a significantly adverse impact on the environment and that are subject to the decisions of a competent national authority.

Agenda 21 proposes that governments should promote the development at the national level of appropriate methodologies for making integrated energy, environment, and economic policy decisions for sustainable development, inter alia, through an EIA (9.12(b)).

The Universal Declaration of Human Rights makes clear a common standard of achievement for all peoples and all nations: to promote respect for human rights and freedoms, and to secure their universal and effective recognition and observance. Environmental and social considerations refer not only to the natural environment, but also to social issues such as involuntary resettlement and respect for the human rights of indigenous peoples.

In 1985, the Organization for Economic Cooperation and Development (OECD) Council Recommendation on the Environmental Assessment of Development Assistance Projects and Programs was endorsed. Since then, multilateral donors—including the World Bank and main bilateral donors—have prepared guidelines for environmental considerations and have applied them while implementing Official Development Assistance (ODA).

Until now, the JBIC Guidelines for the Confirmation of Environmental and Social Considerations (2002) and the JICA Guidelines for Environmental and Social Considerations (2004) have been applied to Loan aid and technical cooperation, respectively.

When the law concerning the independent administrative institution Japan International Cooperation Agency (JICA) was revised in June 2006, JICA, an implementing agency of the Japanese ODA, came to manage three forms of assistance—technical cooperation, Loan aid, and Grant aid—in an integrated fashion through a merger of the JICA and JBIC wings of the ODA after the effectuation of the law in October 2008. Due to this situation, two sets of guidelines were integrated based on the characteristics of three schemes. JICA established a committee for revising its guidelines for environmental and social considerations. The members of this committee came from universities, non-governmental organizations (NGOs), the private sector, and related ministries, and meetings of the committee were open to the public. In addition to the discussions of the committee, the

guidelines were prepared through public comments and consultation processes in order to ensure their transparency and accountability.

JICA's Business Protocol and Mid-term Plan clearly state that JICA implements cooperation activities in accordance with the guidelines. JICA encourages host country governments, including local governments, borrowers, and project proponents, to implement the appropriate measures for environmental and social considerations when engaging in cooperation activities. At the same time, JICA provides support for and examinations of environmental and social considerations in accordance with the guidelines.

When encouraging the appropriate consideration of environmental and social aspects, it is JICA's policy to provide active support to projects that promote environmental conservation and to projects that contribute to the protection of the global environment, such as attempts to reduce greenhouse gas emissions. JICA also has a policy of being actively involved in supporting the enhancement of environmental and social considerations in developing countries.

1. Basic Matters

1.1 Policy

Japan's ODA Charter states that in formulating and implementing assistance policies, Japan will take steps to assure fairness. This will be achieved by giving consideration to the conditions of the socially vulnerable and to the gap between rich and poor, as well as the gaps among various regions in developing countries. Furthermore, when implementing ODA, great attention will be paid to factors such as environmental and social impacts on developing countries.

JICA, which is responsible for ODA, plays a key role in contributing to sustainable development in developing countries. The inclusion of environmental and social costs in development costs and the social and institutional framework that makes such inclusion possible are crucial for sustainable development. Internalization and an institutional framework are requirements for measures regarding environmental and social considerations, and JICA is required to have suitable consideration for environmental and social impacts.

Democratic decision-making is indispensable for environmental and social considerations. It is important to ensure stakeholder participation, information transparency, accountability, and efficiency, in addition to respect for human rights, in order to conduct an appropriate decision-making process.

In this context, with respect to human rights and in view of the principles of democratic governance, the measures for environmental and social considerations are implemented by ensuring a wide range of meaningful stakeholder participation and transparency of decision-making, as well as by working for information disclosure and by ensuring efficiency. Governments bear the responsibility for accountability, but at the same time stakeholders are responsible for their comments.

Owing to the issues discussed above, JICA always considers environmental and social impacts when implementing cooperation projects.

1.2 Objectives

The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavors to ensure

transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

1.3 Definitions

1. “Environmental and social considerations” means considering environmental impacts including air, water, soil, ecosystem, flora, and fauna, as well as social impacts including involuntary resettlement, respect for the human rights of indigenous people, and so on.
2. “Project proponents etc.” stands for host countries and host country governments, including local governments, borrowers, and project proponents.
3. “Cooperation projects” include the following: (1) Loan aid, (2) Grant aid (excluding projects executed through international organizations), (3) Preliminary studies of grant aid undertaken by the Ministry of Foreign Affairs (MOFA), (4) Technical cooperation for development planning, and (5) Technical cooperation projects, undertaken by JICA.
4. “Projects” are undertakings that project proponents etc. conduct and that JICA supports.
5. “Environmental and social considerations studies” include baseline surveys, predicting and evaluating the adverse impacts and likely impacts that projects may have on the environment and on local society, and mitigation measures to avoid and minimize these.
6. “Environmental impact assessment” includes evaluating the environmental and social impacts that projects are to have, analyzing alternative plans, and preparing adequate mitigation measures and monitoring plans in accordance with the laws or guidelines of host countries.
7. A “strategic environmental assessment” is an assessment that is implemented at the policy, planning, and program levels, but not a project-level EIA.
8. “Support for environmental and social considerations” means offering project proponents etc. assistance by conducting environmental and social considerations studies, analyzing countermeasures, accumulating knowledge and experience, developing human resources, and so on.
9. An “examination of environmental and social considerations” is a confirmation of the measures taken by project proponents etc. to meet the requirements of the guidelines in view of the project’s characteristic features and the inherent nature of the affected countries and/or area.
10. “Screening” means deciding whether proposed projects are likely to have impacts that need to be assessed by conducting environmental and social considerations studies according to project description and site description. JICA conducts screening by classifying proposed projects into four categories: A, B, C, and FI.
11. “Scoping” means choosing alternatives for analysis, a range of significant and potentially significant impacts, and study methods.
12. “Local stakeholders” means affected individuals or groups (including illegal dwellers) and local NGOs. “Stakeholders” are individuals or groups who have views about cooperation projects,

including local stakeholders.

13. The “Advisory Committee for Environmental and Social Considerations” is a third-party council that consists of external experts and provides advice regarding JICA’s support for and examination of the environmental and social considerations of cooperation projects.

14. “Follow-up activities” range from the confirmation that project proponents etc. reflect the conclusions of environmental and social considerations studies in Technical Cooperation for Development Planning, to the implementation of plans.

15. “Terms of Reference” (TOR) are a set of administrative, procedural, and technical requirements.

16. An “Environmental Impact Assessment (EIA) level study” is a study that includes the analysis of alternative plans, the prediction and assessment of environmental impacts, and the preparation of mitigation measures and monitoring plans based on detailed field surveys.

17. An “Initial Environmental Examination (IEE) level study” is a study that includes an analysis of alternative plans, a prediction and assessment of environmental impacts, and a preparation of mitigation measures and monitoring plans based on easily available information including existing data and simple field surveys.

18. An “agreement document” details an agreement between JICA and project proponents etc. to implement cooperation projects; these documents include Loan Agreements (L/A) for Loan aid, Grant Agreements (G/A) for grant aid, and others.

19. A “preparatory survey” is a survey that prepares JICA cooperation programs and also identifies and prepares individual projects by confirming relevance, effectiveness, efficiency, etc.

20. A “JICA cooperation program” is a strategic framework for assisting developing countries in achieving their specific mid- to long-term development objectives (including cooperation objectives and appropriate cooperation scenarios that will help to achieve them).

21. “Project formation” is a type of preparatory survey that identifies and prepares a project to be supported by Loan aid, grant aid, or technical cooperation projects; it also confirms the relevance, effectiveness, efficiency, etc. of the project.

22. “Detailed design study” is a study that decides the detailed plan of a project such as project objective, confirmation of feasibility, scale of input and activities, and it is conducted after the approval of the project by MOFA.

1.4 Basic Principles Regarding Environmental and Social Considerations

While project proponents etc. bear the ultimate responsibility for the environmental and social considerations of projects, JICA supports and examines appropriate environmental and social considerations undertaken by project proponents etc. to avoid or minimize development projects’ impacts on the environment and local communities, and to prevent the occurrence of unacceptable adverse impacts. JICA thus promotes sustainable development in developing countries.

In these guidelines, JICA has created clear requirements regarding environmental and social considerations, which project proponents etc. must meet. JICA provides project proponents etc. with support in order to facilitate the achievement of these requirements through the preparation and implementation of cooperation projects. JICA examines undertakings by project proponents etc. in accordance with the requirements, and makes adequate decisions regarding environmental and social considerations on the basis of examination results.

JICA recognizes the following seven principles to be very important.

1. A wide range of impacts must be addressed.

   The types of impacts addressed by JICA cover a wide range of environmental and social issues.

2. Measures for environmental and social considerations must be implemented from an early stage to a monitoring stage.

   JICA applies a Strategic Environmental Assessment (SEA) when conducting Master Plan Studies etc., and encourages project proponents etc. to ensure environmental and social considerations from an early stage to a monitoring stage.

3. JICA is responsible for accountability when implementing cooperation projects.

   JICA ensures accountability and transparency when implementing cooperation projects.

4. JICA asks stakeholders for their participation.

   JICA incorporates stakeholder opinions into decision-making processes regarding environmental and social considerations by ensuring the meaningful participation of stakeholders in order to have consideration for environmental and social factors and to reach a consensus accordingly. JICA replies to stakeholders' questions. Stakeholders who participate in meetings are responsible for what they say.

5. JICA discloses information.

   JICA itself discloses information on environmental and social considerations in collaboration with project proponents etc., in order to ensure accountability and to promote the participation of various stakeholders.

6. JICA enhances organizational capacity.

   JICA makes efforts to enhance the comprehensive capacity of organizations and operations in order for project proponents etc., to have consideration for environmental and social factors, appropriately and effectively, at all times.

7. JICA makes serious attempts at promptness.

   JICA addresses request of acceleration for the prompt implementation of projects while undertaking environmental and social considerations.

1.5 Responsibility of JICA

While project proponents etc. take the initiative to deal with the environmental and social considerations of projects, JICA provides support for and examinations of the environmental and social considerations that project proponents etc. implement in accordance with Sections 2 and 3 of the guidelines, depending on the nature of cooperation projects.

1.6 Requirements of project proponents etc.

1. Project proponents etc. are required to incorporate the output of environmental and social considerations studies into project planning and decision-making processes.
2. When JICA provides support for and examinations of environmental and social considerations, JICA examines the requirements that must be met, as mentioned in Appendix 1. In addition, JICA examines the items shown in Appendix 2 in order to satisfy the environmental impact assessment reports required for Category A projects.

1.7 Covered Schemes

The guidelines cover five schemes: (1) Loan aid, (2) Grant aid (excluding projects executed through international organizations), (3) Preliminary studies of grant aid undertaken by MOFA, (4) Technical cooperation for development planning, and (5) Technical cooperation projects.

1.8 Measures Taken in an Emergency

In an emergency—which means a case that must be dealt with immediately, such as restoration after natural disasters or post-conflict restoration—when it is clear that there is no time to follow the procedures of environmental and social considerations mentioned in the guidelines, JICA reports at an early stage to the Advisory Committee for Environmental and Social Considerations on categorization, judgment of emergency, and procedures to follow, and discloses a result. JICA asks advice from the Advisory Committee when it is necessary.

1.9 Dissemination

JICA explains the guidelines to project proponents etc. and requests their understanding.

1.10 Advisory Committee for Environmental and Social Considerations

JICA establishes the Advisory Committee for Environmental and Social Considerations as an independent council composed of external experts with the knowledge necessary to provide advice regarding support for and examinations of the environmental and social considerations of cooperation projects.

2. Process of Environmental and Social Considerations

2.1 Information Disclosure

1. In principle, project proponents etc. disclose information about the environmental and social considerations of their projects. JICA assists project proponents etc. by implementing cooperation projects as needed.
2. JICA itself discloses important information about environmental and social considerations at the main stages of cooperation projects, in a manner in accordance with the guidelines.
3. JICA discusses frameworks with project proponents etc. in order to ensure information disclosure, and comes to an agreement in an early stage of cooperation projects.
4. The information to be disclosed includes that of environmental and social considerations and of the cooperation projects themselves.
5. Besides the information to be disclosed publicly by JICA, JICA provides information about environmental and social considerations to third parties to the extent possible in response to requests.
6. JICA encourages project proponents etc. to disclose and present information about environmental and social considerations to local stakeholders.
7. Project proponents etc. disclose information well in advance when they have meetings with local stakeholders in cooperation with JICA. On these occasions, JICA supports project proponents etc. in the preparation of documents in an official or widely used language and in a form understandable by local people.
8. JICA discloses information on its website in Japanese, English, and/or local languages, and provides related reports for public reading at its library and at related overseas offices.
9. JICA pays due consideration to the confidentiality of the commercial and other matters of Project proponents etc.., taking into account their competitive relationships, and encourages them to exclude such confidential information from any documents on environmental considerations that they submit which may later be subject to public disclosure. JICA takes into account information control in Project proponents etc.. and discloses their documents subject to their approval. Any information that is prohibited from public disclosure in the agreement between JICA and Project proponents etc.. may be disclosed only through the agreement of Project proponents etc.. or in accordance with legal requirements.

2.2 Categorization

1. JICA classifies projects into four categories according to the extent of environmental and social impacts, taking into account an outline of project, scale, site condition, etc.
2. Category A: Proposed projects are classified as Category A if they are likely to have significant

adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas. An illustrative list of sensitive sectors, characteristics, and areas is provided in Appendix 3.

3. Category B: Proposed projects are classified as Category B if their potential adverse impacts on the environment and society are less adverse than those of Category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily.

4. Category C: Proposed projects are classified as Category C if they are likely to have minimal or little adverse impact on the environment and society.

5. Category FI: Proposed projects are classified as Category FI if they satisfy all of the following requirements: JICA's funding of projects is provided to a financial intermediary or executing agency; the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval of funding (or project appraisal); and those sub-projects are expected to have a potential impact on the environment.

6. When necessary, JICA can change a category even after screening. This might occur such as when a new significant impact has come to light as a result of the cooperation project process, or in other specific situations.

7. Projects may not be clearly specified at an early stage of a Master Plan Study. In such cases, the study is categorized based on its likely significant impacts. At that time, derivative, secondary, and cumulative impacts are also considered. When considering plural alternatives, projects are classified in the category of the alternative that has the most significant impact. JICA reviews the categorization accordingly after projects have been identified with a progression of studies.

8. JICA requests that Project proponents etc.. fill in the screening form found in Appendix 4; the information in this form will be a reference for the categorization of proposed projects.

2.3 Impacts to be Assessed

1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and

livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. Items to be addressed in the specific project are narrowed down to the needed ones through the scoping process.

2. In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects will also be assessed with regard to environmental and social considerations, so far as it is rational. The life cycle impact of a project period is also considered.

3. Various kinds of relevant information are needed in order to assess impacts on the environment and local communities. There are, however, uncertainties in predicting such impacts caused by the incomplete understanding of impact mechanisms and the limited information available. Therefore, if the scale of uncertainty is considered to be large, project proponents etc. provide environmental and social considerations that include preventive measures as much as possible.

2.4 Consultation with Local Stakeholders

1. In principle, project proponents etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent, in order to take into consideration the environmental and social factors in a way that is most suitable to local situations, and in order to reach an appropriate consensus. JICA assists project proponents etc. by implementing cooperation projects as needed.

2. In an early stage of cooperation projects, JICA holds discussions with project proponents etc. and the two parties reach a consensus on frameworks for consultation with local stakeholders.

3. In order to have meaningful meetings, JICA encourages project proponents etc. to publicize in advance that they plan to consult with local stakeholders, with particular attention to directly affected people.

4. In the case of Category A projects, JICA encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed.

5. In the case of Category B projects, JICA encourages project proponents etc. to consult with local stakeholders when necessary.

6. JICA encourages project proponents etc. to prepare minutes of their meetings after such consultations occur.

2.5 Concern about Social Environment and Human Rights

1. Environmental and social factors are affected by the social and institutional conditions of host countries and by the actual conditions of each project location. Therefore, JICA fully takes these conditions into account when examining environmental and social factors. In particular, special consideration must be taken for cooperation projects when disclosing information and holding consultations with local stakeholders, after obtaining understanding from the host governments in countries and areas affected by conflict or where basic freedoms, including freedom of expression and the right to receive legal remedy, are restricted.
2. JICA respects the principles of internationally established human rights standards such as the International Convention on Human Rights, and gives special attention to the human rights of vulnerable social groups including women, indigenous peoples, persons with disabilities, and minorities when implementing cooperation projects. JICA obtains country reports and information widely about human rights that are issued by related institutions, and seeks to understand local human rights situations by disclosing information about cooperation projects. Thus, JICA integrates local human rights situations into decision-making processes that relate to environmental and social considerations.

2.6 Laws, Regulations and Standards of Reference

1. In principle, JICA confirms that projects meet the requirements for environmental and social considerations stated in the Guidelines in the following ways.
2. JICA confirms that projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries; it also confirms that projects conform to those governments' policies and plans on the environment and local communities.
3. JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies, and refers as a benchmark to the standards of international financial organizations; to internationally recognized standards, or international standards, treaties, and declarations, etc.; and to the good practices etc. of developed nations including Japan, when appropriate. When JICA recognizes that laws and regulations related to the environmental and social considerations of the project are significantly inferior to the aforementioned standards and good practices, JICA encourages project proponents etc., including local governments, to take more appropriate steps through a series of dialogues, in which JICA clarifies the background of and reasons for the inferior regulations and takes measures to mitigate the adverse impacts when necessary.
4. JICA takes note of the importance of good governance surrounding projects in order that measures for appropriate environmental and social considerations are implemented.
5. JICA discloses information with reference to the relevant laws of project proponents etc. and of

the government of Japan.

2.7 Advice of the Advisory Committee for Environmental and Social Considerations

1. On necessary projects among Categories A and Category B, the Advisory Committee for Environmental and Social Considerations gives advice on environmental and social considerations in preparatory surveys. JICA reports to the Committee, and the Committee gives advice as needed at the environmental review and monitoring stages. On the projects of technical cooperation for development planning, the Advisory Committee gives advice at full-scale study stage. Ad hoc members are requested to participate in the meetings when necessary, taking into account the nature of each project.
2. Meetings of the Advisory Committee are open to the public. Minutes are prepared with the names of speakers in the order of speaking and are made available to the public.
3. Any committee established for the purpose of giving technical advice to cooperation projects shall obtain advice regarding environmental and social considerations from the Advisory Committee.

2.8 Decision-making by JICA

2.8.1 Loan aid, Grant Aid, and Technical Cooperation Projects

1. JICA takes the outcomes of its environmental reviews into account when making decisions regarding the conclusion of agreement documents. If, as a result of its environmental review, JICA decides that appropriate environmental and social considerations are not ensured, it will encourage project proponents etc. to undertake appropriate environmental and social considerations. If appropriate environmental and social considerations are not undertaken, JICA will not undertake Loan aid, grant aid, or technical cooperation projects.
2. Cases in which JICA judges that appropriate environmental and social considerations are not ensured are, for example, ones in which it is obvious that the justification of projects is not recognized by an analysis of alternatives, including the “without project” scenario; cases in which projects are expected to have significant impacts when they are implemented even if mitigation measures are ensured; cases in which the residents or social organizations concerned have participated little in the process of project planning and are not expected to do so in the future even though serious impacts are predicted; and cases in which it is expected to be difficult to implement mitigation measures that will avoid or minimize impacts on the social and institutional conditions of project sites.
3. When it is considered necessary to ensure the enforcement of environmental and social considerations by Project proponents etc.., JICA will make the utmost effort to ensure that the following through agreement documents:

1) Project proponents etc. are to report to JICA on measures and monitoring related to the environmental and social considerations that they undertake. If, owing to unforeseen circumstances, there is a possibility that the requirements for environmental and social considerations may not be fulfilled, they are to report this to JICA.
2) If any problems regarding environmental and social considerations arise, project proponents etc. are to attempt to hold discussions with local stakeholders.
3) If it becomes evident that project proponents etc. have not met the conditions set out by JICA in the guidelines, or if it becomes apparent that projects will have adverse impacts on the environment after the conclusion of agreement documents because of the failure of Project proponents etc. to supply correct information during the environmental review process, JICA may, in accordance with agreement documents, make changes to the agreement, including the suspension and declaration of the principal outstanding due and of Loan aid, grant aid, and technical cooperation projects.

2.8.2 Technical Cooperation for Development Planning and Preliminary Studies of Grant Aid Projects undertaken by MOFA

1. JICA confirms environmental and social considerations at the review stage of proposed projects and makes recommendations to MOFA based on the results.
2. JICA takes necessary measures to ensure that cooperation projects have suitable environmental and social considerations, if unexpected inadequacy issues come to light after MOFA selects the projects.
3. JICA recommends that MOFA cease to operate cooperation projects when JICA concludes that it is impossible to ensure environmental and social considerations even if the above measures are taken. Cases in which it is impossible to ensure environmental and social considerations are the same as the cases mentioned in statement 2 of Section 2.8.1.

2.9 Ensuring Appropriate Implementation of and Compliance with the Guidelines

JICA appropriately implements the principles and procedures mentioned in the guidelines, and ensures compliance with them. JICA responds to objections regarding non-compliance with the guidelines by establishing an independent body that is separate from project execution departments, in accordance with the Objection Procedures based on the Guidelines for Environmental and Social Considerations.

2.10. Implementation and Review of the Guidelines

1. The guidelines will be proclaimed on April 1st, 2010, will come into force on July 1st, 2010, and will be applied to the projects whose applications are made by project proponents etc., on and after

the effective date of the guidelines. For the projects whose applications have been made before the effective date, the “JBIC Guidelines for Confirmation of Environmental and Social Considerations 2002” will apply to Loan aid, and the “JICA Guidelines for Environmental and Social Considerations 2004” will apply to technical cooperation for development planning. In case of Grant aid, “JICA Guidelines for Environmental and Social Considerations 2004” will be referred to. On the other hand, preparatory surveys whose implementation has been agreed between project proponents etc., and JICA on and before June 30th, 2010, will follow previous JICA and JBIC guidelines, respectively.

2. JICA verifies the status of the implementation of the guidelines, and will reexamine its way of procedures within five years of their enforcement by hearing the opinions of concerned people. In addition, JICA will create a comprehensive review of the guidelines within ten years of their enforcement on the basis of its findings. Revisions are made as needed, based upon the results mentioned above. When JICA revises the guidelines, JICA seeks opinions from the government of Japan and developing countries, NGOs in developing countries, as well as NGOs in Japan, the private sector, experts, etc., in a process designed to ensure transparency and accountability.

3. JICA studies the issues as well as its methods in applying the guidelines, and incorporates the results of these studies in a review of the guidelines.

3. Procedures of Environmental and Social Considerations

3.1 Preparatory Survey

3.1.1 Preparation of JICA Cooperation Program

1. JICA collects information from project proponents etc., and when necessary, it consults with project proponents etc. and conducts field surveys in order to consider the environmental and social aspects of potential projects.
2. JICA makes efforts to avoid or minimize significant environmental and social impacts by applying a SEA when preparing a sectoral or regional cooperation program.
3. JICA discloses final reports on its website promptly after their completion.

3.1.2 Project Formation (Loan aid, Grant aid (excluding projects executed through international organizations), and Technical cooperation projects)

The following stipulations range from the decision to undertake surveys to the preparation of TOR.

1. JICA classifies projects into one of the aforementioned four categories, taking into account an outline of project, scale, site conditions, etc. For Category C projects, the environmental and social considerations process is completed at this stage.
2. JICA discloses the results of such categorization on its website—including the name of each project and its country, location, project outline, category, and its reason—before making the decision to undertake preparatory surveys.
3. Prior to the implementation of preparatory surveys, JICA conducts field surveys and collects opinions and information from stakeholders for Category A projects. It also does so, if necessary, for Category B projects, and incorporates the results into a TOR of the surveys. In addition, when project documents on environmental and social considerations are available, JICA makes any necessary confirmation of the contents prior to the surveys.

The following stipulations specify the procedure for the implementation of Feasibility Studies.

4. JICA applies a SEA when the preparatory surveys include not only project-level but also upper-stream-level studies, which are called Master Plan Studies. For Category A projects, JICA encourages project proponents etc. to disclose related information, hold local stakeholder meetings based on stakeholder analysis, and make efforts to avoid and minimize environmental and social impacts while scoping and alternative scenario analyses are being conducted. Such actions are also taken for Category B projects if necessary.
5. JICA ensures sufficient survey periods and assigns an expert(s) on environmental and social considerations to missions to prepare scoping drafts by collecting related information, conducting field surveys, and consulting with project proponents etc.

6. Project proponents etc. disclose scoping drafts, which consist of project name, countries, locations, project outlines, categorizations and the reasons behind them, alternatives, impacts, and contents. Project proponents etc. also consult with local stakeholders reflecting stakeholder analysis for Category A projects and, if necessary, for Category B projects. JICA supports project proponents etc. in doing so in order that they incorporate the results of such consultations into their environmental and social considerations surveys. Consultations broadly cover the needs of cooperation projects and alternative analyses, including "without project" scenarios.
7. JICA conducts environmental and social surveys at the EIA level for Category A projects and at the IEE level for Category B projects and Master Plan Studies, in accordance with TOR. JICA prepares drafts of mitigation measures—including avoidance, minimization, and compensation—as well as drafts of monitoring plans and of institutional arrangements for environmental and social considerations.
8. Project proponents etc. consult with local stakeholders after information disclosure when considering the rough outline of environmental and social considerations, as needed. JICA supports this process and incorporates the results of such consultations into survey results.
9. Project proponents etc. consult with local stakeholders on draft reports for Category A projects and also, if necessary, for Category B projects, after the information disclosure. JICA supports this process and incorporates the results of such consultations into final reports.
10. JICA discloses final reports on its website promptly upon their completion.
11. If, for technical cooperation projects, a preparatory survey is not conducted but a detailed planning survey is conducted, the aforementioned procedures are followed for the detailed planning survey.
12. In the case of supplementary types of preparatory surveys, the necessary procedures mentioned in items 5 through 10 are followed according to the contents of the survey after the completion of the procedures in items 1 and 2.

3.2 Loan aid, Grant Aid (excluding projects executed through international organizations) and Technical Cooperation Projects

3.2.1 Environmental Review

1. JICA conducts an environmental review in accordance with the project category, and refers to the corresponding environmental checklists for each sector when conducting that review as appropriate.
2. If JICA does not conduct preparatory surveys, it classifies projects promptly after receiving official requests and discloses such categorization on its website. In addition, JICA discloses the classification of projects based on detailed information on its website prior to the environmental review.
3. When JICA concludes preparatory surveys, it discloses final reports or equivalent documents on

its website in the case of Category A projects and also, if necessary, in case of Category B projects prior to the environmental review. In cases in which JICA conducts a detailed plan preparing study in place of preparatory surveys, it follows the same procedure. Bidding information is excluded from disclosed documents.

4. JICA changes the category of projects, if necessary, when new environmental and social impacts are found.

(1) Category A projects

1. Project proponents etc. must submit EIA reports (see Appendix 2) for Category A projects. For projects that will result in large-scale involuntary resettlement, a Resettlement Action Plan (RAP) also must be submitted. For projects that will require the measures for indigenous people, an Indigenous People Plan (IPP) must be submitted as well.

2. JICA publishes the status of host countries' submission of major documents on environmental and social considerations on its website. Prior to its environmental review, JICA also discloses the following: (1) EIA reports and environmental permit certifications, (2) RAPs for projects that will result in large-scale involuntary resettlement, and (3) IPPs for projects that address issues of indigenous people. Specifically, JICA discloses EIA reports 120 days prior to concluding agreement documents. In addition, JICA discloses a translated version of these major documents, subject to approval by project proponents etc.

3. JICA undertakes its environmental reviews based on the EIA and other documents submitted by project proponents etc. Environmental reviews for Category A projects examine the potential positive and negative environmental impacts of projects. JICA examines necessary measures to avoid, minimize, mitigate, or compensate for potential negative impacts, as well as measures to promote positive impacts, if any such measures are available. JICA also examines the results of information disclosure and local stakeholder consultation.

4. JICA discloses the results of environmental reviews on its website after agreement documents are concluded.

(2) Category B projects

1. The scope of environmental reviews for Category B projects may vary from project to project, but it is narrower than that of Category A projects. JICA undertakes its environmental reviews based on information provided by project proponents etc. and others. Environmental reviews for Category B projects examine the potential positive and negative environmental impacts and necessary measures to avoid, minimize, mitigate, or

compensate for potential negative impacts, as well as measures to promote positive impacts, if any such measures are available. When an EIA procedure has been conducted, the EIA report may be referred to, but this is not a mandatory requirement.
2. JICA discloses the following: (1) EIA reports and environmental permit certifications, (2) RAPs for projects, and (3) IPPs for projects that will require measures for indigenous people, when these documents are submitted by project proponents etc.
3. JICA discloses the results of environmental reviews on its website after concluding agreement documents.

(3) Category C projects
1. For projects in this category, environmental review will not proceed after categorization.

(4) Category FI projects
1. JICA examines the related financial intermediary or executing agency to see whether appropriate environmental and social considerations as stated in the guidelines are ensured for projects in this category. JICA also examines institutional capacity in order to confirm environmental and social considerations of the financial intermediary or executing agency, and, if necessary, requires that adequate measures be taken to strengthen capacity.
2. The financial intermediary or executing agency examines the potential positive and negative environmental impacts of sub-projects and takes the necessary measures to avoid, minimize, mitigate, or compensate for potential negative impacts, as well as measures to promote positive impacts if any such measures are available.
3. In principle, JICA undertakes environmental reviews and information disclosure for the sub-projects prior to their implementation in a same manner as specified for Category A projects, if those sub-projects are likely to be under the cooperation projects.
4. JICA discloses the results of environmental reviews on its website after concluding agreement documents.

(5) Engineering Service Loans
1. In the case of engineering service loans, which are Loan aids that cover only engineering services (including surveys, designs, etc.) of the project, JICA carries out environmental reviews according to the projects' category.
2. However, if surveys for environmental and social considerations are conducted in or in parallel with the said engineering service loans, fulfillment of necessary environmental and social considerations may be confirmed at the time of the environmental review of the proceeding phases of the project.

3.2.2 Monitoring and its confirmation by JICA

1. Over a certain period of time, JICA confirms with project proponents etc. the results of monitoring the items that have significant environmental impacts. This is done in order to confirm that project proponents etc. are undertaking environmental and social considerations for projects that fall under Categories A, B, and FI.

2. The information necessary for monitoring confirmation by JICA must be supplied by project proponents etc. by appropriate means, including in writing. When necessary, JICA may also conduct its own investigations.

3. When third parties point out in concrete terms that environmental and social considerations are not being fully undertaken, JICA forwards such claims to project proponents etc. and, if necessary, encourages them to take appropriate action. When project proponents etc. respond to the claim, JICA confirms that they carry out an investigation of the specific claim, an examination of countermeasures, and incorporation into the project plans through transparent and accountable processes.

4. Also, when necessary, JICA may request the cooperation of project proponents etc. in conducting its own investigations in order to confirm the state of the undertaking of environmental and social considerations.

5. If JICA judges that there is a need for improvement in a situation with respect to environmental and social considerations, it may ask project proponents etc. to take appropriate actions in accordance with the agreement documents. Also, when necessary, JICA may provide assistance by itself. If the response of project proponents etc.. is inappropriate, JICA may consider taking its own actions in accordance with the agreement documents, including the suspension of the disbursement.

6. When projects undergo significant changes, JICA recategorizes them and carries out an environmental review according to Section 3.2.1. JICA discloses an outline of changes and new categories as well as major environmental and social considerations documents promptly after receiving them.

7. JICA discloses the results of monitoring conducted by project proponents etc. on its website to the extent that they are made public in project proponents etc. When third parties request further information, JICA discloses it, subject to approval by project proponents etc.

8. If JICA conducts a detailed design study by itself, JICA carries out an environmental review for the target project before the commencement of the study. JICA reviews detailed resettlement action plans if necessary. JICA discloses the final report on its website.

3.3 Preliminary Studies of Grant Aid Undertaken by MOFA

For preliminary studies of grant aid undertaken by MOFA, JICA follows the procedures of

preparatory surveys mentioned in Section 3.1.2, taking the environmental review procedures mentioned in Section 3.2.1 into consideration. JICA recommends that MOFA suspend cooperation projects when JICA concludes that it is impossible to ensure environmental and social considerations.

3.4 Technical Cooperation for Development Planning

3.4.1 Review Stage of Proposed Projects

1. JICA reviews proposed projects submitted to MOFA by confirming the scope of the project , site description, etc., and categorizes projects through a first screening. After that, JICA makes decisions on proposed projects from the viewpoint of environmental and social considerations and makes recommendations to MOFA.
2. For a certain period, JICA discloses information on its website regarding Category A projects, such as country, area, and project description, before making its recommendation to MOFA. JICA then collects external information and opinions in order to incorporate these in the recommendation. Environmental and social considerations procedures of Category C projects will not proceed after screening.
3. If there is not sufficient information for category classification, JICA makes inquiries to project proponents etc. through the Embassies of Japan, JICA overseas offices, and other institutions. If information obtained through inquiries is considered insufficient, JICA dispatches teams to collect information regarding environmental and social aspects through consultations with the persons concerned and conducts field visits in host countries, along with other methods. JICA promptly discloses study reports.
4. Soon after the conclusion of international agreements by MOFA, JICA discloses names, countries, locations, outlines, and sectors of projects, as well as their categorization and their reasons, on its website. For Category A and B projects, JICA discloses recommendations to MOFA on its website.

3.4.2. Detailed Plan Preparatory Study Stage (Master Plan Study and Feasibility Study)

1. JICA conducts detailed plan preparatory studies based on the results of first screenings. JICA dispatches an expert(s) on environmental and social considerations to conduct field surveys for Category A and B projects, ensuring the provision of an adequate study period.
2. JICA examines measures for environmental and social considerations described in requests and collected at the aforementioned review stage, and conducts information-gathering, field surveys, and consultations with project proponents etc. On the basis of collected information and consultations, JICA categorizes projects through second screening and reviews the categorization when necessary.
3. JICA conducts provisional scoping according to categorization, and prepares drafts of TOR for environmental and social considerations studies. For Category A projects, JICA conducts field

surveys, obtains information and opinions from local stakeholders, and incorporates results into drafts of TOR.
4. JICA consults with project proponents etc. about environmental and social considerations and concludes mutual undertakings, partnership, and coordination.
5. JICA prepares drafts of agreement documents after consultation with project proponents etc. about the organizational structure of environmental and social considerations. JICA obtains basic agreements with host countries to incorporate the results of environmental and social considerations studies into the decision-making process of projects.
6. When JICA makes agreements with project proponents etc., JICA concludes agreement documents that include draft TOR for projects. If no agreement can be reached, JICA suspends studies without concluding agreement documents. When JICA decides that projects will not be implemented, it makes recommendations to MOFA to cease cooperation.
7. JICA discloses agreement documents and information regarding environmental and social considerations on its website promptly after concluding them.

3.4.3. Full-scale Study Stage (Master Plan Study)
1. JICA enlists an expert(s) on environmental and social considerations to participate in study teams for Category A and B studies, ensuring the provision of an adequate study period.
2. JICA collects relevant information and conducts field surveys covering a wider area than that of the detailed plan preparatory study stage, holds consultations with project proponents etc., and prepares scoping drafts.
3. For Category A studies, after the disclosure of the scoping drafts, project proponents etc. conduct consultations with local stakeholders based on stakeholder analyses. JICA incorporates the results of such consultations into its TOR. The consultations cover the needs of projects and the analysis of alternatives. For Category B studies, project proponents etc. consult with local stakeholders after the disclosure of scoping drafts when necessary.
4. TOR includes understanding of needs, impacts to be assessed, study methods, analysis of alternatives, a schedule, and other items. JICA applies a SEA to such studies.
5. In accordance with TOR and in collaboration with project proponents etc., JICA conducts IEE-level environmental and social considerations studies, and analyzes alternatives, including “without project” situations. During studies, JICA incorporates its results into related reports prepared accordingly.
6. For Category A studies, when preparing a rough outline of environmental and social considerations, a series of stakeholder consultations are conducted after information disclosure when necessary. JICA incorporates the results of such consultations into such studies.
7. Based on the aforementioned procedure, JICA prepares draft reports incorporating the results of

environmental and social considerations studies, explains them to project proponents etc., and obtains their comments. For Category A studies, draft reports are disclosed and consultations with local stakeholders are conducted. JICA incorporates the results of such consultations in its final reports. For Category B studies, consultations with local stakeholders after the disclosure of draft final reports are conducted when necessary.
8. JICA prepares final reports incorporating the study results and submits them to project proponents etc. after confirming that the reports meet the requirements of the guidelines.
9. JICA discloses final reports on its website promptly after their completion.

3.4.4. Full-scale Study Stage (Feasibility Study)
1. JICA enlists expert(s) on environmental and social considerations to participate in study teams, ensuring the provision of an adequate study period.
2. JICA collects relevant information, conducts field surveys in a wider area than that of preparatory studies, holds consultations with project proponents etc., and prepares scoping drafts.
3. For all Category A projects and for Category B projects as needed, after disclosing scoping drafts, project proponents etc. conduct consultations with local stakeholders based on stakeholder analyses. JICA incorporates the results of such consultations in the TOR of environmental and social considerations studies. The consultations cover project needs and analyses of alternatives.
4. The TOR includes understanding of development needs, impacts to be assessed, study methods, analysis of alternatives, a schedule, etc.
5. In line with the TOR and in collaboration with project proponents etc., JICA conducts (at the EIA level for Category A projects and at the IEE level for Category B projects) environmental and social considerations studies, including mitigation measures to avoid, minimize, or compensate for adverse impacts; a monitoring plan; and an institutional arrangement. JICA also analyzes alternatives, including “without project” situations. JICA incorporates the results of such studies into related reports that are prepared accordingly.
6. When considering a rough outline of environmental and social considerations, information is disclosed and consultations with local stakeholders are conducted as needed. JICA incorporates the results into its studies.
7. JICA prepares draft reports, incorporating the results of environmental and social considerations studies, and explains them to project proponents etc. in order to obtain comments. After the disclosure of draft reports, consultations with local stakeholders are conducted for all Category A projects and for Category B projects as needed. JICA incorporates the results of such consultations into final reports.
8. JICA prepares final reports and submits them to project proponents etc. after confirming that they meet the requirements of the guidelines.

9. JICA discloses final reports on its website promptly after their completion.

3.4.5 Follow-up Activity

1. JICA confirms as needed reflection of results and recommendations regarding environmental and social considerations studies into EIA, resettlement action plans, mitigation measures, etc., and discloses the results of such confirmations on its website.

2. When third parties indicate that unexpected environmental and social impacts appear after the completion of Technical Cooperation for Development Planning, JICA uncovers problems by conducting field surveys and makes recommendations to related organizations when necessary. JICA discloses all such recommendations.

Appendix 1. Environmental and Social Considerations Required for Intended Projects

In principle, appropriate environmental and social considerations are undertaken, according to the nature of the project, based on the following:

1. Underlying Principles

1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.
2. Such examinations must be endeavored to include an analysis of environmental and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis; these must be conducted in close harmony with the economic, financial, institutional, social, and technical analyses of projects.
3. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures, and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts.
4. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seek their opinions, in order to increase accountability.

2. Examination of Measures

1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any of the aforementioned measures.
2. Appropriate follow-up plans and systems, such as monitoring plans and environmental management plans, must be prepared; the costs of implementing such plans and systems, and the financial methods to fund such costs, must be determined. Plans for projects with particularly large potential adverse impacts must be accompanied by detailed environmental management plans.

3. Scope of Impacts to Be Assessed

1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted

through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.

2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.

4. Compliance with Laws, Standards, and Plans

1. Projects must comply with the laws, ordinances, and standards related to environmental and social considerations established by the governments that have jurisdiction over project sites (including both national and local governments). They must also conform to the environmental and social consideration policies and plans of the governments that have such jurisdiction.

2. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas.

5. Social Acceptability

1. Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans.

2. Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor, and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.

6. Ecosystem and Biota

1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.
2. Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest certification systems as a way to ensure the prevention of illegal logging.

7. Involuntary Resettlement

1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.
2. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.
3. Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.
4. For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

8. Indigenous Peoples

1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.

2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of relevant international declarations and treaties, including the United Nations Declaration on the Rights of Indigenous Peoples. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.
3. Measures for the affected indigenous peoples must be prepared as an indigenous peoples plan (which may constitute a part of other documents for environmental and social consideration) and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the indigenous peoples plan, consultations must be made with the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, it is desirable that explanations be given in a form, manner, and language that are understandable to the people concerned. It is desirable that the indigenous peoples plan include the elements laid out in the World Bank Safeguard Policy, OP4.10, Annex B.

8. Monitoring

1. After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring.
2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents etc. must ensure that project plans include feasible monitoring plans.
3. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.
4. When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.

Appendix 2. EIA Reports for Category A Projects

The following conditions are met in principle:

•When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents etc. must officially finish those procedures and obtain the approval of the government of the host country;
•EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them;
•EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted;
•In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared;
•Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared; and
•It is desirable that EIA reports cover the items enumerated in the following.

Illustrative Environmental Impact Assessment Report for Category A Projects[NB]

An EIA's scope and level of detail should be determined in accordance with the project's potential impacts. The EIA report should include the following items (not necessarily in the order shown):

- Executive summary: This concisely discusses significant findings and recommended actions.
- Policy, legal, and administrative framework: This is the framework within which the EIA report is to be carried out.
- Project description: This describes the proposed project and its geographic, ecological, social and temporal context, including any off-site investments that may be required (e.g. dedicated pipelines, access roads, power plants, water supply, housing, or raw material and product storage facilities). It also indicates the need for any resettlement or social development plan. It normally includes a map showing the project site and the area affected

by the project.

- Baseline data: This assesses the dimensions of the study area and describes relevant physical, biological, and socio-economic conditions, including all changes anticipated to occur before the project commences. Additionally, it takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project site, design, operation, or mitigation measures, and it is necessary to indicate the accuracy, reliability, and sources of the data.
- Environmental impacts: This predicts and assesses the project's likely positive and negative impacts in quantitative terms, to the extent possible. It identifies mitigation measures and any negative environmental impacts that cannot be mitigated, and explores opportunities for environmental enhancement. It identifies and estimates the extent and quality of available data, essential data gaps and uncertainties associated with predictions, and it specifies topics that do not require further attention.
- Analysis of alternatives: This systematically compares feasible alternatives to the proposed project site, technology, design, and operation including the "without project" situation in terms of the following: the potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, it quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. It also states the basis for selecting the particular proposed project design, and offers justification for recommended emission levels and approaches to pollution prevention and abatement.
- Environmental Management Plan (EMP): This describes mitigation, monitoring, and institutional measures to be taken during construction and operation in order to eliminate adverse impacts, offset them, or reduce them to acceptable levels.
- Consultation: This includes a record of consultation meetings (date, venue, participants, procedures, opinions of major local stakeholders and responses to them, and other items), including consultations for obtaining the informed views of the affected people, local NGOs, and regulatory agencies.

NB

This Appendix is based on the World Bank Operational Policy - OP 4.01, Annex B.

Appendix 3. Illustrative List of Sensitive Sectors, Characteristics, and Areas

The project of sensitive sectors, characteristics, and areas shown in this illustrative list are those that will likely have a significant adverse impact on the environment and society. Each individual project is categorized in accordance with the standards for “Category A” indicated in the categorization section of the guidelines, depending on the impacts of the individual projects. Consequently, projects that are likely to have a significant adverse impact on the environment and society are categorized as “Category A” even if they are not included in the sectors, characteristic, or areas on the list.

1. Sensitive Sectors

Large-scale projects in the following sectors:

(1) Mining, including oil and natural gas development

(2) Oil and gas pipelines

(3) Industrial development

(4) Thermal power, including geothermal power

(5) Hydropower, dams, and reservoirs

(6) Power transmission and distribution lines involving large-scale involuntary resettlement, large-scale logging, or submarine electrical cables

(7) River/erosion control

(8) Roads, railways, and bridges

(9) Airports

(10) Ports and harbors

(11) Water supply, sewage, and wastewater treatment that have sensitive characteristics or that are located in sensitive areas or in their vicinity

(12) Waste management and disposal

(13) Agriculture involving large-scale land clearing or irrigation

2. Sensitive Characteristics

(1)Large-scale involuntary resettlement

(2)Large-scale groundwater pumping

(3)Large-scale land reclamation, land development, and land clearing

(4)Large-scale logging

3. Sensitive Areas

Projects in the following areas or their vicinity:

(1)National parks, nationally-designated protected areas (coastal areas, wetlands, areas for ethnic minorities or indigenous peoples and cultural heritage, etc. designated by national governments)

(2)Areas that are thought to require careful consideration by the country or locality

Natural Environment

a) Primary forests or natural forests in tropical areas

b) Habitats with important ecological value (coral reefs, mangrove wetlands, tidal flats, etc.)

c) Habitats of rare species that require protection under domestic legislation, international treaties, etc.

d) Areas in danger of large-scale salt accumulation or soil erosion

e) Areas with a remarkable tendency towards desertification

Social Environment

a) Areas with unique archeological, historical, or cultural value

b) Areas inhabited by ethnic minorities, indigenous peoples, or nomadic peoples with traditional ways of life, and other areas with special social value

Appendix 4. Screening Format

Name of Proposed Project:
Project Executing Organization, Project Proponent. or Investment Company:
Name, Address, Organization, and Contact Point of a Responsible Officer:

Name:
Address:
Organization:
Tel:
Fax:
E-Mail:
Date:
Signature:

Check Items

Please write “to be advised (TBA)” when the details of a project are yet to be determined.

Question 1: Address of project site

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

□YES: Please describe the higher program/policy.

（ ）

□NO

2-3. Did the proponent consider alternatives before this request?

□YES: Please describe outline of the alternatives

（ ）

□NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

□Implemented □Not implemented

If implemented, please mark the following stakeholders.

□Administrative body
□Local residents
□NGO
□Others（ ）

2-2 Does the project include any of the following items?

Yes No

If yes, please mark the items included in the project.

Involuntary resettlement (scale: households persons)
Groundwater pumping (scale: m3/year)
Land reclamation, land development, and/or land-clearing (scale: hectors)
Logging (scale: hectors)

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

New Ongoing (with complaints) Ongoing (without complaints)
Other （ ）

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE) Is, required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

☐Necessity (□Implemented □Ongoing/planning)
(Reason why EIA is required:)
☐Not necessary
☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the

host country? If yes, please note the date of approval and the competent authority.

Approved without a supplementary condition	Approved with a supplementary condition	Under appraisal

(Date of approval: Competent authority:)

Under implementation

Appraisal process not yet started

Other ( )

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

Already certified

Title of the certificate: ( )

Requires a certificate but not yet approved

Not required

Other ( )

Question 7:

Are any of the following areas present either inside or surrounding the project site?

Yes No

If yes, please mark the corresponding items.

National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

Primeval forests, tropical natural forests

Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)

Habitats of endangered species for which protection is required under local laws and/or international treaties

Areas that run the risk of a large scale increase in soil salinity or soil erosion

Remarkable desertification areas

Areas with special values from an archaeological, historical, and/or cultural points of view

Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

Yes No

If yes, please mark the appropriate items.

Involuntary resettlement (scale: households persons)

Groundwater pumping (scale: m3/year)

Land reclamation, land development, and/or land-clearing (scale: hectors)

Logging (scale: hectors)

Question 9:

Please mark related environmental and social impacts, and describe their outlines.

☐Air pollution
☐Water pollution
☐Soil pollution
☐Waste
☐Noise and vibrations
☐Ground subsidence
☐Offensive odors
☐Geographical features
☐Bottom sediment
☐Biota and ecosystems
☐Water usage
☐Accidents
☐Global warming

☐Involuntary resettlement
☐Local economies, such as employment, livelihood, etc.
☐Land use and utilization of local resources
☐Social institutions such as social infrastructure and local decision-making institutions
☐Existing social infrastructures and services
☐Poor, indigenous, or ethnic people
☐Misdistribution of benefits and damages
☐Local conflicts of interest
☐Limitation of accessibility to information, meetings, etc. on a specific person or group
☐Gender
☐Children’s rights
☐Cultural heritage
☐Infectious diseases such as HIV/AIDS
☐Other ( )

Outline of related impact:

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐Yes ☐No

Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

☐Yes ☐No

Appendix 5. Categories and Items in Checklist

These checklists include the following categories and items related to the environment. When using these checklists, the appropriate items should be checked based on the sector and nature of the project.

Category	Item
1. Permits and approvals, explanations	• EIA and environmental permits • Explanations to the public
2. Anti-pollution measures	• Air quality • Water quality • Waste • Soil contamination • Noise and vibration • Subsidence • Odor • Sediment
3. Natural environment	• Protected areas • Ecosystem • Hydrology • Topography and geology • Management of abandoned sites
4. Social environment	• Resettlement • Living and livelihood • Heritage • Landscape • Ethnic minorities and indigenous peoples • Working conditions (including occupational safety)
5. Other	• Impact during construction • Accident prevention measures • Monitoring

Appendix 6. Items Requiring Monitoring

Items that require monitoring shall be decided on according to the sector and nature of the project, with reference to the following list of items.

Items

1. Permits and approvals, explanations

    • Response to matters indicated by authorities

2. Anti-pollution measures

    •Air quality: SO_2, NO_2, CO, O_2, soot and dust, suspended particulate matter, coarse particulates, etc.
    •Water quality: pH, SS (suspended solids), BOD (biochemical oxygen demand) and COD (chemical oxygen demand), DO (dissolved oxygen), total nitrogen, total phosphorus, heavy metals, hydrocarbons, phenols, cyanogen compounds, mineral oils, water temperature, etc.
    • Waste
    • Noise and vibration
    • Odors

3. Natural environment

    • Ecosystems: impact on valuable species, countermeasures, etc.

4. Social environment

    • Resettlement
    • Lifestyle and livelihood

NB: For air and water quality, specify whether you are monitoring emission levels or environmental levels. Also, it should be noted that the items which require monitoring will differ depending on whether the impact in question will occur during construction or during the operation of the project.

EIA ANNEX 1-2

JICA Check List for Thermal Power Station

Environmental Checklist: 2. Thermal Power Station（1）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) (b) (c) (d)	(a) (b) (c) (d)
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) (b)	(a) (b)
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)	(a)
2 Pollution Control	(1) Air Quality	(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by the power plant operations comply with the country’s emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country’s ambient air quality standards? Are any mitigating measures taken? (b) In the case of coal-fired power plants, is there a possibility that fugitive dust from the coal piles, coal handling facilities, and dust from the coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?	(a) (b)	(a) (b)
	(2) Water Quality	(a) Do effluents including thermal effluents from the power plant comply with the country’s effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country’s ambient water quality standards or cause any significant temperature rise in the receiving waters? (b) In the case of coal-fired power plants, do leachates from the coal piles and coal ash disposal sites comply with the country’s effluent standards? (c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?	(a) (b) (c)	(a) (b) (c)
	(3) Wastes	(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country’s regulations?	(a)	(a)

Environmental Checklist: 2. Thermal Power Station（2）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2 Pollution Control	(4) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	(a)	(a)
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a)	(a)
	(6) Odor	(a) Are there any odor sources? Are adequate odor control measures taken?	(a)	(a)
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)	(a)
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms? (e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	(a) (b) (c) (d) (e)	(a) (b) (c) (d) (e)

Environmental Checklist: 2. Thermal Power Station（3）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)	(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is sufficient infrastructure (e.g., hospitals, schools, and roads) available for the project implementation? If the existing infrastructure is insufficient, are any plans developed to construct new infrastructure or improve the existing infrastructure? (c) Is there a possibility that large vehicles traffic for transportation of materials, such as raw materials and products will have impacts on traffic in the surrounding areas, impede the movement of inhabitants, and any cause risks to pedestrians? (d) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishery)?	(a) (b) (c) (d) (e)	(a) (b) (c) (d) (e)

Environmental Checklist: 2. Thermal Power Station（4）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country' s laws?	(a)	(a)
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)	(a)
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) (b)	(a) (b)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) (b) (c) (d)	(a) (b) (c) (d)

Environmental Checklist: 2. Thermal Power Station（5）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	(a) (b) (c)	(a) (b) (c)
	(2) Accident Prevention Measures	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles (e.g., sprinkler systems)?	(a)	(a)
	(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) (b) (c) (d)	(a) (b) (c) (d)
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities). (b) Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	(a) (b)	(a) (b)
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).	(a)	(a)

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriat environmental considerations are requested to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experienc
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

EIA ANNEX 1-3

JICA Check List for
Transmission and Distribution Lines

Environmental Checklist: 6. Power Transmission and Distribution Lines（1）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) (b) (c) (d)	(a) (b) (c) (d)
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) (b)	(a) (b)
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)	(a)
2 Pollution Control	(1) Water Quality	(a) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If the water quality degradation is anticipated, are adequate measures considered?	(a)	(a)
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)	(a)
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (e) Is there any possibility that the project will cause the negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? (f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?	(a) (b) (c) (d) (e) (f)	(a) (b) (c) (d) (e) (f)

Environmental Checklist: 6. Power Transmission and Distribution Lines（2）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(3) Topography and Geology	(a) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken	(a) (b) (c)	(a) (b) (c)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)	(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (c) Is there any possibility that installation of structures, such as power line towers will cause a radio interference? If any significant radio interference is anticipated, are adequate measures considered? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) (b) (c) (d)	(a) (b) (c) (d)

Environmental Checklist: 6. Power Transmission and Distribution Lines（3）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)	(a)
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)	(a)
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) (b)	(a) (b)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) (b) (c) (d)	(a) (b) (c) (d)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are	(a) (b) (c)	(a) (b) (c)
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) (b) (c) (d)	(a) (b) (c) (d)

Environmental Checklist: 6. Power Transmission and Distribution Lines（4）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Road checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a)	(a)
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)	(a)

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

EIA ANNEX 1-4

IFC/WB Environmental, Health, and Safety
Guidelines for Thermal Power Plants, 2009

Environmental, Health, and Safety Guidelines for Thermal Power Plants

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/sustainability.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, based on environmental assessments and/or environmental audits as appropriate, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

Applicability

This document includes information relevant to combustion processes fueled by gaseous, liquid and solid fossil fuels and biomass and designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type (except for solid waste which is covered under a separate Guideline for Waste Management Facilities), with a total rated heat input capacity above 50 Megawatt thermal input (MWth) on Higher Heating Value (HHV) basis.[2] It applies to boilers, reciprocating engines, and combustion turbines in new and existing facilities. Annex A contains a detailed description of industry activities for this sector, and Annex B contains guidance for Environmental Assessment (EA) of thermal power projects. Emissions guidelines applicable to facilities with a total heat input capacity of less than 50 MWth are presented in Section 1.1 of the General EHS Guidelines. Depending on the characteristics of the project and its associated activities (i.e., fuel sourcing and evacuation of generated electricity), readers should also consult

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

[2] Total capacity applicable to a facility with multiple units.

the EHS Guidelines for Mining and the EHS Guidelines for Electric Power Transmission and Distribution.

Decisions to invest in this sector by one or more members of the World Bank Group are made within the context of the World Bank Group strategy on climate change.

This document is organized according to the following sections:

Section 1.0 – Industry Specific Impacts and Management
Section 2.0 – Performance Indicators and Monitoring
Section 3.0 – References and Additional Sources
Annex A – General Description of Industry Activities
Annex B – Environmental Assessment Guidance for Thermal Power Projects.

1.0 Industry-Specific Impacts and Management

The following section provides a summary of the most significant EHS issues associated with thermal power plants, which occur during the operational phase, along with recommendations for their management.

As described in the introduction to the General EHS Guidelines, the general approach to the management of EHS issues in industrial development activities, including power plants, should consider potential impacts as early as possible in the project cycle, including the incorporation of EHS considerations into the site selection and plant design processes in order to maximize the range of options available to prevent and control potential negative impacts.

Recommendations for the management of EHS issues common to most large industrial and infrastructure facilities during the construction and decommissioning phases are provided in the General EHS Guidelines.

1.1 Environment

Environmental issues in thermal power plant projects primarily include the following:

- Air emissions
- Energy efficiency and Greenhouse Gas emissions
- Water consumption and aquatic habitat alteration
- Effluents
- Solid wastes
- Hazardous materials and oil
- Noise

Air Emissions

The primary emissions to air from the combustion of fossil fuels or biomass are sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO), and greenhouse gases, such as carbon dioxide (CO_2). Depending on the fuel type and quality, mainly waste fuels or solid fuels, other substances such as heavy metals (i.e., mercury, arsenic, cadmium, vanadium, nickel, etc), halide compounds (including hydrogen fluoride), unburned hydrocarbons and other volatile organic compounds (VOCs) may be emitted in smaller quantities, but may have a significant influence on the environment due to their toxicity and/or persistence. Sulfur dioxide and nitrogen oxide are also implicated in long-range and trans-boundary acid deposition.

The amount and nature of air emissions depends on factors such as the fuel (e.g., coal, fuel oil, natural gas, or biomass), the type and design of the combustion unit (e.g., reciprocating engines, combustion turbines, or boilers), operating practices, emission control measures (e.g., primary combustion control, secondary flue gas treatment), and the overall system efficiency. For example, gas-fired plants generally produce negligible quantities of particulate matter and sulfur oxides, and levels of nitrogen oxides are about 60% of those from plants using coal (without

emission reduction measures). Natural gas-fired plants also release lower quantities of carbon dioxide, a greenhouse gas.

Some measures, such as choice of fuel and use of measures to increase energy conversion efficiency, will reduce emissions of multiple air pollutants, including CO_2, per unit of energy generation. Optimizing energy utilization efficiency of the generation process depends on a variety of factors, including the nature and quality of fuel, the type of combustion system, the operating temperature of the combustion turbines, the operating pressure and temperature of steam turbines, the local climate conditions, the type of cooling system used, etc. Recommended measures to prevent, minimize, and control air emissions include:

- Use of the cleanest fuel economically available (natural gas is preferable to oil, which is preferable to coal) if that is consistent with the overall energy and environmental policy of the country or the region where the plant is proposed. For most large power plants, fuel choice is often part of the national energy policy, and fuels, combustion technology and pollution control technology, which are all interrelated, should be evaluated very carefully upstream of the project to optimize the project's environmental performance;
- When burning coal, giving preference to high-heat-content, low-ash, and low-sulfur coal;
- Considering beneficiation to reduce ash content, especially for high ash coal;[3]
- Selection of the best power generation technology for the fuel chosen to balance the environmental and economic benefits. The choice of technology and pollution control systems will be based on the site-specific environmental assessment (some examples include the use of higher energy-efficient systems, such as combined cycle gas turbine system for natural gas and oil-fired units, and supercritical, ultra-supercritical or integrated coal gasification combined cycle (IGCC) technology for coal-fired units);
- Designing stack heights according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations and minimize impacts, including acid deposition;[4]
- Considering use of combined heat and power (CHP, or co-generation) facilities. By making use of otherwise wasted heat, CHP facilities can achieve thermal efficiencies of 70 – 90 percent, compared with 32 – 45 percent for conventional thermal power plants.
- As stated in the General EHS Guidelines, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed.[5]

Pollutant-specific control recommendations are provided below.

Sulfur Dioxide

The range of options for the control of sulfur oxides varies substantially because of large differences in the sulfur content of different fuels and in control costs as described in Table 1. The choice of technology depends on a benefit-cost analysis of the environmental performance of different fuels, the cost of controls, and the existence of a market for sulfur control by-products[6]. Recommended measures to prevent, minimize, and control SO_2 emissions include:

[3] If sulfur is inorganically bound to the ash, this will also reduce sulfur content.

[4] For specific guidance on calculating stack height see Annex 1.1.3 of the General EHS Guidelines. Raising stack height should not be used to allow more emissions. However, if the proposed emission rates result in significant incremental ambient air quality impacts to the attainment of the relevant ambient air quality standards, options to raise stack height and/or to further reduce emissions should be considered in the EA. Typical examples of GIIP stack heights are up to around 200m for large coal-fired power plants, up to around 80m for HFO-fueled diesel engine power plants, and up to 100m for gas-fired combined cycle gas turbine power plants. Final selection of the stack height will depend on the terrain of the surrounding areas, nearby buildings, meteorological conditions, predicted incremental impacts and the location of existing and future receptors.

[5] For example, the US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds provide the following: SO_2 (91 µg/m^3 for 2nd highest 24-hour, 20 µg/m^3 for annual average), NO_2 (20 µg/m^3 for annual average), and PM_{10} (30 µg/m^3 for 2nd highest 24-hour, and 17 µg/m^3 for annual average).

- Use of fuels with a lower content of sulfur where economically feasible;
- Use of lime (CaO) or limestone ($CaCO_3$) in coal-fired fluidized bed combustion boilers to have integrated desulfurization which can achieve a removal efficiency of up to 80-90 % through use of Fluidized Bed Combustion[7, 8];
- Depending on the plant size, fuel quality, and potential for significant emissions of SO_2 , use of flue gas desulfurization (FGD) for large boilers using coal or oil and for large reciprocating engines . The optimal type of FGD system (e.g., wet FGD using limestone with 85 to 98% removal efficiency, dry FGD using lime with 70 to 94% removal efficiency, seawater FGD with up to 90% removal efficiency) depends on the capacity of the plant, fuel properties, site conditions, and the cost and availability of reagent as well as by-product disposal and utilization.[9]

Table 1 - Performance / Characteristics of FGDs

Type of FGD	Characteristics	Plant Capital Cost Increase
Wet FGD	• Flue gas is saturated with water • Limestone ($CaCO_3$) as reagent • Removal efficiency up to 98% • Use 1-1.5% of electricity generated • Most widely used • Distance to limestone source and the limestone reactivity to be considered • High water consumption • Need to treat wastewater • Gypsum as a saleable by-product or waste	11-14%
Semi-Dry FGD	• Also called "Dry Scrubbing" – under controlled humidification. • Lime (CaO) as reagent • Removal efficiency up to 94% • Can remove SO_3 as well at higher removal rate than Wet FGD • Use 0.5-1.0% of electricity generated, less than Wet FGD • Lime is more expensive than limestone • No wastewater • Waste – mixture of fly ash, unreacted additive and $CaSO_3$	
Seawater FGD	• Removal efficiency up to 90% • Not practical for high S coal (>1%S) • Impacts on marine environment need to be carefully examined (e.g., reduction of pH, inputs of remaining heavy metals, fly ash, temperature, sulfate, dissolved oxygen, and chemical oxygen demand) • Use 0.8-1.6% of electricity generated • Simple process, no wastewater or solid waste,	7-10%

Sources: EC (2006) and World Bank Group.

Nitrogen Oxides

Formation of nitrogen oxides can be controlled by modifying operational and design parameters of the combustion process (primary measures). Additional treatment of NO_X from the flue gas (secondary measures; see Table 2) may be required in some cases depending on the ambient air quality objectives. Recommended measures to prevent, minimize, and control NO_X emissions include:

- Use of low NO_X burners with other combustion modifications, such as low excess air (LEA) firing, for boiler plants. Installation of additional NO_X controls for boilers may be necessary to meet emissions limits; a selective catalytic reduction (SCR) system can be used for pulverized coal-fired, oil-fired, and gas-fired boilers or a selective non-catalytic reduction (SNCR) system for a fluidized-bed boiler;
- Use of dry low-NO_X combustors for combustion turbines burning natural gas;
- Use of water injection or SCR for combustion turbines and

[6] Regenerative Flue Gas Desulfurization (FGD) options (either wet or semi-dray) may be considered under these conditions.

[7] EC (2006).

[8] The SO2 removal efficiency of FBC technologies depends on the sulfur and lime content of fuel, sorbent quantity, ratio, and quality.

[9] The use of wet scrubbers, in addition to dust control equipment (e.g. ESP or Fabric Filter), has the advantage of also reducing emissions of HCl, HF, heavy metals, and further dust remaining after ESP or Fabric Filter. Because of higher costs, the wet scrubbing process is generally not used at plants with a capacity of less than 100 MWth (EC 2006).

reciprocating engines burning liquid fuels;[10]

- Optimization of operational parameters for existing reciprocating engines burning natural gas to reduce NOx emissions;
- Use of lean-burn concept or SCR for new gas engines.

Table 2 - Performance / Characteristics of Secondary NOx Reduction Systems

Type	Characteristics	Plant Capital Cost Increase
SCR	• NOx emission reduction rate of 80 – 95% • Use 0.5% of electricity generated • Use ammonia or urea as reagent. • Ammonia slip increases with increasing NH_3/NOx ratio may cause a problem (e.g., too high ammonia in the fly ash). Larger catalyst volume / improving the mixing of NH_3 and NOx in the flue gas may be needed to avoid this problem. • Catalysts may contain heavy metals. Proper handling and disposal / recycle of spent catalysts is needed. • Life of catalysts has been 6-10 years (coal-fired), 8-12 years (oil-fired) and more than 10 years (gas-fired).	4-9% (coal-fired boiler) 1-2% (gas-fired combined cycle gas turbine) 20-30% (reciprocating engines)
SNCR	• NOx emission reduction rate of 30 – 50% • Use 0.1-0.3% of electricity generated • Use ammonia or urea as reagent. • Cannot be used on gas turbines or gas engines. • Operates without using catalysts.	1-2%

Source: EC (2006), World Bank Group

Particulate Matter

Particulate matter[11] is emitted from the combustion process, especially from the use of heavy fuel oil, coal, and solid biomass. The proven technologies for particulate removal in power plants are fabric filters and electrostatic precipitators (ESPs), shown in Table 3. The choice between a fabric filter and an ESP depends on the fuel properties, type of FGD system if used for SO_2 control, and ambient air quality objectives. Particulate matter can also be released during transfer and storage of coal and additives, such as lime. Recommendations to prevent, minimize, and control particulate matter emissions include:

- Installation of dust controls capable of over 99% removal efficiency, such as ESPs or Fabric Filters (baghouses), for coal-fired power plants. The advanced control for particulates is a wet ESP, which further increases the removal efficiency and also collects condensables (e.g., sulfuric acid mist) that are not effectively captured by an ESP or a fabric filter;[12]
- Use of loading and unloading equipment that minimizes the height of fuel drop to the stockpile to reduce the generation of fugitive dust and installing of cyclone dust collectors;
- Use of water spray systems to reduce the formation of fugitive dust from solid fuel storage in arid environments;
- Use of enclosed conveyors with well designed, extraction and filtration equipment on conveyor transfer points to prevent the emission of dust;
- For solid fuels of which fine fugitive dust could contain vanadium, nickel and Polycyclic Aromatic Hydrocarbons (PAHs) (e.g., in coal and petroleum coke), use of full enclosure during transportation and covering stockpiles where necessary;
- Design and operate transport systems to minimize the generation and transport of dust on site;
- Storage of lime or limestone in silos with well designed, extraction and filtration equipment;
- Use of wind fences in open storage of coal or use of enclosed storage structures to minimize fugitive dust

[10] Water injection may not be practical for industrial combustion turbines in all cases. Even if water is available, the facilities for water treatment and the operating and maintenance costs of water injection may be costly and may complicate the operation of a small combustion turbine.

[11] Including all particle sizes (e.g. TSP, PM_{10}, and $PM_{2.5}$)

[12] Flue gas conditioning (FGC) is a recommended approach to address the issue of low gas conductivity and lower ESP collection performance which occurs when ESPs are used to collect dust from very low sulfur fuels. One particular FGC design involves introduction of sulfur trioxide (SO_3) gas into the flue gas upstream of the ESP, to increase the conductivity of the flue gas dramatically improve the ESP collection efficiency. There is typically no risk of increased SOx emissions as the SO_3 is highly reactive and adheres to the dust.

emissions where necessary, applying special ventilation systems in enclosed storage to avoid dust explosions (e.g., use of cyclone separators at coal transfer points).

See Annex 1.1.2 of the General EHS Guidelines for an additional illustrative presentation of point source emissions prevention and control technologies.

Table 3 – Performance / Characteristics of Dust Removal Systems

Type	Performance / Characteristics
ESP	• Removal efficiency of >96.5% (<1 µm), >99.95% (>10 µm) • 0.1-1.8% of electricity generated is used • It might not work on particulates with very high electrical resistivity. In these cases, flue gas conditioning (FGC) may improve ESP performance. • Can handle very large gas volume with low pressure drops
Fabric Filter	• Removal efficiency of >99.6% (<1 µm), >99.95% (>10 µm). Removes smaller particles than ESPs. • 0.2-3% of electricity generated is used • Filter life decreases as coal S content increases • Operating costs go up considerably as the fabric filter becomes dense to remove more particles • If ash is particularly reactive, it can weaken the fabric and eventually it disintegrates.
Wet Scrubber	• Removal efficiency of >98.5% (<1 µm), >99.9% (>10 µm) • Up to 3% of electricity generated is used. • As a secondary effect, can remove and absorb gaseous heavy metals • Wastewater needs to be treated

Sources: EC (2006) and World Bank Group.

Other Pollutants

Depending on the fuel type and quality, other air pollutants may be present in environmentally significant quantities requiring proper consideration in the evaluation of potential impacts to ambient air quality and in the design and implementation of management actions and environmental controls. Examples of additional pollutants include mercury in coal, vanadium in heavy fuel oil, and other heavy metals present in waste fuels such as petroleum coke (petcoke) and used lubricating oils[13]. Recommendations to prevent, minimize, and control emissions of other air pollutants such as mercury in particular from thermal power plants include the use of conventional secondary controls such as fabric filters or ESPs operated in combination with FGD techniques, such as limestone FGD, Dry Lime FGD, or sorbent injection.[14] Additional removal of metals such as mercury can be achieved in a high dust SCR system along with powered activated carbon, bromine-enhanced Powdered Activated Carbon (PAC) or other sorbents. Since mercury emissions from thermal power plants pose potentially significant local and transboundary impacts to ecosystems and public health and safety through bioaccumulation, particular consideration should be given to their minimization in the environmental assessment and accordingly in plant design.[15]

Emissions Offsets

Facilities in degraded airsheds should minimize incremental impacts by achieving emissions values outlined in Table 6. Where these emissions values result nonetheless in excessive ambient impacts relative to local regulatory standards (or in their absence, other international recognized standards or guidelines, including World Health Organization guidelines), the project should explore and implement site-specific offsets that result in no net increase in the total emissions of those pollutants (e.g., particulate matter, sulfur dioxide, or nitrogen dioxide) that are responsible for the degradation of the airshed. Offset provisions should be implemented before the power plant comes fully on stream. Suitable offset measures could include reductions in emissions of particulate matter, sulfur dioxide, or nitrogen dioxide, as necessary through (a) the installation of new or more effective controls at other units within the same power plant or at other power plants in

[13] In these cases, the EA should address potential impacts to ambient air quality for such heavy metals as mercury, nickel, vanadium, cadmium, lead, etc.

[14] For Fabric Filters or Electrostatic Precipitators operated in combination with FGD techniques, an average removal rate of 75% or 90 % in the additional presence of SCR can be obtained (EC, 2006).

[15] Although no major industrial country has formally adopted regulatory limits for mercury emissions from thermal power plants, such limitations where under consideration in the United States and European Union as of 2008. Future updates of these EHS Guidelines will reflect changes in the international state of

the same airshed, (b) the installation of new or more effective controls at other large sources, such as district heating plants or industrial plants, in the same airshed, or (c) investments in gas distribution or district heating systems designed to substitute for the use of coal for residential heating and other small boilers. Wherever possible, the offset provisions should be implemented within the framework of an overall air quality management strategy designed to ensure that air quality in the airshed is brought into compliance with ambient standards. The monitoring and enforcement of ambient air quality in the airshed to ensure that offset provisions are complied with would be the responsibility of the local or national agency responsible for granting and supervising environmental permits. Project sponsors who cannot engage in the negotiations necessary to put together an offset agreement (for example, due to the lack of the local or national air quality management framework) should consider the option of relying on an appropriate combination of using cleaner fuels, more effective pollution controls, or reconsidering the selection of the proposed project site. The overall objective is that the new thermal power plants should not contribute to deterioration of the already degraded airshed.

Energy Efficiency and GHG Emissions

Carbon dioxide, one of the major greenhouse gases (GHGs) under the UN Framework Convention on Climate Change, is emitted from the combustion of fossil fuels. Recommendations to avoid, minimize, and offset emissions of carbon dioxide from new and existing thermal power plants include, among others:

- Use of less carbon intensive fossil fuels (i.e., less carbon containing fuel per unit of calorific value -- gas is less than oil and oil is less than coal) or co-firing with carbon neutral fuels (i.e., biomass);
- Use of combined heat and power plants (CHP) where feasible;
- Use of higher energy conversion efficiency technology of the same fuel type / power plant size than that of the country/region average. New facilities should be aimed to be in top quartile of the country/region average of the same fuel type and power plant size. Rehabilitation of existing facilities must achieve significant improvements in efficiency. Typical CO_2 emissions performance of different fuels / technologies are presented below in Table 4;
- Consider efficiency-relevant trade-offs between capital and operating costs involved in the use of different technologies. For example, supercritical plants may have a higher capital cost than subcritical plants for the same capacity, but lower operating costs. On the other hand, characteristics of existing and future size of the grid may impose limitations in plant size and hence technological choice. These tradeoffs need to be fully examined in the EA;
- Use of high performance monitoring and process control techniques, good design and maintenance of the combustion system so that initially designed efficiency performance can be maintained;
- Where feasible, arrangement of emissions offsets (including the Kyoto Protocol's flexible mechanisms and the voluntary carbon market), including reforestation, afforestation, or capture and storage of CO_2 or other currently experimental options[16];
- Where feasible, include transmission and distribution loss reduction and demand side measures. For example, an investment in peak load management could reduce cycling requirements of the generation facility thereby improving its operating efficiency. The feasibility of these types of off-set options may vary depending on whether the facility is part of a vertically integrated utility or an independent power producer;
- Consider fuel cycle emissions and off-site factors (e.g., fuel

practice regarding mercury emissions prevention and control.

[16] The application of carbon capture and storage (CCS) from thermal power projects is still in experimental stages worldwide although consideration has started to be given to CCS-ready design. Several options are currently under evaluation including CO_2 storage in coal seams or deep aquifers and oil reservoir injection for enhanced oil recovery.

supply, proximity to load centers, potential for off-site use of waste heat, or use of nearby waste gases (blast furnace gases or coal bed methane) as fuel. etc).

Table 4 - Typical CO_2 Emissions Performance of New Thermal Power Plants

Fuel	Efficiency	CO_2 (gCO_2 / kWh – Gross)
Efficiency (% Net, HHV)		
Coal (*1, *2)	Ultra-Supercritical (*1): 37.6 – 42.7	 676-795
	Supercritical: 35.9-38.3 (*1) 39.1 (w/o CCS) (*2) 24.9 (with CCS) (*2)	 756-836 763 95
	Subcritical: 33.1-35.9 (*1) 36.8 (w/o CCS) (*2) 24.9 (with CCS) (*2)	 807-907 808 102
	IGCC: 39.2-41.8 (*1) 38.2–41.1 (w/o CCS) (*2) 31.7–32.5 (with CCS) (*2)	 654-719 640 – 662 68 – 86
Gas (*2)	Advanced CCGT (*2): 50.8 (w/o CCS) 43.7 (with CCS)	 355 39
Efficiency (% Net, LHV)		
Coal (*3)	42 (Ultra-Supercritical) 40 (Supercritical) 30 – 38 (Subcritical) 46 (IGCC) 38 (IGCC+CCS)	811 851 896-1,050 760 134
Coal and Lignite (*4, *7)	(*4) 43-47 (Coal-PC) >41(Coal-FBC) 42-45 (Lignite-PC) >40 (Lignite-FBC)	(*6) 725-792 (Net) <831 (Net) 808-866 (Net) <909 (Net)
Gas (*4, *7)	(*4) 36–40 (Simple Cycle GT) 38-45 (Gas Engine) 40-42 (Boiler) 54-58 (CCGT)	(*6) 505-561 (Net) 531-449 (Net) 481-505 (Net) 348-374 (Net)
Oil (*4, *7)	(*4) 40 – 45 (HFO/LFO Reciprocating Engine)	(*6) 449-505 (Net)
Efficiency (% Gross, LHV)		
Coal (*5, *7)	(*5) 47 (Ultra-supercritical) 44 (Supercritical) 41-42 (Subcritical) 47-48 (IGCC)	(*6) 725 774 811-831 710-725
Oil (*5, *7)	(*5) 43 (Reciprocating Engine) 41 (Boiler)	(*6) 648 680
Gas (*5)	(*5) 34 (Simple Cycle GT) 51 (CCGT)	(*6) 594 396

Source: (*1) US EPA 2006, (*2) US DOE/NETL 2007, (*3) World Bank, April 2006, (*4) European Commission 2006, (*5) World Bank Group, Sep 2006, (*6) World Bank Group estimates

Water Consumption and Aquatic Habitat Alteration

Steam turbines used with boilers and heat recovery steam generators(HRSG) used in combined cycle gas turbine units require a cooling system to condense steam used to generate electricity. Typical cooling systems used in thermal power plants include: (i) once-through cooling system where sufficient cooling water and receiving surface water are available; (ii) closed circuit wet cooling system; and (iii) closed circuit dry cooling system (e.g., air cooled condensers).

Combustion facilities using once-through cooling systems require large quantities of water which are discharged back to receiving surface water with elevated temperature. Water is also required for boiler makeup, auxiliary station equipment, ash handling, and FGD systems.[17] The withdrawal of such large quantities of water has the potential to compete with other important water uses such as agricultural irrigation or drinking water sources. Withdrawal and discharge with elevated temperature and chemical contaminants such as biocides or other additives, if used, may affect aquatic organisms, including phytoplankton, zooplankton, fish, crustaceans, shellfish, and many other forms of aquatic life. Aquatic organisms drawn into cooling water intake structures are either impinged on components of the cooling water intake structure or entrained in the cooling water system itself. In the case of either impingement or entrainment, aquatic organisms may be killed or subjected to significant harm. In some cases (e.g., sea turtles), organisms are entrapped in the intake canals. There may be special concerns about the potential impacts of cooling water intake structures located in or near habitat areas that support threatened, endangered, or other protected species or where local fishery is active.

Conventional intake structures include traveling screens with relative high through-screen velocities and no fish handling or

[17] The availability of water and impact of water use may affect the choice of FGD

return system.[18] Measures to prevent, minimize, and control environmental impacts associated with water withdrawal should be established based on the results of a project EA, considering the availability and use of water resources locally and the ecological characteristics of the project affected area. Recommended management measures to prevent or control impacts to water resources and aquatic habitats include[19]:

- Conserving water resources, particularly in areas with limited water resources, by:
  - Use of a closed-cycle, recirculating cooling water system (e.g., natural or forced draft cooling tower), or closed circuit dry cooling system (e.g., air cooled condensers) if necessary to prevent unacceptable adverse impacts. Cooling ponds or cooling towers are the primary technologies for a recirculating cooling water system. Once-through cooling water systems may be acceptable if compatible with the hydrology and ecology of the water source and the receiving water and may be the preferred or feasible alternative for certain pollution control technologies such as seawater scrubbers
  - Use of dry scrubbers in situations where these controls are also required or recycling of wastewater in coal-fired plants for use as FGD makeup
  - Use of air-cooled systems
- Reduction of maximum through-screen design intake velocity to 0.5 ft/s;
- Reduction of intake flow to the following levels:
  - For freshwater rivers or streams to a flow sufficient to maintain resource use (i.e., irrigation and fisheries) as well as biodiversity during annual mean low flow conditions[20]
  - For lakes or reservoirs, intake flow must not disrupt the thermal stratification or turnover pattern of the source water
  - For estuaries or tidal rivers, reduction of intake flow to 1% of the tidal excursion volume
- If there are threatened, endangered, or other protected species or if there are fisheries within the hydraulic zone of influence of the intake, reduction of impingement and entrainment of fish and shellfish by the installation of technologies such as barrier nets (seasonal or year-round), fish handling and return systems, fine mesh screens, wedgewire screens, and aquatic filter barrier systems. Examples of operational measures to reduce impingement and entrainment include seasonal shutdowns, if necessary, or reductions in flow or continuous use of screens. Designing the location of the intake structure in a different direction or further out into the water body may also reduce impingement and entrainment.

Effluents

Effluents from thermal power plants include thermal discharges, wastewater effluents, and sanitary wastewater.

Thermal Discharges

As noted above, thermal power plants with steam-powered generators and once-through cooling systems use significant volume of water to cool and condense the steam for return to the boiler. The heated water is normally discharged back to the source water (i.e., river, lake, estuary, or the ocean) or the nearest surface water body. In general, thermal discharge should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. The mixing zone is typically defined as the zone where initial dilution of a discharge takes place within which relevant water quality

system used (i.e., wet vs. semi-dry).

[18] The velocity generally considered suitable for the management of debris is 1 fps [0.30 m/s] with wide mesh screens; a standard mesh for power plants of 3/8 in (9.5 mm).

[19] For additional information refer to Schimmoller (2004) and USEPA (2001).

[20] Stream flow requirements may be based on mean annual flow or mean low flow. Regulatory requirements may be 5% or higher for mean annual flows and 10% to 25% for mean low flows. Their applicability should be verified on a site-specific

temperature standards are allowed to exceed and takes into account cumulative impact of seasonal variations, ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations. Establishment of such a mixing zone is project specific and may be established by local regulatory agencies and confirmed or updated through the project's environmental assessment process. Where no regulatory standard exists, the acceptable ambient water temperature change will be established through the environmental assessment process. Thermal discharges should be designed to prevent negative impacts to the receiving water taking into account the following criteria:

- The elevated temperature areas because of thermal discharge from the project should not impair the integrity of the water body as a whole or endanger sensitive areas (such as recreational areas, breeding grounds, or areas with sensitive biota);
- There should be no lethality or significant impact to breeding and feeding habits of organisms passing through the elevated temperature areas;
- There should be no significant risk to human health or the environment due to the elevated temperature or residual levels of water treatment chemicals.

If a once-through cooling system is used for large projects (i.e., a plant with > 1,200MWth steam generating capacity), impacts of thermal discharges should be evaluated in the EA with a mathematical or physical hydrodynamic plume model, which can be a relatively effective method for evaluating a thermal discharge to find the maximum discharge temperatures and flow rates that would meet the environmental objectives of the receiving water.[21]

Recommendations to prevent, minimize, and control thermal discharges include:

- Use of multi-port diffusers;
- Adjustment of the discharge temperature, flow, outfall location, and outfall design to minimize impacts to acceptable level (i.e., extend length of discharge channel before reaching the surface water body for pre-cooling or change location of discharge point to minimize the elevated temperature areas);
- Use of a closed-cycle, recirculating cooling water system as described above (e.g., natural or forced draft cooling tower), or closed circuit dry cooling system (e.g., air cooled condensers) if necessary to prevent unacceptable adverse impacts. Cooling ponds or cooling towers are the primary technologies for a recirculating cooling water system.

Liquid Waste

The wastewater streams in a thermal power plant include cooling tower blowdown; ash handling wastewater; wet FGD system discharges; material storage runoff; metal cleaning wastewater; and low-volume wastewater, such as air heater and precipitator wash water, boiler blowdown, boiler chemical cleaning waste, floor and yard drains and sumps, laboratory wastes, and backflush from ion exchange boiler water purification units. All of these wastewaters are usually present in plants burning coal or biomass; some of these streams (e.g., ash handling wastewater) may be present in reduced quantities or may not be present at all in oil-fired or gas-fired power plants. The characteristics of the wastewaters generated depend on the ways in which the water has been used. Contamination arises from demineralizers; lubricating and auxiliary fuel oils; trace contaminants in the fuel (introduced through the ash-handling wastewater and wet FGD system discharges); and chlorine, biocides, and other chemicals used to manage the quality of water in cooling systems. Cooling tower blowdown tends to be very high in total dissolved solids but is generally classified as non-contact cooling water and, as such,

basis taking into consideration resource use and biodiversity requirements.

[21] An example model is CORMIX (Cornell Mixing Zone Expert System) hydrodynamic mixing zone computer simulation, which has been developed by the U.S. Environmental Protection Agency. This model emphasizes predicting the site- and discharge-specific geometry and dilution characteristics to assess the environmental effects of a proposed discharge.

is typically subject to limits for pH, residual chlorine, and toxic chemicals that may be present in cooling tower additives (including corrosion inhibiting chemicals containing chromium and zinc whose use should be eliminated).

Recommended water treatment and wastewater conservation methods are discussed in Sections 1.3 and 1.4, respectively, of the General EHS Guidelines. In addition, recommended measures to prevent, minimize, and control wastewater effluents from thermal power plants include:

- Recycling of wastewater in coal-fired plants for use as FGD makeup. This practice conserves water and reduces the number of wastewater streams requiring treatment and discharge[22];
- In coal-fired power plants without FGD systems, treatment of process wastewater in conventional physical-chemical treatment systems for pH adjustment and removal of total suspended solids (TSS), and oil / grease, at a minimum. Depending on local regulations, these treatment systems can also be used to remove most heavy metals to part-per-billion (ppb) levels by chemical precipitation as either metal hydroxide or metal organosulfide compounds;
- Collection of fly ash in dry form and bottom ash in drag chain conveyor systems in new coal-fired power plants;
- Consider use of soot blowers or other dry methods to remove fireside wastes from heat transfer surfaces so as to minimize the frequency and amount of water used in fireside washes;
- Use of infiltration and runoff control measures such as compacted soils, protective liners, and sedimentation controls for runoff from coal piles;
- Spraying of coal piles with anionic detergents to inhibit bacterial growth and minimize acidity of leachate;[23]
- Use of SO_X removal systems that generate less wastewater, if feasible; however, the environmental and cost characteristics of both inputs and wastes should be assessed on a case-by-case basis;
- Treatment of low-volume wastewater streams that are typically collected in the boiler and turbine room sumps in conventional oil-water separators before discharge;
- Treatment of acidic low-volume wastewater streams, such as those associated with the regeneration of makeup demineralizer and deep-bed condensate polishing systems, by chemical neutralization in-situ before discharge;
- Pretreatment of cooling tower makeup water, installation of automated bleed/feed controllers, and use of inert construction materials to reduce chemical treatment requirements for cooling towers;
- Elimination of metals such as chromium and zinc from chemical additives used to control scaling and corrosion in cooling towers;
- Use the minimum required quantities of chlorinated biocides in place of brominated biocides or alternatively apply intermittent shock dosing of chlorine as opposed to continuous low level feed.

Sanitary Wastewater

Sewage and other wastewater generated from washrooms, etc. are similar to domestic wastewater. Impacts and management of sanitary wastewater is addressed in Section 1.3 of the General EHS Guidelines.

Solid Wastes

Coal-fired and biomass-fired thermal power plants generate the greatest amount of solid wastes due to the relatively high percentage of ash in the fuel.[24] The large-volume coal

[22] Suitable wastewater streams for reuse include gypsum wash water, which is a different wastewater stream than the FGD wastewater. In plants that produce marketable gypsum, the gypsum is rinsed to remove chloride and other undesirable trace elements.

[23] If coal pile runoff will be used as makeup to the FGD system, anionic detergents may increase or create foaming within the scrubber system. Therefore, use of anionic surfactants on coal piles should be evaluated on a case-by-case basis.

[24] For example, a 500 MWe plant using coal with 2.5% sulfur (S), 16% ash, and 30,000 kilojoules per kilogram (kJ/kg) heat content will generate about 500 tons of

combustion wastes (CCW) are fly ash, bottom ash, boiler slag, and FGD sludge. Biomass contains less sulfur; therefore FGD may not be necessary. Fluidized-bed combustion (FBC) boilers generate fly ash and bottom ash, which is called bed ash. Fly ash removed from exhaust gases makes up 60–85% of the coal ash residue in pulverized-coal boilers and 20% in stoker boilers. Bottom ash includes slag and particles that are coarser and heavier than fly ash. Due to the presence of sorbent material, FBC wastes have a higher content of calcium and sulfate and a lower content of silica and alumina than conventional coal combustion wastes. Low-volume solid wastes from coal-fired thermal power plants and other plants include coal mill rejects/pyrites, cooling tower sludge, wastewater treatment sludge, and water treatment sludge.

Oil combustion wastes include fly ash and bottom ash and are normally only generated in significant quantities when residual fuel oil is burned in oil-fired steam electric boilers. Other technologies (e.g., combustion turbines and diesel engines) and fuels (e.g., distillate oil) generate little or no solid wastes. Overall, oil combustion wastes are generated in much smaller quantities than the large-volume CCW discussed above. Gas-fired thermal power plants generate essentially no solid waste because of the negligible ash content, regardless of the combustion technology.

Metals are constituents of concern in both CCW and low-volume solid wastes. For example, ash residues and the dust removed from exhaust gases may contain significant levels of heavy metals and some organic compounds, in addition to inert materials.

Ash residues are not typically classified as a hazardous waste due to their inert nature.[25] However, where ash residues are expected to contain potentially significant levels of heavy metals, radioactivity, or other potentially hazardous materials, they should be tested at the start of plant operations to verify their classification as hazardous or non-hazardous according to local regulations or internationally recognized standards. Additional information about the classification and management of hazardous and non-hazardous wastes is presented in Section 1.6 of the General EHS Guidelines.

The high-volume CCWs wastes are typically managed in landfills or surface impoundments or, increasingly, may be applied to a variety of beneficial uses. Low-volume wastes are also managed in landfills or surface impoundments, but are more frequently managed in surface impoundments. Many coal-fired plants co-manage large-volume and low-volume wastes.

Recommended measures to prevent, minimize, and control the volume of solid wastes from thermal power plants include:

- Dry handling of the coal combustion wastes, in particular fly ash. Dry handling methods do not involve surface impoundments and, therefore, do not present the ecological risks identified for impoundments (e.g., metal uptake by wildlife);
- Recycling of CCWs in uses such as cement and other concrete products, construction fills (including structural fill, flowable fill, and road base), agricultural uses such as calcium fertilizers (provided trace metals or other potentially hazardous materials levels are within accepted thresholds), waste management applications, mining applications, construction materials (e.g., synthetic gypsum for plasterboard), and incorporation into other products provided the residues (such as trace metals and radioactivity) are not considered hazardous. Ensuring consistent quality of fuels and additives helps to ensure the CCWs can be recycled. If beneficial reuse is not feasible, disposal of CCW in permitted landfills with environmental controls such as run-on/run-off controls, liners, leachate collection systems, ground-water monitoring, closure controls, daily (or other operational) cover, and fugitive dust controls is recommended;

solid waste per day.

[25] Some countries may categorize fly ash as hazardous due to the presence of arsenic or radioactivity, precluding its use as a construction material.

- Dry collection of bottom ash and fly ash from power plants combusting heavy fuel oil if containing high levels of economically valuable metals such as vanadium and recycle for vanadium recovery (where economically viable) or disposal in a permitted landfill with environmental controls;
- Management of ash disposal and reclamation so as to minimize environmental impacts – especially the migration of toxic metals, if present, to nearby surface and groundwater bodies, in addition to the transport of suspended solids in surface runoff due to seasonal precipitation and flooding. In particular, construction, operation, and maintenance of surface impoundments should be conducted in accordance with internationally recognized standards.[26, 27]
- Reuse of sludge from treatment of waste waters from FGD plants. This sludge may be re-used in the FGD plant due to the calcium components. It can also be used as an additive in coal-fired plant combustion to improve the ash melting behavior

Hazardous Materials and Oil

Hazardous materials stored and used at combustion facilities include solid, liquid, and gaseous waste-based fuels; air, water, and wastewater treatment chemicals; and equipment and facility maintenance chemicals (e.g., paint certain types of lubricants, and cleaners). Spill prevention and response guidance is addressed in Sections 1.5 and 3.7 of the General EHS Guidelines.

In addition, recommended measures to prevent, minimize, and control hazards associated with hazardous materials storage and handling at thermal power plants include the use of double-walled, underground pressurized tanks for storage of pure liquefied ammonia (e.g., for use as reagent for SCR) in quantities over 100 m^3; tanks of lesser capacity should be manufactured using annealing processes (EC 2006).

Noise

Principal sources of noise in thermal power plants include the turbine generators and auxiliaries; boilers and auxiliaries, such as coal pulverizers; reciprocating engines; fans and ductwork; pumps; compressors; condensers; precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; circuit breakers; and cooling towers. Thermal power plants used for base load operation may operate continually while smaller plants may operate less frequently but still pose a significant source of noise if located in urban areas.

Noise impacts, control measures, and recommended ambient noise levels are presented in Section 1.7 of the General EHS Guidelines. Additional recommended measures to prevent, minimize, and control noise from thermal power plants include:

- Siting new facilities with consideration of distances from the noise sources to the receptors (e.g., residential receptors, schools, hospitals, religious places) to the extent possible. If the local land use is not controlled through zoning or is not effectively enforced, examine whether residential receptors could come outside the acquired plant boundary. In some cases, it could be more cost effective to acquire additional land as buffer zone than relying on technical noise control measures, where possible;
- Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound-absorptive materials in walls and ceilings; using vibration isolators and flexible connections (e.g., helical steel springs and rubber elements); applying a carefully detailed design to prevent possible noise leakage through openings or to minimize pressure variations in piping;

[26] See, for example, U.S. Department of Labor, Mine Safety and Health Administration regulations at 30 CFR §§ 77.214 - 77.216.

[27] Additional detailed guidance applicable to the prevention and control of impacts to soil and water resources from non-hazardous and hazardous solid waste disposal is presented in the World Bank Group EHS Guidelines for Waste Management Facilities.

- Modification of the plant configuration or use of noise barriers such as berms and vegetation to limit ambient noise at plant property lines, especially where sensitive noise receptors may be present.

Noise propagation models may be effective tools to help evaluate noise management options such as alternative plant locations, general arrangement of the plant and auxiliary equipment, building enclosure design, and, together with the results of a baseline noise assessment, expected compliance with the applicable community noise requirements.

1.2 Occupational Health and Safety

Occupational health and safety risks and mitigation measures during construction, operation, and decommissioning of thermal power plants are similar to those at other large industrial facilities, and are addressed in Section 2.0 of the General EHS Guidelines. In addition, the following health and safety impacts are of particular concern during operation of thermal power plants:

- Non-ionizing radiation
- Heat
- Noise
- Confined spaces
- Electrical hazards
- Fire and explosion hazards
- Chemical hazards
- Dust

Non-ionizing radiation

Combustion facility workers may have a higher exposure to electric and magnetic fields (EMF) than the general public due to working in proximity to electric power generators, equipment, and connecting high-voltage transmission lines. Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities;
- Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers;
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Institute of Electrical and Electronics Engineers (IEEE).[28] Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g., 50 percent). Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

Heat

Occupational exposure to heat occurs during operation and maintenance of combustion units, pipes, and related hot equipment. Recommended prevention and control measures to address heat exposure at thermal power plants include:

- Regular inspection and maintenance of pressure vessels and piping;
- Provision of adequate ventilation in work areas to reduce heat and humidity;

[28] The ICNIRP exposure guidelines for Occupational Exposure are listed in Section 2.2 of this Guideline.

- Reducing the time required for work in elevated temperature environments and ensuring access to drinking water;
- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc;
- Use of warning signs near high temperature surfaces and personal protective equipment (PPE) as appropriate, including insulated gloves and shoes.

Noise

Noise sources in combustion facilities include the turbine generators and auxiliaries; boilers and auxiliaries, such as pulverizers; diesel engines; fans and ductwork; pumps; compressors; condensers; precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; circuit breakers; and cooling towers. Recommendations for reducing noise and vibration are discussed in Section 1.1, above. In addition, recommendations to prevent, minimize, and control occupational noise exposures in thermal power plants include:

- Provision of sound-insulated control rooms with noise levels below 60 dBA[29];
- Design of generators to meet applicable occupational noise levels;
- Identify and mark high noise areas and require that personal noise protecting gear is used all the time when working in such high noise areas (typically areas with noise levels >85 dBA).

Confined Spaces

Specific areas for confined space entry may include coal ash containers, turbines, condensers, and cooling water towers (during maintenance activities). Recommend confined space entry procedures are discussed in Section 2.8 of the General EHS Guidelines.

Electrical Hazards

Energized equipment and power lines can pose electrical hazards for workers at thermal power plants. Recommended measures to prevent, minimize, and control electrical hazards at thermal power plants include:

- Consider installation of hazard warning lights inside electrical equipment enclosures to warn of inadvertent energization;
- Use of voltage sensors prior to and during workers' entrance into enclosures containing electrical components;
- Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on or proximal to them;
- Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training should include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tagout procedures, first aid including CPR, and proper rescue procedures. Provisions should be made for periodic retraining as necessary.

Fire and Explosion Hazards

Thermal power plants store, transfer, and use large quantities of fuels; therefore, careful handling is necessary to mitigate fire and explosion risks. In particular, fire and explosion hazards increase as the particle size of coal is reduced. Particle sizes of coal that can fuel a propagating explosion occur within thermal dryers, cyclones, baghouses, pulverized-fuel systems, grinding mills, and other process or conveyance equipment. Fire and explosion prevention management guidance is provided in Section 2.1 and

[29] Depending on the type and size of the thermal power plants, distance between control room and the noise emitting sources differs. CSA Z107.58 provides design guidelines for control rooms as 60 dBA. Large thermal power plants using steam boilers or combustion turbines tend to be quieter than 60 dBA. Reciprocating engine manufacturers recommend 65 to 70 dBA instead of 60 dBA (Euromot Position as of 9 May 2008). This guideline recommends 60 dBA as GIIP, with an understanding that up to 65 dBA can be accepted for reciprocating engine power plants if 60 dBA is economically difficult to achieve.

2.4 of the General EHS Guidelines. Recommended measures to prevent, minimize, and control physical hazards at thermal power plants include:

- Use of automated combustion and safety controls;
- Proper maintenance of boiler safety controls;
- Implementation of startup and shutdown procedures to minimize the risk of suspending hot coal particles (e.g., in the pulverizer, mill, and cyclone) during startup;
- Regular cleaning of the facility to prevent accumulation of coal dust (e.g., on floors, ledges, beams, and equipment);
- Removal of hot spots from the coal stockpile (caused by spontaneous combustion) and spread until cooled, never loading hot coal into the pulverized fuel system;
- Use of automated systems such as temperature gauges or carbon monoxide sensors to survey solid fuel storage areas to detect fires caused by self-ignition and to identify risk points.

Chemical Hazards

Thermal power plants utilize hazardous materials, including ammonia for NO_X control systems, and chlorine gas for treatment of cooling tower and boiler water. Guidance on chemical hazards management is provided in Section 2.4 of the General EHS Guidelines. Additional, recommended measures to prevent, minimize, and control physical hazards at thermal power plants include:

- Consider generation of ammonia on site from urea or use of aqueous ammonia in place of pure liquefied ammonia;
- Consider use of sodium hypochlorite in place of gaseous chlorine.

Dust

Dust is generated in handing solid fuels, additives, and solid wastes (e.g., ash). Dust may contain silica (associated with silicosis), arsenic (skin and lung cancer), coal dust (black lung), and other potentially harmful substances. Dust management guidance is provided in the Section 2.1 and 2.4 of the General EHS Guidelines. Recommended measures to prevent, minimize, and control occupational exposure to dust in thermal power plants include:

- Use of dust controls (e.g., exhaust ventilation) to keep dust below applicable guidelines (see Section 2) or wherever free silica levels in airborne dust exceed 1 percent;
- Regular inspection and maintenance of asbestos containing materials (e.g., insulation in older plants may contain asbestos) to prevent airborne asbestos particles.

1.3 Community Health and Safety

Many community health and safety impacts during the construction, operation, and decommissioning of thermal power plant projects are common to those of most infrastructure and industrial facilities and are discussed in Section 3.0 the General EHS Guidelines. In addition to these and other aspects covered in Section 1.1, the following community health and safety impacts may be of particular concern for thermal power plant projects:

- Water Consumption;
- Traffic Safety.

Water Consumption

Boiler units require large amounts of cooling water for steam condensation and efficient thermal operation. The cooling water flow rate through the condenser is by far the largest process water flow, normally equating to about 98 percent of the total process water flow for the entire unit. In a once-through cooling water system, water is usually taken into the plant from surface waters, but sometimes ground waters or municipal supplies are used. The potential effects of water use should be assessed, as discussed in Section 3.1 of the General EHS Guidelines, to

ensure that the project does not compromise the availability of water for personal hygiene, agriculture, recreation, and other community needs.

Traffic Safety

Operation of a thermal power plant will increase traffic volume, in particular for facilities with fuels transported via land and sea, including heavy trucks carrying fuel, additives, etc. The increased traffic can be especially significant in sparsely populate areas where some thermal power plants are located. Prevention and control of traffic-related injuries are discussed in Section 3.4 of the General EHS Guidelines. Water transport safety is covered in the EHS Guidelines for Shipping.

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

Effluent guidelines are described in Table 5. Emissions guidelines are described in Table 6. Effluent guidelines are applicable for direct discharges of treated effluents to surface waters for general use. Site-specific discharge levels may be established based on the availability and conditions in the use of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in the General EHS Guideline. Guideline values for process emissions and effluents in this sector are indicative of good international industry practice as reflected in standards of countries with recognized regulatory frameworks. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. Deviation from these levels due to specific local project conditions should be justified in the environmental assessment.

Table 5 - Effluent Guidelines
(To be applicable at relevant wastewater stream: e.g., from FGD system, wet ash transport, washing boiler / air preheater and precipitator, boiler acid washing, regeneration of demineralizers and condensate polishers, oil-separated water, site drainage, coal pile runoff, and cooling water)

Parameter	mg/L, except pH and temp
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium - Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1.0
Zinc (Zn)	1.0
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

Note: Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants.

Emissions levels for the design and operation of each project should be established through the EA process on the basis of country legislation and the recommendations provided in this guidance document, as applied to local conditions. The emissions levels selected should be justified in the EA.[30] The maximum emissions levels given here can be consistently achieved by well-designed, well-operated, and well-maintained pollution control systems. In contrast, poor operating or maintenance procedures affect actual pollutant removal efficiency and may reduce it to well

[30] For example, in cases where potential for acid deposition has been identified as a significant issue in the EA, plant design and operation should ensure that emissions mass loadings are effectively reduced to prevent or minimize such impacts.

below the design specification. Dilution of air emissions to achieve these guidelines is unacceptable. Compliance with ambient air quality guidelines should be assessed on the basis of good international industry practice (GIIP) recommendations.

As described in the General EHS Guidelines, emissions should not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards[31] by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[32], or other internationally recognized sources[33]. Also, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed. [34]

As described in the General EHS Guidelines, facilities or projects located within poor quality airsheds[35], and within or next to areas established as ecologically sensitive (e.g., national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment.

Environmental Monitoring

Environmental monitoring programs for this sector are presented in Table 7. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Examples of emissions, stack testing, ambient air quality, and noise monitoring recommendations applicable to power plants are provided in Table 7. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the General EHS Guidelines.

[31] Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization).

[32] Available at World Health Organization (WHO). http://www.who.int/en

[33] For example the United States National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/air/criteria.html) and the relevant European Council Directives (Council Directive 1999/30/EC of 22 April 1999 / Council Directive 2002/3/EC of February 12 2002).

[34] US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds.

[35] An airshed should be considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly.

Table 6 (A) - Emissions Guidelines (in mg/Nm³ or as indicated) for Reciprocating Engine

Note:

- Guidelines are applicable for new facilities.
- EA may justify more stringent or less stringent limits due to ambient environment, technical and economic considerations provided there is compliance with applicable ambient air quality standards and incremental impacts are minimized.
- For projects to rehabilitate existing facilities, case-by-case emission requirements should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) cost and technical feasibility of bringing the existing emission levels to meet these new facilities limits.
- EA should demonstrate that emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards, and more stringent limits may be required.

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)		Dry Gas, Excess O_2 Content (%)
Reciprocating Engine	NDA	DA	NDA	DA	NDA	DA	
Natural Gas	N/A	N/A	N/A	N/A	200 (Spark Ignition) 400 (Dual Fuel) (a)	200(SI) 400 (Dual Fuel / CI)	15%
Liquid Fuels (Plant >50 MWth to <300 MWth)	50	30	1,170 or use of 2% or less S fuel	0.5% S	1,460 (Compression Ignition, bore size diameter [mm] < 400) 1,850 (Compression Ignition, bore size diameter [mm] ≥ 400) 2,000 (Dual Fuel)	400	15%
Liquid Fuels (Plant >/=300 MWth)	50	30	585 or use of 1% or less S fuel	0.2% S	740 (contingent upon water availability for injection)	400	15%
Biofuels / Gaseous Fuels other than Natural Gas	50	30	N/A	N/A	30% higher limits than those provided above for Natural Gas and Liquid Fuels.	200 (SI, Natural Gas), 400 (other)	15%

General notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; S = sulfur content (expressed as a percent by mass); Nm³ is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack. Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- (a) Compression Ignition (CI) engines may require different emissions values which should be evaluated on a case-by-case basis through the EA process.

Comparison of the Guideline limits with standards of selected countries / region (as of August 2008):

- Natural Gas-fired Reciprocating Engine – NOx
  - Guideline limits: 200 (SI), 400 (DF)
  - UK: 100 (CI) , US: Reduce by 90% or more, or alternatively 1.6 g/kWh
- Liquid Fuels-fired Reciprocating Engine – NOx (Plant >50 MWth to <300 MWth)
  - Guideline limits: 1,460 (CI, bore size diameter < 400 mm), 1,850 (CI, bore size diameter ≥ 400 mm), 2,000 (DF)
  - UK: 300 (> 25 MWth), India: 1,460 (Urban area & ≤ 75 MWe (≈ 190 MWth), Rural area & ≤ 150 MWe (≈ 380 MWth))
- Liquid Fuels-fired Reciprocating Engine – NOx (Plant ≥300 MWth)
  - Guideline limits: 740 (contingent upon water availability for injection)
  - UK: 300 (> 25 MWth), India: 740 (Urban area & > 75MWe (≈ 190 MWth), Rural area & > 150 MWe (≈ 380 MWth))
- Liquid Fuels-fired Reciprocating Engine – SO2
  - Guideline limits: 1,170 or use of ≤ 2% S (Plant >50 MWth to <300 MWth), 585 or use of ≤ 1% S (Plant ≥300 MWth)
  - EU: Use of low S fuel oil or the secondary FGD (IPCC LCP BREF), HFO S content ≤ 1% (Liquid Fuel Quality Directive), US: Use of diesel fuel with max S of 500 ppm (0.05%); EU: Marine HFO S content ≤ 1.5% (Liquid Fuel Quality Directive) used in SOx Emission Control Areas; India: Urban (< 2% S), Rural (< 4%S), Only diesel fuels (HSD, LDO) should be used in Urban

Source: UK (S2 1.03 Combustion Processes: Compression Ignition Engines, 50 MWth and over), India (SOx/NOx Emission Standards for Diesel Engines ≥ 0.8 MW), EU (IPCC LCP BREF July 2006), EU (Liquid Fuel Quality Directive 1999/32/EC amended by 2005/33/EC), US (NSPS for Stationary Compression Ignition Internal Combustion Engine – Final Rule – July 11, 2006)

Table 6 (B) - Emissions Guidelines (in mg/Nm^3 or as indicated) for Combustion Turbine

Note:

- Guidelines are applicable for new facilities.
- EA may justify more stringent or less stringent limits due to ambient environment, technical and economic considerations provided there is compliance with applicable ambient air quality standards and incremental impacts are minimized.
- For projects to rehabilitate existing facilities, case-by-case emission requirements should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) cost and technical feasibility of bringing the existing emission levels to meet these new facilities limits.
- EA should demonstrate that emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards, and more stringent limits may be required.

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)	Dry Gas, Excess O_2 Content (%)
Combustion Turbine			NDA/DA		NDA/DA	
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	N/A	N/A	51 (25 ppm)	15%
Fuels other than Natural Gas (Unit > > 50MWth)	50	30	Use of 1% or less S fuel	Use of 0.5% or less S fuel	152 (74 ppm)[a]	15%

General notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; S = sulfur content (expressed as a percent by mass); Nm^3 is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to single units; Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- If supplemental firing is used in a combined cycle gas turbine mode, the relevant guideline limits for combustion turbines should be achieved including emissions from those supplemental firing units (e.g., duct burners).
- (a) Technological differences (for example the use of Aeroderivatives) may require different emissions values which should be evaluated on a cases-by-case basis through the EA process but which should not exceed 200 mg/Nm3.

Comparison of the Guideline limits with standards of selected countries / region (as of August 2008):

- Natural Gas-fired Combustion Turbine – NOx
  - Guideline limits: 51 (25 ppm)
  - EU: 50 (24 ppm), 75 (37 ppm) (if combined cycle efficiency > 55%), 50*η / 35 (where η = simple cycle efficiency)
  - US: 25 ppm (> 50 MMBtu/h (≈ 14.6 MWth) and ≤ 850 MMBtu/h (≈ 249MWth)), 15 ppm (> 850 MMBtu/h (≈ 249 MWth))
  - (Note: further reduced NOx ppm in the range of 2 to 9 ppm is typically required through air permit)
- Liquid Fuel-fired Combustion Turbine – NOx
  - Guideline limits: 152 (74 ppm) – Heavy Duty Frame Turbines & LFO/HFO, 300 (146 ppm) – Aeroderivatives & HFO, 200 (97 ppm) – Aeroderivatives & LFO
  - EU: 120 (58 ppm), US: 74 ppm (> 50 MMBtu/h (≈ 14.6 MWth) and ≤ 850 MMBtu/h (≈ 249MWth)), 42 ppm (> 850 MMBtu/h (≈ 249 MWth))
- Liquid Fuel-fired Combustion Turbine – SOx
  - Guideline limits: Use of 1% or less S fuel
  - EU: S content of light fuel oil used in gas turbines below 0.1% / US: S content of about 0.05% (continental area) and 0.4% (non-continental area)

Source: EU (LCP Directive 2001/80/EC October 23 2001), EU (Liquid Fuel Quality Directive 1999/32/EC, 2005/33/EC), US (NSPS for Stationary Combustion Turbines, Final Rule – July 6, 2006)

Table 6 (C) - Emissions Guidelines (in mg/Nm^3 or as indicated) for Boiler

Note:

- Guidelines are applicable for new facilities.
- EA may justify more stringent or less stringent limits due to ambient environment, technical and economic considerations provided there is compliance with applicable ambient air quality standards and incremental impacts are minimized.
- For projects to rehabilitate existing facilities, case-by-case emission requirements should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) cost and technical feasibility of bringing the existing emission levels to meet these new facilities limits.
- EA should demonstrate that emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards, and more stringent limits may be required.

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)		Dry Gas, Excess O_2 Content (%)
Boiler	NDA	DA	NDA	DA	NDA	DA	
Natural Gas	N/A	N/A	N/A	N/A	240	240	3%
Other Gaseous Fuels	50	30	400	400	240	240	3%
Liquid Fuels (Plant >50 MWth to <600 MWth)	50	30	900 – 1,500[a]	400	400	200	3%
Liquid Fuels (Plant >/=600 MWth)	50	30	200 – 850[b]	200	400	200	3%
Solid Fuels (Plant >50 MWth to <600 MWth)	50	30	900 – 1,500[a]	400	510[c] Or up to 1,100 if volatile matter of fuel < 10%	200	6%
Solid Fuels (Plant >/=600 MWth)	50	30	200 – 850[b]	200			6%

General notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; CFB = circulating fluidized bed coal-fired; PC = pulverized coal-fired; Nm^3 is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack. Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- a. Targeting the lower guidelines values and recognizing issues related to quality of available fuel, cost effectiveness of controls on smaller units, and the potential for higher energy conversion efficiencies (FGD may consume between 0.5% and 1.6% of electricity generated by the plant). b. Targeting the lower guidelines values and recognizing variability in approaches to the management of SO_2 emissions (fuel quality vs. use of secondary controls) and the potential for higher energy conversion efficiencies (FGD may consume between 0.5% and 1.6% of electricity generated by the plant). Larger plants are expected to have additional emission control measures. Selection of the emission level in the range is to be determined by EA considering the project's sustainability, development impact, and cost-benefit of the pollution control performance. c. Stoker boilers may require different emissions values which should be evaluated on a case-by-case basis through the EA process.

Comparison of the Guideline limits with standards of selected countries / region (as of August 2008):

- Natural Gas-fired Boiler – NOx
  - Guideline limits: 240
  - EU: 150 (50 to 300 MWth), 200 (> 300 MWth)
- Solid Fuels-fired Boiler - PM
  - Guideline limits: 50
  - EU: 50 (50 to 100 MWth), 30 (> 100 MWth), China: 50, India: 100 - 150
- Solid Fuels-fired Boiler – SO_2
  - Guideline limits: 900 – 1,500 (Plant > 50 MWth to < 600 MWth), 200 – 850 (Plant ≥ 600 MWth)
  - EU: 850 (50 – 100 MWth), 200 (> 100 MWth)
  - US: 180 ng/J gross energy output OR 95% reduction (≈ 200 mg/Nm3 at 6%O_2 assuming 38% HHV efficiency)
  - China: 400 (general), 800 (if using coal < 12,550 kJ/kg), 1,200 (if mine-mouth plant located in non-double control area of western region and burning low S coal (<0.5%))

Source: EU (LCP Directive 2001/80/EC October 23 2001), US (NSPS for Electric Utility Steam Generating Units (Subpart Da), Final Rule – June 13, 2007), China (GB 13223-2003)

Table 7 – Typical Air Emission Monitoring Parameters / Frequency for Thermal Power Plants
(Note: Detailed monitoring programs should be determined based on EA)

Combustion Technology / Fuel	Emission Monitoring			Stack Emission Testing				Ambient Air Quality	Noise
	Particulate Matter (PM)	Sulfur Dioxide (SO_2)	Nitrogen Oxides (NOx)	PM	SO_2	NOx	Heavy Metals		
Reciprocating Engine								If incremental impacts predicted by EA >/= 25 % of relevant short-term ambient air quality standards or if the plant >/= 1,200 MWth: - Monitor parameters (e.g., $PM_{10}/PM_{2.5}/SO_2$/NOx to be consistent with the relevant ambient air quality standards) by continuous ambient air quality monitoring system (typically a minimum of 2 systems to cover predicted maximum ground level concentration point / sensitive receptor / background point). If incremental impacts predicted by EA < 25% of relevant short term ambient air quality standards and if the facility < 1,200 MWth but >/= 100 MWth - Monitor parameters either by passive samplers (monthly average) or by seasonal manual sampling (e.g., 1 weeks/season) for parameters consistent with the relevant air quality standards. Effectiveness of the ambient air quality monitoring program should be reviewed regularly. It could be simplified or reduced if alternative program is developed (e.g., local government's monitoring network). Continuation of the program is recommended during the life of the project if there are sensitive receptors or if monitored levels are not far below the relevant ambient air quality standards.	If EA predicts noise levels at residential receptors or other sensitive receptors are close to the relevant ambient noise standards / guidelines, or if there are such receptors close to the plant boundary (e.g., within 100m) then, conduct ambient noise monitoring every year to three years depending on the project circumstances. Elimination of noise monitoring can be considered acceptable if a comprehensive survey showed that there are no receptors affected by the project or affected noise levels are far below the relevant ambient noise standards / guidelines.
Natural Gas (Plant >50 MWth to <300 MWth)	N/A	N/A	Continuous or indicative	N/A	N/A	Annual	N/A		
Natural Gas (Plant >/= 300 MWth)	N/A	N/A	Continuous	N/A	N/A	Annual	N/A		
Liquid (Plant >50 MWth to <300 MWth)	Continuous or indicative	Continuous if FGD is used or monitor by S content.	Continuous or indicative	Annual					
Liquid (Plant >/=300 MWth)	Continuous or indicative		Continuous						
Biomass	Continuous or indicative	N/A	Continuous or indicative	Annual	N/A	Annual	N/A		
Combustion Turbine									
Natural Gas (all turbine types of Unit > 50MWth)	N/A	N/A	Continuous or indicative	N/A	N/A	Annual	N/A		
Fuels other than Natural Gas (Unit > 50MWth)	Continuous or indicative	Continuous if FGD is used or monitor by S content.	Continuous or indicative	Annual					
Boiler									
Natural Gas	N/A	N/A	Continuous or indicative	N/A	N/A	Annual	N/A		
				Annual	Annual	Annual	N/A		
Other Gaseous fuels	Indicative	Indicative	Continuous or indicative	Annual					
Liquid (Plant >50 MWth to <600 MWth)	Continuous or indicative	Continuous if FGD is used or monitor by S content.	Continuous or indicative						
Liquid (Plant >=600 MWth)		Continuous							
Solid (Plant >50 MWth to <600 MWth)		Continuous if FGD is used or monitor by S Content.	Continuous or indicative						
Solid (Plant >/=600 MWth)		Continuous							

Note: Continuous or indicative means "Continuously monitor emissions or continuously monitor indicative parameters". Stack emission testing is to have direct measurement of emission levels to counter check the emission monitoring system.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[36] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[37] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[38] Indicative Occupational Exposure Limit Values published by European Union member states,[39] or other similar sources.

Additional indicators specifically applicable to electric power sector activities include the ICNIRP exposure limits for occupational exposure to electric and magnetic fields listed in Table 8. Additional applicable indicators such as noise, electrical hazards, air quality, etc. are presented in Section 2.0 of the General EHS Guidelines.

Table 8 - ICNIRP exposure limits for occupational exposure to electric and magnetic fields.

Frequency	Electric Field (V/m)	Magnetic Field (μT)
50 Hz	10,000	500
60 Hz	8300	415

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. The accident and fatality rates of the specific facility may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g., US Bureau of Labor Statistics and UK Health and Safety Executive)[40].

Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals[41] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the General EHS Guidelines.

[36] http://www.acgih.org/TLV/[36] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/

[37] Available at: http://www.cdc.gov/niosh/npg/

[38] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992

[39] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/

[40] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm

[41] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

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Annex A: General Description of Industry Activities

Thermal power plants burn fossil fuels or biomass to generate electrical energy and heat. Mechanical power is produced by a heat engine, which transforms thermal energy from combustion of a fossil fuel into rotational energy. A generator converts that mechanical energy into electrical energy by creating relative motion between a magnetic field and a conductor. Figure A-1 is a generalized flow diagram of a boiler-based thermal power plant and its associated operations.

Not all thermal energy can be transformed to mechanical power, according to the second law of thermodynamics. Therefore, thermal power plants also produce low-temperature heat. If no use is found for the heat, it is lost to the environment. If reject heat is employed as useful heat (e.g., for industrial processes or district heating), the power plant is referred to as a cogeneration power plant or CHP (combined heat-and-power) plant.

Types of Thermal power plants

Thermal power plants can be divided based on the type of combustion or gasification: boilers, internal reciprocating engines, and combustion turbines. In addition, combined-cycle and cogeneration systems increase efficiency by utilizing heat lost by conventional combustion systems. The type of system is chosen based on the loads, the availability of fuels, and the energy requirements of the electric power generation facility. Other ancillary processes, such as coal processing and pollution control, must also be performed to support the generation of electricity. The following subsections describe each system and then discuss ancillary processes at the facility (USEPA 1997).

Boilers (Steam Turbines)

Conventional steam-producing thermal power plants generate electricity through a series of energy conversion stages: fuel is burned in boilers to convert water to high-pressure steam, which is then used to drive a steam turbine to generate electricity. Heat for the system is usually provided by the combustion of coal, natural gas, oil, or biomass as well as other types of waste or recovered fuel. High-temperature, high-pressure steam is generated in the boiler and then enters the steam turbine. At the other end of the steam turbine is the condenser, which is maintained at a low temperature and pressure. Steam rushing from the high-pressure boiler to the low-pressure condenser drives the turbine blades, which powers the electric generator.

Low-pressure steam exiting the turbine enters the condenser shell and is condensed on the condenser tubes, which are maintained at a low temperature by the flow of cooling water. As the steam is cooled to condensate, the condensate is transported by the boiler feedwater system back to the boiler, where it is used again. A constant flow of low-temperature cooling water in the condenser tubes is required to keep the condenser shell (steam side) at proper pressure and to ensure efficient electricity generation. Through the condensing process, the cooling water is warmed. If the cooling system is an open or a once-through system, this warm water is released back to the source water body.[42] In a closed system, the warm water is cooled by recirculation through cooling towers, lakes, or ponds, where the heat is released into the air through evaporation and/or sensible heat transfer. If a recirculating cooling system is used, only a relatively small amount of make-up water is required to offset the evaporative losses and cooling tower blowdown that must be discharged periodically to control the build-up of solids. A recirculating system uses about one-twentieth the water of a once-through system.

Steam turbines typically have a thermal efficiency of about 35 percent, meaning that 35 percent of the heat of combustion is transformed into electricity. The remaining 65 percent of the heat either goes up the stack (typically 10 percent) or is

[42] If groundwater is used for cooling, the cooling water is usually discharged to a

discharged with the condenser cooling water (typically 55 percent).

Coal and lignite are the most common fuels in thermal power plants although heavy fuel oil is also used. Coal-fired steam generation systems are designed to use pulverized coal or crushed coal. Several types of coal-fired steam generators are in use, and are generally classified based on the characteristics of the coal fed to the burners and the mode of burning the coal. In fluidized-bed combustors, fuel materials are forced by gas into a state of buoyancy. The gas cushion between the solids allows the particles to move freely, thus flowing like a liquid. By using this technology, SO_2 and NO_X emissions are reduced because an SO_2 sorbent, such as limestone, can be used efficiently. Also, because the operating temperature is low, the amount of NO_X gases formed is lower than those produced using conventional technology.

Natural gas and liquid fuels are usually transported to thermal power plants via pipelines. Coal and biomass fuels can be transported by rail, barge, or truck. In some cases, coal is mixed with water to form slurry that can be pumped to the thermal power plant in a pipeline. Once coal arrives at the plant, it is unloaded to storage or directly to the stoker or hopper. In transporting coal during warmer months and in dry climates, dust suppression may be necessary.

Coal may be cleaned and prepared before being either crushed or pulverized. Impurities in coal such as ash, metals, silica, and sulfur can cause boiler fouling and slagging. Coal cleaning can be used to reduce sulfur in the coal to meet sulfur dioxide (SO_2) emissions regulations and also reduce ash content and the amount of heavy metals. Cleaning the coal is costly, but the cost can be at least partially offset by an increase in fuel efficiency, reduced emission control requirements, and lower waste management costs. Coal cleaning is typically performed at the mine by using gravity concentration, flotation, or dewatering methods.

Coal is transported from the coal bunker or silo to be crushed, ground, and dried further before it is fired in the burner or combustion system. Many mechanisms can be used to grind the coal and prepare it for firing. Pulverizers, cyclones, and stokers are all used to grind and dry the coal. Increasing the coal's particle surface area and decreasing its moisture content greatly boosting its heating capacity. Once prepared, the coal is transported within the plant to the combustion system. Devices at the bottom of the boilers catch ash and/or slag.

Reciprocating Engines

Internal combustion engines convert the chemical energy of fuels (typically diesel fuel or heavy fuel oil) into mechanical energy in a design similar to a truck engine, and the mechanical energy is used to turn a generator. Two types of engines normally used: the medium-speed, four-stroke trunk piston engine and the low-speed, two-stroke crosshead engine. Both types of engine operate on the air-standard diesel thermodynamic cycle. Air is drawn or forced into a cylinder and is compressed by a piston. Fuel is injected into the cylinder and is ignited by the heat of the compression of the air. The burning mixture of fuel and air expands, pushing the piston. The products of combustion are then removed from the cylinder, completing the cycle.

The exhaust gases from an engine are affected by the load profile of the prime mover; ambient conditions such as air humidity and temperature; fuel oil quality, such as sulfur content, nitrogen content, viscosity, ignition ability, density, and ash content; and site conditions and the auxiliary equipment associated with the prime mover, such as cooling properties and exhaust gas back pressure. The engine parameters that affect NO_X emissions are fuel injection in terms of timing, duration, and atomization; combustion air conditions, which are affected by

surface water body.

valve timing, the charge air system, and charge air cooling before cylinders; and the combustion process, which is affected by air and fuel mixing, combustion chamber design, and the compression ratio.[43] The particulate matter emissions are dependent on the general conditions of the engine, especially the fuel injection system and its maintenance, in addition to the ash content of the fuel, which is in the range 0.05–0.2%. SOx emissions are directly dependent on the sulfur content of the fuel. Fuel oil may contain as little as 0.3% sulfur and, in some cases, up to 5% sulfur.

Diesel engines are fuel flexible and can use fuels such as diesel oil, heavy fuel oil, natural gas, crude oil, bio-fuels (such as palm oil, etc.) and emulsified fuels (such as Orimulsion, etc.).

Typical electrical efficiencies in single mode are typically ranging from 40 % for the medium speed engines up to about 50 % for large engines and even higher efficiencies in combined cycle mode. Total efficiency in CHP (Combined Heat and Power) is typically in liquid operation up to 60 – 80 % and in gas mode even higher dependent on the application. The heat to power ratio is typically 0.5 to 1.3 in CHP applications, dependent on the application.

Lean Burn Gas Engines

Typical electrical efficiencies for bigger stationary medium speed engines in single mode are typically 40 – 47 % and up to close to 50 % in combined cycle mode. Total efficiency in CHP facilities is typically up to 90 % dependent on the application. The heat to power ratios are typically 0.5 to 1.3 in CHP-applications, dependent on the application.

Spark Ignition (SG)

Often a spark ignited gas-otto engine works according to the lean burn concept meaning that a lean mixture of combustion air and fuel is used in the cylinder (e.g., much more air than needed for the combustion). In order to stabilize the ignition and combustion of the lean mixture, in bigger engine types a prechamber with a richer air/fuel mixture is used. The ignition is initiated with a spark plug or some other device located in the prechamber, resulting in a high-energy ignition source for the main fuel charge in the cylinder. The most important parameter governing the rate of NOx formation in internal combustion engines is the combustion temperature; the higher the temperature the higher the NOx content of the exhaust gases. One method is to lower the fuel/air ratio, the same specific heat quantity released by the combustion of the fuel is then used to heat up a larger mass of exhaust gases, resulting in a lower maximum combustion temperature. This method low fuel/air ratio is called lean burn and it reduces NOx effectively. The spark-ignited lean-burn engine has therefore low NOx emissions. This is a pure gas engine; it operates only on gaseous fuels.

Dual fuel engines (DF)

Some DF engine types are fuel versatile, these can be run on low pressure natural gas or liquid fuels such as diesel oil (as back-up fuel, etc.), heavy fuel oil, etc. This engine type can operate at full load in both fuel modes. Dual Fuel (DF) engines can also be designed to work in gas mode only with a pilot liquid fuel used for ignition of the gas.

Combustion Turbines

Gas turbine systems operate in a manner similar to steam turbine systems except that combustion gases are used to turn the turbine blades instead of steam. In addition to the electric generator, the turbine also drives a rotating compressor to pressurize the air, which is then mixed with either gas or liquid

[43] If the fuel timing is too early, the cylinder pressure will increase, resulting in higher nitrogen oxide formation. If injection is timed too late, fuel consumption and turbocharger speed will increase. NO_X emissions can be reduced by later injection timing, but then particulate matter and the amount of unburned species will increase.

fuel in a combustion chamber. The greater the compression, the higher the temperature and the efficiency that can be achieved in a gas turbine. Higher temperatures, however, typically lead to increases in NO_X emissions. Exhaust gases are emitted to the atmosphere from the turbine. Unlike a steam turbine system, gas turbine systems do not have boilers or a steam supply, condensers, or a waste heat disposal system. Therefore, capital costs are much lower for a gas turbine system than for a steam system.

In electrical power applications, gas turbines are often used for peaking duty, where rapid startup and short runs are needed. Most installed simple gas turbines with no controls have only a 20- to 30-percent efficiency.

Combined Cycle

Combined-cycle generation is a configuration using both gas turbines and steam generators. In a combined-cycle gas turbine (CCGT), the hot exhaust gases of a gas turbine are used to provide all, or a portion of, the heat source for the boiler, which produces steam for the steam generator turbine. This combination increases the thermal efficiency to approximately 50 - 60 percent. Combined-cycle systems may have multiple gas turbines driving one steam turbine. Combined-cycle systems with diesel engines and steam generators are also sometimes used.

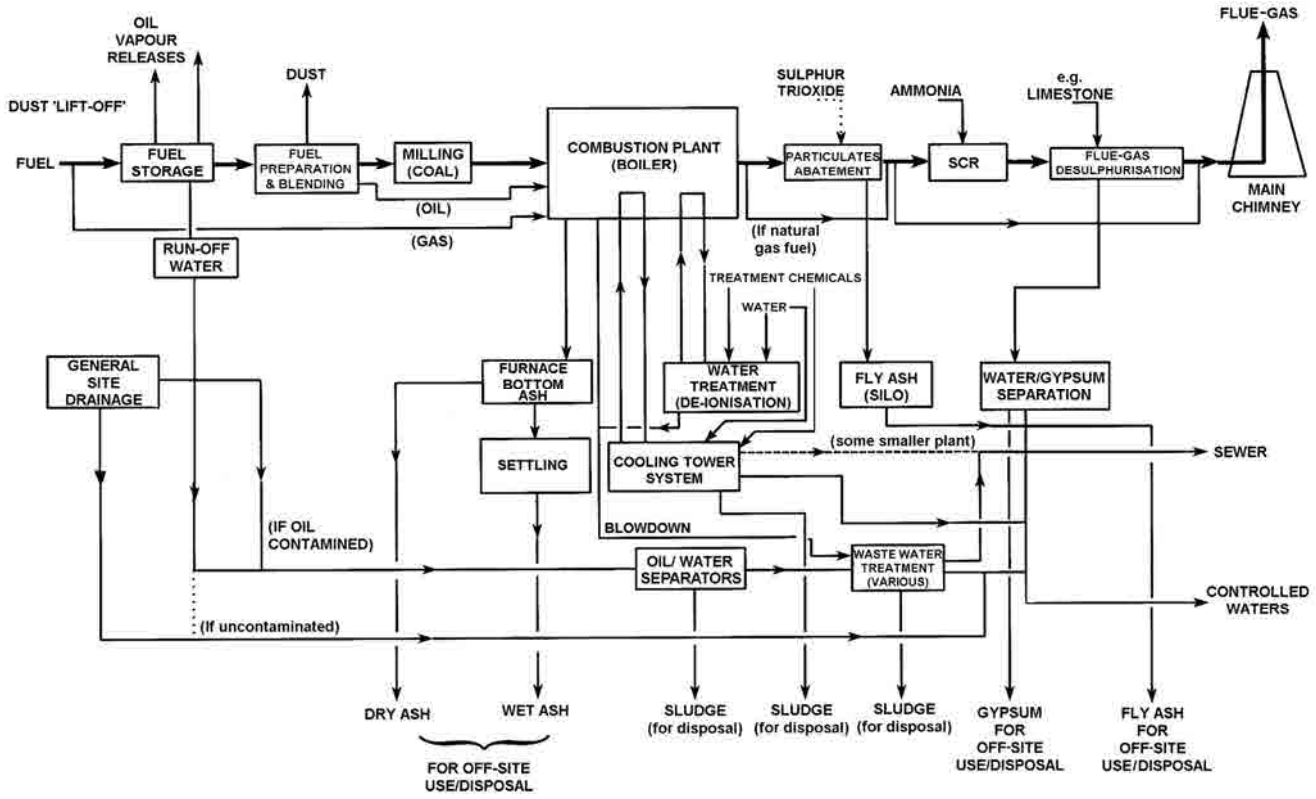
In addition, integrated coal gasification combined-cycle (IGCC) units are emerging technologies. In an IGCC system, coal gas is manufactured and cleaned in a "gasifier" under pressure, thereby reducing emissions and particulates.[44] The coal gas then is combusted in a CCGT generation system.

Cogeneration

Cogeneration is the merging of a system designed to produce electric power and a system used for producing industrial heat and steam and/or municipal heating. This system is a more efficient way of using energy inputs and allows the recovery of otherwise wasted thermal energy for use in an industrial process. Cogeneration technologies are classified as "topping cycle" and "bottoming cycle" systems, depending on whether electrical (topping cycle) or thermal (bottoming cycle) energy is derived first. Most cogeneration systems use a topping cycle.

[44] Gasification is a process in which coal is introduced to a reducing atmosphere with oxygen or air and steam.

Figure A-1
Generalized Flow Diagram of a Thermal power plant[45] and Associated Operations



Source: EC 2006

[45] Applicable to boiler plant with cooling tower only. Diagram does not apply to engines and turbines which have completely different configurations.

Annex B: Environmental Assessment Guidance for Thermal Power Projects

The development of an environmental assessment (EA) for a thermal power project should take into account any government energy and/or environmental policy or strategy including strategic aspects such as energy efficiency improvements in existing power generation, transmission, and distribution systems, demand side management, project siting, fuel choice, technology choice, and environmental performance.

New Facilities and Expansion of Existing Facilities

An (EA) for new facilities and a combined EA and environmental audit for existing facilities should be carried out early in the project cycle in order to establish site-specific emissions requirements and other measures for a new or expanded thermal power plant. Table B-1 provides suggested key elements of the EA, the scope of which will depend on project-specific circumstances.

Table B-1 Suggested Key EHS Elements for EA of New Thermal Power Project

Analysis of Alternatives	• Fuel selection including non-fossil fuel options (coal, oil, gas, biomass, other renewable options – wind, solar, geothermal, hydro), fuel supply sources • Power generation technology o Thermal generating efficiency (HHV-gross, LHV-gross, HHV-net, LHV-net) o Cost o CO_2 emissions performance (gCO2/kWh) • GHG emissions reduction / offset options o Energy conversion efficiency o Offset arrangement o Use of renewable energy sources, etc. • Baseline water quality of receiving water bodies • Water supply o Surface water, underground water, desalination • Cooling system o Once-through, wet closed circuit, dry closed circuit • Ash disposal system - wet disposal vs. dry disposal • Pollution control o Air emission – primary vs. secondary flue gas treatment (cost, performance) o Effluent (cost, performance) • Effluent discharge o Surface water o Evaporation o Recycling – zero discharge • Siting o Land acquisition consideration o Access to fuel / electricity grid o Existing and future land use zoning o Existing and predicted environmental baseline (air, water, noise)
Impact Assessment	• Estimation of GHG emissions (tCO_2/year, gCO_2/kWh) • Air quality impact o SO_2, NO_2, PM_{10}, $PM_{2.5}$, Heavy metals as appropriate, Acid deposition if relevant o Incremental impacts to the attainment of relevant air quality standards o Isopleth concentration lines (short-term, annual average, as appropriate) overlaid with land use and topographic map o Cumulative impacts of existing sources / future projects if known o Stack height determination o Health impact consideration • Water quality / intake impact o thermal discharge if once-through cooling system is used o other key contaminants as appropriate o water intake impact • Noise impact o Noise contour lines overlaid with land use and locations of receptors • Determination of pollution prevention and abatement measures
Mitigation Measures /	• Air (Stack height, pollution control measures, cost)

Management Program	• Effluent (wastewater treatment measures, cost) • Noise (noise control measures, cost) • Waste utilization / disposal (e.g., ash, FGD by-product, used oil) o Ash management plan (quantitative balance of ash generation, disposal, utilization, size of ash disposal site, ash transportation arrangement) • Fuel supply arrangement • Emergency preparedness and response plan • Industrial risk assessment if relevant
Monitoring Program	• Parameters • Sampling Frequency • Evaluation Criteria • Sampling points overlaid with relevant site layout / surrounding maps • Cost

Tasks related to carrying out the quality impact analysis for the EA should include:

- Collection of baseline data ranging from relatively simple qualitative information (for smaller projects) to more comprehensive quantitative data (for larger projects) on ambient concentrations of parameters and averaging time consistent with relevant host country air quality standards (e.g., parameters such as PM_{10}, $PM_{2.5}$, SO_2 (for oil and coal-fired plants), NO_X, and ground-level ozone; and averaging time such as 1-hour maximum, 24-hour maximum, annual average), within a defined airshed encompassing the proposed project;[46]
- Evaluation of the baseline airshed quality (e.g., degraded or non-degraded);
- Evaluation of baseline water quality, where relevant;
- Use of appropriate mathematical or physical air quality dispersion models to estimate the impact of the project on the ambient concentrations of these pollutants;
- If acid deposition is considered a potentially significant impact, use of appropriate air quality models to evaluate long-range and trans-boundary acid deposition;
- The scope of baseline data collection and air quality impact assessment will depend on the project circumstances (e.g., project size, amount of air emissions and the potential impacts on the airshed). Examples of suggested practices are presented in Table B-2.

Table B-2 - Suggested Air Quality Impact Assessment Approach

Baseline air quality collection	• Qualitative information (for small projects e.g., < 100MWth) • Seasonal manual sampling (for mid-sized projects e.g., < 1,200MWth) • Continuous automatic sampling (for large projects e.g., >= 1,200MWth) • Modeling existing sources
Baseline meteorological data collection	• Continuous one-year data for dispersion modeling from nearby existing meteorological station (e.g., airport, meteorological station) or site-specific station, if installed, for mid-sized and large projects
Evaluation of airshed quality	• Determining if the airshed is degraded (i.e., ambient air quality standards are not attained) or non-degraded (i.e., ambient air quality standards are attained)
Air quality impact assessment	• Assess incremental and resultant levels by screening models (for small projects) • Assess incremental and resultant levels by refined models (for mid-sized and large projects, or for small projects if determined necessary after using screening models)[47] • Modify emission levels, if needed, to ensure that incremental impacts are small (e.g., 25% of relevant ambient air quality standard levels) and that the airshed will not become degraded.

[46] The term "airshed" refers to the local area around the plant whose ambient air quality is directly affected by emissions from the plant. The size of the relevant local airshed will depend on plant characteristics, such as stack height, as well as on local meteorological conditions and topography. In some cases, airsheds are defined in legislation or by the relevant environmental authorities. If not, the EA should clearly define the airshed on the basis of consultations with those responsible for local environmental management.

[47] For further guidance on refined / screening models, see Appendix W to Part 51 – Guidelines on Air Quality Models by US EPA (Final Rule, November 9, 2005)

When there is a reasonable likelihood that in the medium or long term the power plant will be expanded or other pollution sources will increase significantly, the analysis should take account of the impact of the proposed plant design both immediately and after any formally planned expansion in capacity or in other sources of pollution. Plant design should allow for future installation of additional pollution control equipment, should this prove desirable or necessary based upon predicted air quality impacts and/or anticipated changes in emission standards (i.e., impending membership into the EU). The EA should also address other project-specific environmental concerns, such as fuel and emissions from fuel impurities. In cases where fuel impurities lead to known hazardous emissions, the EA should estimate the emission amount, assess impacts and propose mitigations to reduce emissions.[48] Examples of compounds which may be present in certain types of coal, heavy fuel oil, petroleum coke, etc. include cadmium, mercury, and other heavy metals.

Rehabilitation of Existing Facilities

An environmental assessment of the proposed rehabilitation should be carried out early in the process of preparing the project in order to allow an opportunity to evaluate alternative rehabilitation options before key design decisions are finalized. The assessment should include an environmental audit that examines the impacts of the existing plant's operations on nearby populations and ecosystems, supplemented by an EA that examines the changes in these impacts that would result under alternative specifications for the rehabilitation, and the estimated capital and operating costs associated with each option. Depending on the scale and nature of the rehabilitation, the audit/environmental assessment may be relatively narrow in scope, focusing on only a small number of specific concerns that would be affected by the project, or it may be as extensive as would be appropriate for the construction of a new unit at the same site. Normally, it should cover the following points:

- Ambient environmental quality in the airshed or water basin affected by the plant, together with approximate estimates of the contribution of the plant to total emissions loads of the main pollutants of concern
- The impact of the plant, under existing operating conditions and under alternative scenarios for rehabilitation, on ambient air and water quality affecting neighboring populations and sensitive ecosystems
- The likely costs of achieving alternative emissions standards or other environmental targets for the plant as a whole or for specific aspects of its operations
- Recommendations concerning a range of cost effective measures for improving the environmental performance of the plant within the framework of the rehabilitation project and any associated emissions standards or other requirements implied by the adoption of specific measures.

These issues should be covered at a level of detail appropriate to the nature and scale of the proposed project. If the plant is located in an airshed or water basin that is polluted as a result of emissions from a range of sources, including the plant itself, comparisons should be made of the relative costs of improving ambient air or water quality by reducing emissions from the plant or by reducing emissions from other sources.

[48] Several U.S. states have adopted regulations that give coal-fired power plants the option to meet either a mercury emissions standard based on electricity output or a control-based standard. For instance, Illinois requires all coal-fired power plants of 25 MW electrical capacity or greater to meet either an emissions standard of 0.0080 lbs mercury per gigawatt hour (GWh) gross electrical output or an emissions control requirement of 90 percent relative to mercury input.

EIA ANNEX 1-5

IFC/WB Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution; 2007

Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

Applicability

The EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas. Annex A provides a summary of industry sector activities. This document is organized according to the following sections:

Section 1.0 — Industry-Specific Impacts and Management
Section 2.0 — Performance Indicators and Monitoring
Section 3.0 — References and Additional Sources
Annex A — General Description of Industry Activities

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with electric power transmission and distribution that occur during the construction and operation phases of a facility, along with recommendations for their management. Additional recommendations for the management of environmental issues during the construction and decommissioning phases of power transmission and distribution systems are provided in the **General EHS Guidelines.** Examples of the impacts addressed in the General EHS Guidelines include:

- Construction site waste generation;
- Soil erosion and sediment control from materials sourcing areas and site preparation activities;
- Fugitive dust and other emissions (e.g. from vehicle traffic, land clearing activities, and materials stockpiles);
- Noise from heavy equipment and truck traffic;
- Potential for hazardous materials and oil spills associated with heavy equipment operation and fueling activities.

1.1 Environmental

Environmental issues during the construction phase of power transmission and distribution projects specific to this industry sector include the following:

- Terrestrial habitat alteration
- Aquatic habitat alteration
- Electric and magnetic fields
- Hazardous materials

Terrestrial Habitat Alteration

The construction and maintenance of transmission line rights-of-way, especially those aligned through forested areas, may result in alteration and disruption to terrestrial habitat, including impacts to avian species and an increased risk of forest fires.

Construction of Right-of-Way[2]

Right-of-way construction activities may transform habitats, depending on the characteristics of existing vegetation, topographic features, and installed height of the transmission lines. Examples of habitat alteration from these activities includes fragmentation of forested habitat; loss of wildlife habitat, including for nesting; establishment of non-native invasive plant species; and visual and auditory disturbance due to the presence of machinery, construction workers, transmission towers, and associated equipment.[3]

Recommended measures to prevent and control impacts to terrestrial habitats during construction of the right-of-way include:

- Site transmission and distribution rights-of-way, access roads, lines, towers, and substations to avoid critical habitat through use of existing utility and transport corridors for transmission and distribution, and existing roads and tracks for access roads, whenever possible;[4]
- Installation of transmission lines above existing vegetation to avoid land clearing;

[2] Also known as a "wayleave" or "easement" in some countries, but referred to as right-of-way for the purposes of these Guidelines.

[3] Alteration of terrestrial habitat for construction of transmission and distribution projects may also yield benefits for wildlife such as the creation of protective nesting, rearing, and foraging habitat for certain species; the establishment of travel and foraging corridors for ungulates and other large mammals; and nesting and perching opportunities for large bird species atop transmission towers and associated infrastructures. California Energy Commission (2005).

[4] Considering potential for electrical interference with telecommunication lines and railway lines due to mutual induction.

- Avoidance of construction activities during the breeding season and other sensitive seasons or times of day;
- Revegetation of disturbed areas with native plant species;
- Removal of invasive plant species during routine vegetation maintenance (see right-of-way maintenance section below);
- Management of construction site activities as described in relevant sections of the **General EHS Guidelines.**

Right-of-Way Maintenance

Regular maintenance of vegetation within the rights-of-way is necessary to avoid disruption to overhead power lines and towers. Unchecked growth of tall trees and accumulation of vegetation within rights-of-way may result in a number of impacts, including power outages through contact of branches and trees with transmission lines and towers; ignition of forest and brush fires; corrosion of steel equipment; blocking of equipment access; and interference with critical grounding equipment.

Regular maintenance of rights-of-way to control vegetation may involve the use of mechanical methods, such as mowing or pruning machinery that may disrupt wildlife and their habitats, in addition to manual hand clearing and herbicide use. Vegetation management should not eradicate all vegetation, but aim to maintain trees and plant growth that may negatively affect infrastructure at a level that is under an economically-damaging threshold. Excessive vegetation maintenance may remove unnecessary amounts of vegetation resulting in the continual replacement of successional species and an increased likelihood of the establishment of invasive species.

Recommended measures to prevent and control impacts from right-of-way vegetation maintenance include:

- Implementation of an integrated vegetation management approach (IVM). The selective removal of tall-growing tree species and the encouragement of low-growing grasses and shrubs is the common approach to vegetation management in transmission line rights-of-way. Alternative vegetation management techniques should be selected based on environmental and site considerations including potential impacts to non-target, endangered and threatened species;[5]
- Removal of invasive plant species, whenever possible, cultivating native plant species;
- Scheduling activities to avoid breeding and nesting seasons for any critically endangered or endangered wildlife species;
- Observing manufacturer machinery and equipment guidelines, procedures with regard to noise, and oil spill prevention and emergency response;
- Avoiding clearing in riparian areas;
- Avoiding use of machinery in the vicinity of watercourses.

An integrated approach to vegetation management may indicate that use of herbicides is the preferred approach to control fast-growing vegetation within transmission and distribution rights-of-way. In this case, the following guidance on herbicide application, storage, and handling should be considered.

If herbicides (in this sector, herbicides are the most common type of pesticide used) application is warranted, they should be managed to avoid their migration into off-site land or water

[5] Mowing with heavy-duty power equipment may be used to control growth of ground covers and prevent the establishment of trees and shrubs in the right-of-way. Herbicides, in combination with mowing, may control fast-growing weedy species that have a potential to mature to heights over those permitted within the right-of-way. Trimming and pruning may be utilized at the boundaries of rights-of-way to maintain corridor breadth and prevent the encroachment of tree branches. Hand removal or removal of vegetation, while labor intensive, may be used in the vicinity of structures, streams, fences, and other obstructions which make the use of machinery difficult or dangerous.

environments (see Pesticides under the Hazardous Materials section).

Forest Fires

If underlying growth is left unchecked, or slash from routine maintenance is left to accumulate within right-of-way boundaries, sufficient fuel can accumulate that may promote forest fires.

Recommended measures to prevent and control risk of forest fire include:

- Monitoring right-of-way vegetation according to fire risk;[6]
- Removing blowdown and other high-hazard fuel accumulations;
- Time thinning, slashing, and other maintenance activities to avoid forest fire seasons;
- Disposal of maintenance slash by truck or controlled burning[7] . Controlled burning should adhere to applicable burning regulations, fire suppression equipment requirements, and typically must be monitored by a fire watcher;
- Planting and managing fire resistant species (e.g. hardwoods) within, and adjacent to, rights-of-way;
- Establishing a network of fuel breaks of less flammable materials or cleared land to slow progress of fires and allow fire fighting access.

Avian and Bat Collisions and Electrocutions

The combination of the height of transmission towers and distribution poles and the electricity carried by transmission and distribution lines can pose potentially fatal risk to birds and bats through collisions and electrocutions.[8] Avian collisions with power lines can occur in large numbers if located within daily flyways or migration corridors, or if groups are traveling at night or during low light conditions (e.g. dense fog).[9] In addition, bird and bat collisions with power lines may result in power outages and fires.

Recommended prevention and control measures to minimize avian and bat collisions and electrocutions include[10]:

- Aligning transmission corridors to avoid critical habitats (e.g. nesting grounds, heronries, rookeries, bat foraging corridors, and migration corridors);
- Maintaining 1.5 meter (60-inch)[11] spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;
- Retrofitting existing transmission or distribution systems by installing elevated perches, insulating jumper loops, placing obstructive perch deterrents (e.g. insulated "V's"), changing the location of conductors, and / or using raptor hoods;[12]

[6] As an example, the British Columbia Transmission Corporation (BCTC) maintains a Wildfire Risk Management System (WRMS) that classifies wildfire risk and provides a variety of corresponding mitigation measures. See (Blackwell et al., 2004).

[7] Controlled burning should only be performed after considering potential impacts to air quality and according to the local air quality management requirements.

[8] Birds and bats may be electrocuted by power lines in one of three ways: i) Simultaneously touching an energized wire and a neutral wire; ii) Simultaneously touching two live wires; and iii) Simultaneously touching an energized wire and any other piece of equipment on a pole or tower that is bonded to the earth through a ground wire. Raptor Protection Video Group (2000)

[9] Larger species (e.g. hawks, falcons, owls, vultures, cranes, egrets, and ravens) are at particular risk of simultaneously touching two wires or components while flying due to their long wingspans. Anderson (1991)

[10] Further information is available from Avian Power Line Interaction Committee (2005) and the U.S. Fish and Wildlife Service (2005).

[11] Manville (2005)

[12] California Energy Commission (2005)

- Considering the installation of underground transmission and distribution lines in sensitive areas (e.g. critical natural habitats);
- Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.[13]

Aquatic Habitat Alteration

Power transmission and distribution lines, and associated access roads and facilities, may require construction of corridors crossing aquatic habitats that may disrupt watercourses and wetlands, and require the removal of riparian vegetation. In addition, sediment and erosion from construction activities and storm water runoff may increase turbidity of surface watercourses.

Recommended measures to prevent and control impacts to aquatic habitats include:

- Site power transmission towers and substations to avoid critical aquatic habitat (e.g. watercourses, wetlands, and riparian areas), as well as fish spawning habitat, and critical fish over-wintering habitat;
- Maintaining fish access when road crossings of watercourses are unavoidable by utilizing clearspan bridges, open-bottom culverts, or other approved methods;
- Minimizing clearing and disruption to riparian vegetation;
- Management of construction site activities as described in the relevant sections of the **General EHS Guidelines.**

Marine Habitat Alteration

Transmission across ocean stretches may require use of submarine transmission cables on the ocean floor. Submarine cables are also occasionally used to transmit high-voltage power across long stretches of water to islands and other locations that are inaccessible by conventional techniques. Cables are installed using a cable-laying vessel and a remotely operated, underwater vehicle. Issues associated with marine habitat alteration include disruption to intertidal vegetation (e.g. eelgrass), coral reefs, and marine life, including marine mammals, and sedimentation resulting in turbidity and reductions in water quality.

Recommended measures to prevent and control impacts to marine habitats include:

- Locating and siting cable routes, and shore access, to avoid critical marine habitats (e.g. breeding grounds and eelgrass) and coral reefs;
- Burying submarine cables when traversing sensitive intertidal habitat;
- Monitoring cable laying path for presence of marine mammals;
- Avoiding laying submarine cable during fish and marine mammals breeding periods, calving periods, and spawning seasons.

Electric and Magnetic Fields

Electric and magnetic fields (EMF) are invisible lines of force emitted by and surrounding any electrical device (e.g. power lines and electrical equipment). Electric fields are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and increase in strength as the current increases. Magnetic fields are measured in units of gauss (G) or tesla (T), where 1T equals 10,000G. Electric fields are shielded by materials that conduct electricity, and other materials, such as trees and building

[13] Several studies have found that bird diverters that are installed to increase the visibility of power lines reduce collision rates considerably. Crowder and Rhodes (1999).

materials. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields decrease rapidly with distance. Power frequency EMF typically has a frequency in the range of 50 – 60 Hertz (Hz), and is considered Extremely Low Frequency (ELF).[14]

Although there is public and scientific concern over the potential health effects associated with exposure to EMF (not only high-voltage power lines and substations, but also from everyday household uses of electricity), there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment.[15] However, while the evidence of adverse health risks is weak, it is still sufficient to warrant limited concern.[16]

Recommendations applicable to the management of EMF exposures include:

- Evaluating potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).[17,18] Average and peak exposure levels should remain below the ICNIRP recommendation for General Public Exposure[19];
- Considering siting new facilities so as to avoid or minimize exposure to the public. Installation of transmission lines or other high voltage equipment above or adjacent to residential properties or other locations intended for highly frequent human occupancy, (e.g. schools or offices), should be avoided;
- If EMF levels are confirmed or expected to be above the recommended exposure limits, application of engineering techniques should be considered to reduce the EMF produced by power lines, substations, or transformers. Examples of these techniques include:
  - Shielding with specific metal alloys[20]
  - Burying transmission lines[21]
  - Increasing height of transmission towers
  - Modifications to size, spacing, and configuration of conductors

Hazardous Materials

Hazardous materials in this sector include insulating oils / gases (e.g. Polychlorinated Biphenyls [PCB] and sulfur hexafluoride [SF6], and fuels, in addition to chemicals or products for wood preservation for poles and associated wood construction material. The use of herbicides for right-of-way vegetation maintenance is discussed in the above section on 'Right-of–Way Maintenance'.

[14] National Institute of Environmental Health Sciences (2002)

[15] International Commission on Non-Ionizing Radiation Protection(ICNIRP) (2001); International Agency for Research on Cancer (2002); U.S. National Institute of Health (2002); Advisory Group to the Radiation Protection Board of the UK (2001), and U.S. National Institute of Environmental Health Sciences (1999)).

[16] U.S. National Institute of Environmental Health Sciences (2002)

[17] ICNIRP is a non-governmental organization formally recognized by the World Health Organization (WHO), which published the "Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields" following reviews of all the peer-reviewed scientific literature, including thermal and non-thermal effects. The standards are based on evaluations of biological effects that have been established to have health consequences. The main conclusion from the WHO reviews is that exposures below the limits recommended by the ICNIRP international guidelines do not appear to have any known consequence on health.

[18] An additional source of information is the Institute of Electrical and Electronics Engineers. See IEEE (2005).

[19] The ICNIRP exposure guidelines for General Public Exposure are listed in Section 2.1 of this Guideline.

[20] This is effective for reduction of electric field exposure, but not for reduction of magnetic field exposure.

[21] Ibid.

Insulating Oils and Fuels

Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. They are typically found in the largest quantities at electrical substations and maintenance shops. Sulfur Hexafluoride (SF6) may also be used as a gas insulator for electrical switching equipment and in cables, tubular transmission lines, and transformers. SF6 may be used as an alternative to insulating oils. However, the use of SF6, a greenhouse gas with a significantly higher global warming potential (GWP) than CO_2, should be minimized. In cases the gas is used for applications involving high voltages (>350 KV), equipment with a low leakage- rate (<99 percent) should be used.

Liquid petroleum fuels for vehicles and other equipment may also be used and stored at transmission and distribution projects. Recommendations for prevention and control of hazards associated with spill prevention, emergency response, clean-up, and contaminated soil remediation are addressed in the **General EHS Guidelines.**

Polychlorinated Biphenyls (PCB) were widely used as a dielectric fluid to provide electrical insulation, although their use has been largely discontinued due to potential harmful effects on human health and the environment. Recommendations for the management of PCB include:

- Replacing existing transformers and other electrical equipment containing PCB, and ensuring appropriate storage, decontamination, and disposal of contaminated units;
- Prior to final disposal, retired transformers and equipment containing PCB should be stored on a concrete pad with curbs sufficient to contain the liquid contents of these containers should they be spilled or leaked. The storage area should also have a roof to prevent precipitation from collecting in the storage area. Disposal should involve facilities capable of safely transporting and disposing of hazardous waste containing PCB;[22]
- Surrounding soil exposed to PCB leakage from equipment should be assessed, and appropriate removal and / or remediation measures should be implemented, as addressed in the section on contaminated soil in the **General EHS Guidelines**.

Wood Preservatives

The majority of wooden utility poles are treated with pesticide preservatives to protect against insects, bacteria, and fungi, and to prevent rot. The preservatives most commonly used for power poles are oil-based pesticides such as creosote, pentachlorophenol (PCP), and chromated copper arsenate (CCA). Use of these preservatives is being limited in some countries due to their toxic effects on the environment. While in use, poles may leach preservatives into soils and groundwater, however, levels are highest directly beside poles and decrease to within normal levels at approximately 30 centimeters (cm) distance from the pole.[23] The most significant potential environmental impacts occur at specialized wood treatment facilities if not managed appropriately.

Poles should be pretreated at an appropriate facility to ensure chemical fixation and prevent leaching, and to impede the formation of surface residues at the right-of-way[24]. Further

[22] For a complete discussion on the identification and management of PCB in this industry sector, please see the UNEP publication "PCB Transformers and Capacitors: From Management to Reclassification and Disposal" (2002). Available at: http://www.chem.unep.ch/pops/pdf/PCBtranscap.pdf

[23] Zagury et al. (2003)

[24] Lebow and Tippie (2001)

information is available in the **EHS Guidelines for Sawmilling and Wood-based Products**.

Recommended measures to prevent and control the impacts of wood preservatives at the point of use include:

- Evaluating the cost and benefit of using alternative pole materials (e.g. steel, concrete, and fiberglass);
- Consider use of alternative preservatives(e.g. copper azote);
- Undertake appropriate disposal of used poles. Landfill facilities should be capable of handling wastes that may have chemical leaching properties. Disposal through incineration or through recycling should consider associated air emissions and secondary product residues of preservative chemicals.

Pesticides

Pesticide use should be established as part of an Integrated Pest Management (IPM) strategy and a documented Pest Management Plan (PMP). The following stages should be considered when designing and implementing an IPM strategy, giving preference to alternative pest management strategies, with the use of synthetic chemical pesticides as a last option.

Alternatives to Pesticide Application - The following alternatives to pesticides should be considered:

- Provide those responsible for deciding on pesticides application with training in pest identification, weed identification, and field scouting;
- Use mechanical weed control and / or thermal weeding;
- Support and use beneficial organisms, such as insects, birds, mites, and microbial agents, to perform biological control of pests;
- Protect natural enemies of pests by providing a favorable habitat, such as bushes for nesting sites and other original vegetation that can house pest predators;
- Use animals to graze areas and manage plant coverage;
- Use mechanical controls such as traps, barriers, light, and sound to kill, relocate, or repel pests.

Pesticide Application - If pesticide application is warranted, users should take the following precautions:

- Train personnel to apply pesticides and ensure that personnel have received applicable certifications or equivalent training where such certifications are not required; [25]
- Review the manufacturer's directions on maximum recommended dosage or treatment, as well as published reports on using the reduced rate of pesticide application without loss of effect, and apply the minimum effective dose;
- Apply pesticides based on criteria (e.g. field observations, weather data, time of treatment, and dosage) and maintain a pesticide logbook to record such information;
- Avoid the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a and 1b;
- Avoid the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Class II if the project host country lacks restrictions on distribution and use of these chemicals, or if they are likely to be accessible to personnel without proper training,

[25] Examples of certification schemes are provided by the US EPA (2006), which classifies pesticides as either "unclassified" or "restricted" and requires workers that apply unclassified pesticides to be trained according to the Worker Protection Standard (40 CFR Part 170) for Agricultural Pesticides. It further requires restricted pesticides to be applied by or in the presence of a certified pesticide applicator.

equipment, and facilities to handle, store, apply, and dispose of these products properly;

- Avoid the use of pesticides listed in Annexes A and B of the Stockholm Convention, except under the conditions noted in the convention;[26]
- Use only pesticides that are manufactured under license and registered and approved by the appropriate authority and in accordance with the Food and Agriculture Organization's (FAO) International Code of Conduct on the Distribution and Use of Pesticides[27];
- Use only pesticides that are labeled in accordance with international standards and norms, such as the FAO Revised Guidelines for Good Labeling Practice for Pesticides[28];
- Select application technologies and practices designed to reduce unintentional drift or runoff only as indicated in an IPM program, and under controlled conditions;
- Maintain and calibrate pesticide application equipment in accordance with manufacturer's recommendations;
- Establish untreated buffer zones or strips along water sources, rivers, streams, ponds, lakes, and ditches to help protect water resources.

Pesticide Handling and Storage - Contamination of soils, groundwater, or surface water resources, due to accidental spills during transfer, mixing, and storage of pesticides should be prevented by following the hazardous materials storage and handling recommendations presented in the **General EHS Guidelines**. Additional recommendations include the following:

- Store pesticides in their original packaging, in a dedicated, dry, cool, frost-free, and well aerated location that can be locked and properly identified with signs, with access limited to authorized people[29]. No human or animal food may be stored in this location. The store room should also be designed with spill containment measures and sited in consideration of potential for contamination of soil and water resources;
- Mixing and transfer of pesticides should be undertaken by trained personnel in ventilated and well lit areas, using containers designed and dedicated for this purpose.
- Containers should not be used for any other purpose (e.g. drinking water). Contaminated containers should be handled as hazardous waste, and should be treated accordingly. Disposal of containers contaminated with pesticides should be done in a manner consistent with FAO guidelines and with manufacturer's directions;[30]
- Purchase and store no more pesticide than needed and rotate stock using a "first-in, first-out" principle so that pesticides do not become obsolete.[31] Additionally, the use of obsolete pesticides should be avoided under all circumstances;[32] A management plan that includes measures for the containment, storage and ultimate destruction of all obsolete stocks should be prepared in accordance to guidelines by FAO and consistent with country commitments under the Stockholm, Rotterdam and Basel Conventions.
- Collect rinse water from equipment cleaning for reuse (such as for the dilution of identical pesticides to concentrations used for application);

[26] The Stockholm Convention on Persistent Organic Pollutants (2001) controls the use of the following POPs-pesticides: Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene, Mirex, and Toxaphene.
[27] FAO (2002)
[28] FAO (2000)
[29] FAO (2002)
[30] See FAO Guidelines for the Disposal of Waste Pesticides and Pesticide Containers.
[31] See FAO (1996).
[32] See the FAO publication on pesticide storage and stock control manual. FAO Pesticide Disposal Series No. 3 (1996).

- Ensure that protective clothing worn during pesticide application is either cleaned or disposed of in an environmentally responsible manner
- Implement groundwater supply wellhead setbacks for pesticide application and storage
- Maintain records of pesticide use and effectiveness.

1.2 Occupational Health and Safety

Most occupational health and safety issues during the construction, operation, maintenance, and decommissioning of electric power distribution projects are common to those of large industrial facilities, and their prevention and control is discussed in the **General EHS Guidelines**. These impacts include, among others, exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust and noise; falling objects; work in confined spaces; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery.

Occupational health and safety hazards specific to electric power transmission and distribution projects primarily include:

- Live power lines
- Working at height
- Electric and magnetic fields
- Exposure to chemicals

Live Power Lines

Workers may be exposed to occupational hazards from contact with live power lines during construction, maintenance, and operation activities. Prevention and control measures associated with live power lines include:

- Only allowing trained and certified workers to install, maintain, or repair electrical equipment;
- Deactivating and properly grounding live power distribution lines before work is performed on, or in close proximity, to the lines;
- Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following[33]:
  - Distinguish live parts from other parts of the electrical system
  - Determine the voltage of live parts
  - Understand the minimum approach distances outlined for specific live line voltages
  - Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system
- Workers should not approach an exposed energized or conductive part even if properly trained unless:
  - The worker is properly insulated from the energized part with gloves or other approved insulation; or,
  - The energized part is properly insulated from the worker and any other conductive object; or,
  - The worker is properly isolated and insulated from any other conductive object (live-line work).
- Where maintenance and operation is required within minimum setback distances, specific training, safety measures, personal safety devices, and other precautions should be defined in a health and safety plan. (Table 2 in Section 2.2 provides recommended minimum safety setbacks for workers);

[33] Further information is available from the Occupational Safety and Health Administration (OSHA). Available at: http://www.osha.gov/SLTC/powertransmission/standards.html

- Workers not directly associated with power transmission and distribution activities who are operating around power lines or power substations should adhere to local legislation, standards, and guidelines relating to minimum approach distances for excavations, tools, vehicles, pruning, and other activities;
- Minimum hot stick distances may only be reduced provided that the distance remaining is greater than the distance between the energized part and a grounded surface.

Working at height on poles and structures

Workers may be exposed to occupational hazards when working at elevation during construction, maintenance, and operation activities. Prevention and control measures for working at height include:

- Testing structures for integrity prior to undertaking work;
- Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others;
- Establishment of criteria for use of 100 percent fall protection (typically when working over 2 meters above the working surface, but sometimes extended to 7 meters, depending on the activity). The fall protection system should be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point;
- Installation of fixtures on tower components to facilitate the use of fall protection systems;
- Provision of an adequate work-positioning device system for workers. Connectors on positioning systems should be compatible with the tower components to which they are attached;
- Hoisting equipment should be properly rated and maintained and hoist operators properly trained;
- Safety belts should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident;
- When operating power tools at height, workers should use a second (backup) safety strap;
- Signs and other obstructions should be removed from poles or structures prior to undertaking work;
- An approved tool bag should be used for raising or lowering tools or materials to workers on structures.

Electric and magnetic fields

Electric and magnetic fields (EMF) are described in Section 1.1 above. Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines.[34,35] Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities;

[34] A 1994 study estimated the average exposure of electrical workers (including jobs in electric utilities and other industries) in Los Angeles, California to be 9.6 milligauss (mG), compared to 1.7 mG for workers in other fields (S. J. London et al., 1994).

[35] Although detailed studies of workplace exposure to EMF in the United States, Canada, France, England, and several Northern European countries have found no conclusive link or correlation between typical occupational EMF exposure and adverse health effects, some studies have identified a possible association between occupational exposure to EMF and cancer, such as brain cancer (U.S. National Institute of Environmental Health Sciences 2002) indicating there is evidence to warrant limited concern.

- Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers;
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the Institute of Electrical and Electronics Engineers (IEEE)[36]. Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

Exposure to chemicals

Occupational exposures to chemicals in this sector primarily include handling of pesticides (herbicides) used for right–of-way maintenance, and exposure to PCB in transformers and other electrical components.

Pesticides

Occupational health and safety impacts associated with pesticides are similar to those for other hazardous substances, and their prevention and control are discussed in the **General EHS Guidelines**. Potential exposures to pesticides include dermal contact and inhalation during their storage, preparation and application. The effect of such impacts may be increased by climatic conditions such as wind, which may increase the chance of unintended drift, or high temperatures, which may deter the use of personal protective equipment (PPE). Recommendations specific to the use of pesticides include:

- Train personnel to apply pesticides and ensure that personnel have received the necessary certifications,[37] or equivalent training where such certifications are not required;
- Respect post-treatment intervals to avoid operator exposure during reentry to crops with residues of pesticides;
- Ensure hygiene practices are followed (in accordance to FAO and PMP) to avoid exposure of family members to pesticides residues.

PCBs

Maintenance shops and other facilities, and activities may involve potential contact with PCB or PCB-contaminated machinery. Recommendations for chemical exposure, including PCB, are addressed in the **General EHS Guidelines**.[38]

1.3 Community Health and Safety

Community health and safety impacts during the construction and decommissioning of transmission and distribution power lines are common to those of most large industrial facilities, and

[36] The ICNIRP exposure guidelines for Occupational Exposure are listed in Section 2.2 of this Guideline.

[37] The US EPA classifies pesticides as either "unclassified" or "restricted." All workers that apply unclassified pesticides must be trained according to the Worker Protection Standard (40 CFR Part 170 and 171) for Agricultural Pesticides. Restricted pesticides must be applied by or in the presence of a certified pesticide applicator. For more information, see http://www.epa.gov/pesticides/health/worker.htm

[38] Further information on the management of occupational exposure to PCB can be obtained at UNEP publication "PCB Transformers and Capacitors: From Management to Reclassification and Disposal" (2002) available at: http://www.chem.unep.ch/pops/pdf/PCBtranscap.pdf

are discussed in the **General EHS Guidelines**. These impacts include, among others, dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of temporary construction labor. In addition to general health and safety standards outlined in the **General EHS Guidelines**, the operation of live power distribution lines and substations may generate the following industry-specific impacts:

- Electrocution
- Electromagnetic interference
- Visual amenity
- Noise and Ozone
- Aircraft Navigation Safety

Electrocution

Hazards most directly related to power transmission and distribution lines and facilities occur as a result of electrocution from direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity. Recommended techniques to prevent these hazards include:

- Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding transmission towers, particularly in urban areas), and education / public outreach to prevent public contact with potentially dangerous equipment;
- Grounding conducting objects (e.g. fences or other metallic structures) installed near power lines, to prevent shock.

Electromagnetic Interference

The corona of overhead transmission line conductors and high-frequency currents of overhead transmission lines may result in the creation of radio noise. Typically, transmission line rights-of-way and conductor bundles are created to ensure radio reception at the outside limits remains normal. However, periods of rain, sleet or freezing rain sharply increases the streaming corona on conductors and may affect radio reception in residential areas near transmission lines.

Visual Amenity

Power transmission and distribution are necessary to transport energy from power facilities to residential communities, but may be visually intrusive and undesirable to local residents. To mitigate the visual impact of power distribution projects, the following mitigation measures should be implemented:

- Extensive public consultation during the planning of power line and power line right-of-way locations;
- Accurate assessment of changes in property values due to power line proximity;
- Siting power lines, and designing substations, with due consideration to landscape views and important environmental and community features;
- Location of high-voltage transmission and distribution lines in less populated areas, where possible;
- Burying transmission or distribution lines when power must be transported through dense residential or commercial areas.

Noise and Ozone

Noise in the form of buzzing or humming can often be heard around transformers or high voltage power lines producing corona. Ozone, a colorless gas with a pungent odor, may also be produced. Neither the noise nor ozone produced by power

distribution lines or transformers carries any known health risks.[39]

The acoustic noise produced by transmission lines is greater with high voltage power lines (400-800 kilo volts [kV]) and even greater with ultra-high voltage lines (1000 kV and higher)[40]. Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The sound of rain typically masks the increase in noise produced by the transmission lines, but during other forms of precipitation (e.g. snow and sleet) and fog, the noise from overhead power lines can be troubling to nearby residents.

Measures to mitigate this impact may be addressed during project planning stages to locate rights-of-way away from human receptors, to the extent possible. Use of noise barriers or noise canceling acoustic devices should be considered as necessary.

Aircraft Navigation Safety

Power transmission towers, if located near an airport or known flight paths, can impact aircraft safety directly through collision or indirectly through radar interference. Aircraft collision impacts may be mitigated by:

- Avoiding the siting of transmission lines and towers close to airports and outside of known flight path envelopes;
- Consultation with regulatory air traffic authorities prior to installation;
- Adherence to regional or national air traffic safety regulations;
- Use of buried lines when installation is required in flight sensitive areas.

[39] WHO (1998)
[40] Gerasimov (2003)

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

The power transmission and distribution sector does not typically give rise to significant air emissions or effluents. Where dust or potentially contaminated water runoff exists, site operations should comply with principles and guidelines described in the **General EHS Guidelines** to meet ambient air and surface water guidelines. Table 1 lists exposure limits for general public exposure to electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Table 1. ICNIRP exposure limits for general public exposure to electric and magnetic fields.

Frequency	Electric Field (V/m)	Magnetic Field (μT)
50 Hz	5000	100
60 Hz	4150	83

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored.

Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[41] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[42] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[43] Indicative Occupational Exposure Limit Values published by European Union member states,[44] or other similar sources.

Additional indicators specifically applicable to electric power transmission and distribution activities include the minimum safe working distances for trained employees listed in Table 2 and the ICNIRP exposure limits for occupational exposure to electric and magnetic fields listed in Table 3.

Table 2. Alternating Current - Minimum Working Distances for Trained Employees[a]

Voltage Range (phase to phase – Kilovolts)	Minimum Working and Clear Hot Stick Distance (meters)
2.1 to 15	0.6
15.1 to 35	0.71
35.1 to 46	0.76
46.1 to 72.5	0.91
72.6 to 121	1.01
138 to 145	1.06
161 to 169	1.11
230 to 242	1.5
345 to 362	2.13[b]
500 to 552	3.35[b]
700 to 765	4.5[b]

[a] OSHA

[b] NOTE: From 345-362 kv., 500-552 kv., and 700-765 kv., the minimum working distance and the minimum clear hot stick distance may be reduced provided that such distances are not less than the shortest distance between the energized part and a grounded surface.

Table 3. ICNIRP exposure limits for occupational exposure to electric and magnetic fields.

Frequency	Electric Field (V/m)	Magnetic Field (μT)
50 Hz	10,000	500
60 Hz	8300	415

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with

[41] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/
[42] Available at: http://www.cdc.gov/niosh/npg/
[43] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992
[44] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/

published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)[45].

Occupational Health and Safety Monitoring

The working environment should be occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals[46] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

[45] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm
[46] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

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Annex A: General Description of Industry Activities

Electric power transmission is the bulk transfer of electricity from one place to another. Typically, power transmission occurs between a power generation facility and a substation located in close proximity to consumers. Power distribution refers to the delivery of electricity from a substation to consumers located in residential, commercial, and industrial areas.

Due to the large amount of power involved, transmission-level voltages are generally considered those above 110 kilo volts (kV). Voltages between 110 kV and 33 kV are typically considered sub-transmission voltages, but are occasionally used for long transmission systems with light loads. Voltages of less than 33 kV are representative of distribution projects.

Electric power transmission and distribution systems are often located in conjunction with highway, road, and other rights-of-way to minimize both costs and disturbance to ecological, socio-economic and cultural resources. Other factors, including land value, view sheds, archaeological resources, geotechnical hazards, accessibility, parks and other important features also contribute to the locating of transmission and distribution line right-of-way alignments.

Project development and construction activities typically include access road construction or upgrade, site preparation and development, removal of select vegetation, if any, and the grading and excavation of soils for the installation of structural foundations and site utilities. These activities are typical of industrial development projects and depend upon a number of factors, including topography, hydrology, and desired site layout, among others. Activities generally associated with the development and construction of power transmission and distribution include land clearing for transmission line rights-of way, access road construction or upgrade, equipment staging areas, substation construction and / or upgrade, site preparation, and installation of transmission line components (e.g. transmission towers and substations, access and maintenance roads).

Operational activities may include maintenance of access to the transmission lines, towers and substations (e.g. low-impact trails or new / improved access roads) and vegetation management. Upgrades and maintenance for existing infrastructure are a consideration throughout the life cycle of the project.

Power transmission and distribution facilities are decommissioned when they are obsolete, damaged (e.g. by corrosion) or replaced due to increased power demand. Many power facilities are replaced with new or updated equipment at the same site or right-of-way. Decommissioning activities depend on the proposed subsequent use of the site, environmental sensitivities (e.g. natural grasslands) and the project specifics (e.g. aboveground or underground power lines). Activities may include demolition and removal of the installed infrastructure (e.g. transmission towers, substations, aboveground and underground utilities and road decommissioning) and reclamation of the project site, including ground stabilization and re-vegetation.

The following sections provide a description of the facilities and activities associated with the construction and operation of power transmission and distribution projects. Facilities and activities common to transmission and distribution projects, including right-of-way management and substations, are outlined below as well as facilities unique to transmission and distribution systems, including towers and utility poles. Typical components of a power transmission and distribution project are illustrated in Figure A-1.

Power Transmission Systems

The electric power transmission system is often referred to as a grid. Redundant paths and lines are provided so that power can be routed from any generation facility to any customer area through a variety of routes, based on the economics of the transmission path and the cost of power. The redundant paths and lines also allow power flow to be rerouted during planned maintenance and outages due to weather or accidents.

Power transmission occurs via a system of aboveground power lines and towers located between a power plant and a substation. When crossing a dense residential area is necessary, transmission and distribution systems can also be buried within underground conduits. Though the transmission efficiency is typically lower for underground lines and installation and maintenance are costly, locating the transmission system underground reduces impacts on land values, visual aesthetics, and vegetation loss. Submarine cables placed on the ocean floor by cable-laying boats are also occasionally used to transmit high-voltage power across long stretches of water to islands and other locations that are inaccessible by conventional techniques. Submarine cables are typically self-contained and fluid-filled to provide insulation over long distances.

Regional transmission grids consist of several large transmission systems connected by substations that are designed to transport electricity as efficiently as possible. Transmission networks can cover thousands of kilometers and encompass tens of thousands of towers. Energy is typically transmitted using a three-phase alternating current (AC) that is more efficient than a single phase. Energy is generally produced at low voltage (up to 30 kV) at a generating facility and then stepped up by a power station transformer to a higher voltage in order to reduce resistance and reduce the percentage of energy lost during transmission over a long distance. For long distance transmission, electricity is usually transmitted at voltages between 110 and 1200 kV. At extremely high voltages, such as those over 2000 kV, corona discharge[47] energy losses associated with charged conductors can offset benefits of reductions in energy losses from reduced resistance. Over long distances, energy can also be transmitted via High Voltage Direct Current (HVDC). In these instances, smaller losses in energy and lower construction costs offset the need to construct conversion stations at each end of the transmission line to convert the direct current to alternating current for use in distribution systems.

Transmission towers or pylons are utilized to suspend high-voltage overhead power lines. These systems usually transmit three-phase electric power (the common method for transmission of high-voltage lines of over 50 kV) and, therefore, are designed to carry three (or multiples of three) conductors. One or two ground conductors are often added at the top of each tower for lightning protection. Transmission towers can be constructed from steel, concrete, aluminum, wood and reinforced plastic. The wire conductors on high-voltage lines are generally constructed of aluminum, or aluminum reinforced with steel strands. Each transmission tower or support structure must be constructed to support the load imposed on it by the conductors. As a result, foundations for transmission towers can be large and costly, particularly in areas where ground conditions are poor such as in wetlands. Guy wires can be utilized to stabilize transmission towers and resist some of the force of the conductors.

There are three main types of transmission powers or pylons used in a transmission system. Suspension towers support straight stretches of a transmission line. Deviation towers are

[47] A corona discharge is an electrical discharge resulting from the ionization of the air around the conductor, generally generating power losses and ambient noise.

located at points where a transmission line changes direction. Terminal towers are located at the end of overhead transmission lines where they connect with substations or underground cables.

The most common type of transmission tower or pylon used for high-voltage power lines is a steel lattice structure. Tubular steel monopoles are also used to support high or medium voltage transmission lines, usually in urban areas. Transmission towers constructed of a steel framework can be used to support lines of all voltages, but they are most often used for voltages over 50 kV. Lattice towers can be assembled on the ground and erected by cable (which uses a large laydown area), erected by crane, or, in inaccessible areas, by helicopter. Transmission towers typically range from approximately 15 to 55 meters (m) in height.[48]

Wooden transmission towers consisting of single poles, H-frames, or shapes resembling A's or V's are also commonly used to support high-voltage transmission lines. Wooden transmission towers are limited by the height of available trees (approximately 30m), and generally carry voltages of between 23 kV and 230 kV, lower than those carried by steel lattice transmission towers[49]. Aluminum towers are often used in remote areas where they can be transported in and installed by helicopter. Towers of reinforced plastic are now available, but high costs currently restrict their use.

For underground transmission lines, the three wires used to transmit the three-phase power must be located in individual pipes or conduits. These pipes are covered in thermal concrete and surrounded in thermal backfill materials. Underground cable conduit systems typically require trenches of at least 1.5m in depth and width. Due to difficulties in dissipating heat, underground conduits are typically not used for high-voltage transmission lines over 350 kV.[50]

Power Distribution Systems

Prior to consumer use, high-voltage energy is stepped down to a lower voltage aboveground line for use in sub-transmission or distribution systems. Distribution lines typically vary from 2.5 to 25 kV. Finally, the energy is transformed to low voltage at the point of residential or commercial use. This voltage ranges between 100 and 600 volts (V) depending on country and customer requirements. Power distribution poles (or utility or telephone poles) are typically constructed of wood, but steel, concrete, aluminum and fiberglass are also used. Distribution poles are typically spaced no further than 60m apart and are at least 12m in height[51]. Wooden distribution poles are limited by the height of available trees (approximately 30m).

Electrical Substations

Electrical substations are stations along the electricity transmission and distribution system that transform voltage from low to high or high to low using transformers. Step-up transformers are used to increase voltage while decreasing current, while step-down transformers are used to decrease voltage while increasing current. Substations typically consist of one or more transformers, as well as switching, control, and protection equipment. Substations can be located in fenced enclosures, underground, or inside buildings.

There are two main types of electrical substations. Transmission substations contain high-voltage switches used to connect together high-voltage transmission lines or to allow specific

[48] United Kingdom Parliament (2001)
[49] Great River Energy (2006)
[50] American Transmission Company (2005)
[51] United States of America Department of Defense (2004)

systems to be isolated for maintenance. Distribution substations are used to transfer power from the transmission system to the distribution system. Typically at least two transmission or sub-transmission lines enter a distribution substation, where their voltage is reduced to a value suitable for local consumption. Distribution substations can also be used to isolate faults in either the transmission or distribution systems. Complicated distribution substations containing high-voltage switching, switching, and backup systems are often located within large urban centers.

Rights-of-Way Management

Both aboveground transmission and distribution projects require rights-of-way to protect the system from windfall, contact with trees and branches, and other potential hazards that may result in damage to the system, power failures, or forest fires. Rights-of-way are also utilized to access, service, and inspect transmission and distribution systems. Underground distribution lines also require rights-of-way where excavation is prohibited or strictly monitored, construction activity is limited, and access to lines can be achieved if necessary. Being larger systems transmitting higher voltages, transmission rights-of-way are typically much larger than those for distribution systems and, consequently, require more extensive management.

Right-of-ways widths[52] for transmission lines range from 15 to 100m depending on voltage and proximity to other rights-of-way (typical range is between 15 and 30m)[53]. For overhead distribution power lines up to 35 kV, 12 to 24m corridors (6 to 12m on each side) are recommended[54]. Access roads are often constructed in conjunction, or within, transmission line rights-of-way to provide access for maintenance and upkeep of the system.

To avoid disruption to overhead power lines and towers, regular maintenance of vegetation within the rights-of-way is required. Unchecked growth of tall trees and accumulation of vegetation within rights-of-way can result in a number of impacts including power outages through contact of branches and trees with transmission lines and towers; ignition of forest and brush fires; corrosion of steel equipment; blocking of equipment access; and interference with critical grounding equipment.

Regular maintenance and clearing of rights-of-way prevents natural forest succession and the establishment and growth of tall trees. Typically, tall trees of approximately 4.5m or more are not permitted within aboveground rights-of-way.[55] Underground rights-of-way have far fewer vegetation restrictions, though trees with deep tap roots that may interfere with duct banks are usually prohibited from being grown within the right-of-way. Vegetation maintenance of rights-of-way can be accomplished with the following measures.

Mowing with heavy-duty power equipment is used to control growth of ground covers and prevent the establishment of trees and shrubs in the right-of-way. Herbicides, in combination with mowing, control fast-growing weedy species that have a potential to mature to heights over those permitted within the right-of-way. Trimming and pruning is utilized at the boundaries of rights-of-way to maintain corridor breadth and prevent the encroachment of tree branches. Hand removal or removal of vegetation is costly and time-consuming but is often used in the vicinity of structures, streams, fences, and other obstructions making the use of machinery difficult or dangerous.

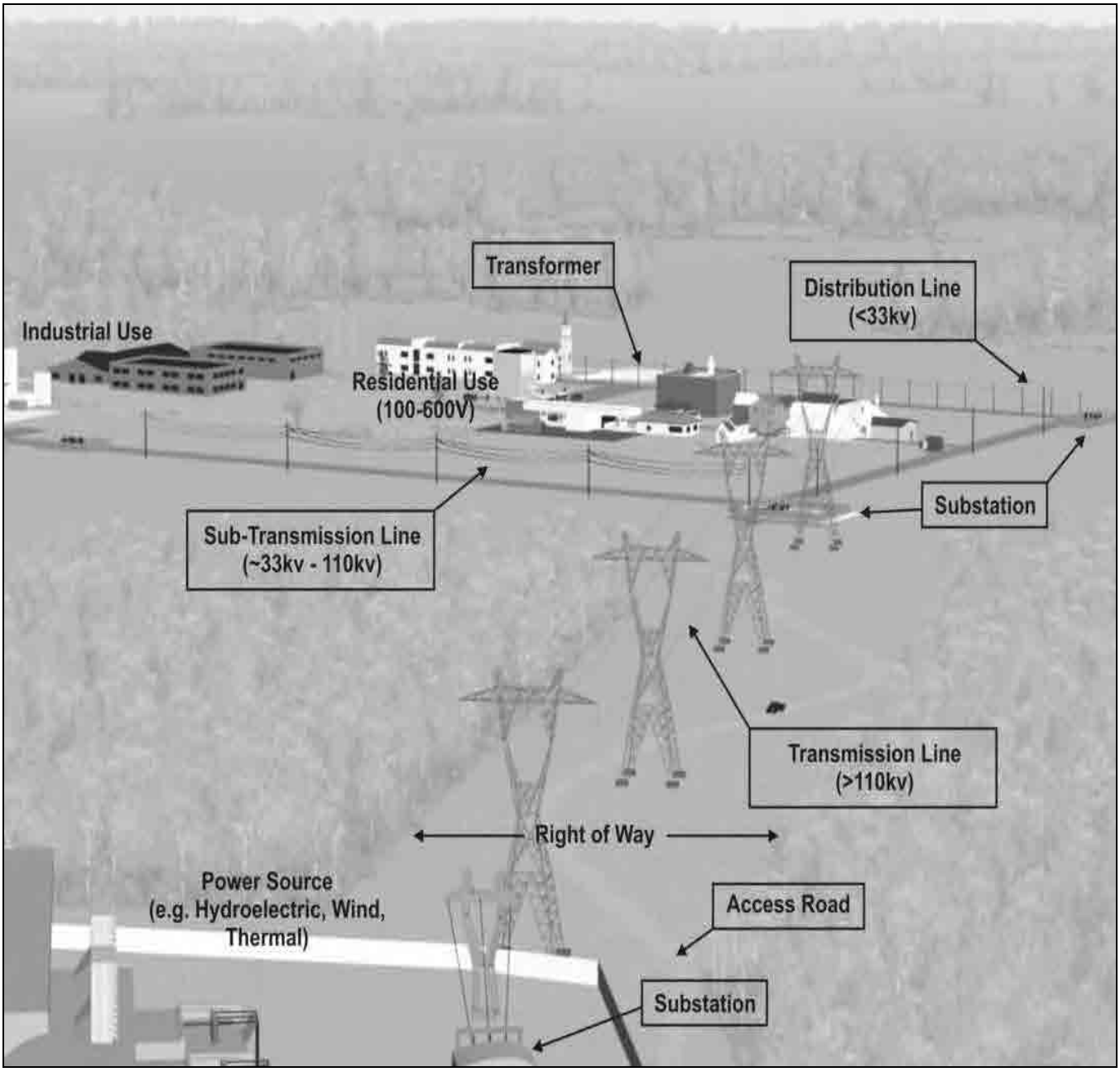
[52] For example, Duke Energy prescribes 21-meter minimum rights-of-way for voltages between 44 and 100 kV, 46-meter minimum rights-of-way for voltages of 230 kV, and 61-meter minimum rights-of-way for voltages of 525 kV (Duke Energy, 2006).

[53] Santee Cooper (2002)

[54] United States of America Department of National Defense (2004)

[55] Georgia Power (2006)

Figure A-1: Electric Power Transmission and Distribution



EIA ANNEX 1-6

IFC/WB Environmental, Health, and Safety
Guidelines for Gas Distribution Systems, 2007

Environmental, Health, and Safety Guidelines for Gas Distribution Systems

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. .

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

Applicability

The EHS Guidelines for Gas Distribution Systems include information relevant to the distribution of low pressure natural gas from the city gate to residential, commercial, and industrial users. Annex A provides a summary of industry sector activities.

This document is organized according to the following sections:

Section 1.0 — Industry-Specific Impacts and Management
Section 2.0 — Performance Indicators and Monitoring
Section 3.0 — References
Annex A — General Description of Industry Activities

1.0 Industry-Specific Impacts and Management

This section provides a summary of EHS issues associated with gas distribution systems that occur during the construction and operations phases, along with recommendations for their management. Recommendations for the management of EHS issues common to most large industrial facilities during the decommissioning phase are provided in the **General EHS Guidelines**.

1.1 Environment

Distribution pipeline construction impacts greatly depend on the location of proposed pipeline installation. In already developed urban areas, environmental impacts are considerably different than in suburban or mixed use areas. Common impacts may include noise and vibration caused by the operation of earth moving and excavation equipment, and materials transport and delivery; dust emissions generated by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind; mobile emissions from exhaust of diesel engines for earth moving equipment; and hazardous materials and waste handling, including oil spills associated with heavy equipment operation and fueling activities. In newly developed areas, impacts may also include soil erosion resulting from excavated areas prior to the reestablishment of vegetation. In urban areas, impacts may include noise, traffic interruption, disposal of contaminated soil, and presence of archeological artifacts.

Recommendations for prevention and control of construction related impacts are addressed in the **General EHS Guidelines**.

Environmental issues that may occur during gas distribution projects include the following:

- Habitat Alteration
- Air Emissions

Habitat Alteration

Habitat alteration is only considered a relevant potential impact during construction of gas distribution pipeline systems in newly developed rural or periurban areas. These impacts may be associated with excavation, trenching, pipe laying, backfilling, and the establishment of infrastructure such as regulating stations, which may create temporary or permanent terrestrial habitat alteration depending on the characteristics of existing vegetation and topographic features along the proposed right of way. The potential for impacts depends on the level of existing development, and will likely be less of an issue in urbanized areas or along existing utility rights-of-way corridors.

Depending on the level of existing urbanization in the proposed project area, examples of habitat alteration from these activities may include landscape fragmentation; loss of wildlife habitat, including for nesting; and establishment of non-native invasive plant species. In addition, construction of distribution pipelines crossing aquatic habitats that may disrupt watercourses and wetlands, and require the removal of riparian vegetation. Sediment and erosion from construction activities and storm water runoff may increase turbidity of surface watercourses.

To prevent and control impacts to terrestrial habitats, distribution pipeline rights-of-way and regulating stations should be sited to avoid critical habitat through use of existing utility and transport corridors, whenever possible. To prevent and control impacts to aquatic habitats, distribution pipeline rights-of-way should be sited to avoid critical aquatic habitat such as watercourses, wetlands, and riparian areas, as well as fish spawning habitat, and critical fish over-wintering habitat, whenever possible. Use of guided / directional drilling for distribution pipeline installation

should be considered where feasible to reduce impacts to both terrestrial and aquatic habitats.

Air Emissions

Gas distribution systems may generate gas leaks as a result of normal operations, equipment venting for maintenance, and aging.[2] Gas leakage, principally consisting of methane (CH_4), a greenhouse gas, may result from corrosion[3] and degradation of pipelines and related components over time and from fugitive emissions from pipelines and regulating stations.

Recommended measures to prevent and control air emissions due to leaks include:

- Gas pipelines and pipeline components, in addition to general installation and pipe joining techniques such as welding, should meet international standards for structural integrity and operational performance;[4]
- Corrosion prevention of buried ferrous metal pipelines should be undertaken using coating or cathodic protection techniques.[5] For underground applications, the use of polyethylene pipe[6], which is not subject to corrosion, should be considered as an alternative to ferrous metal pipeline materials;
- Testing of pipelines and pipeline components for pressure specifications and presence of leaks should be undertaken prior to commissioning. The system should be gas tight when tested at a higher pressure than the normal maximum operation gas pressure;
- Leak and corrosion detection programs should be undertaken, including use of appropriate leak detection assessment techniques and equipment.[7] Maintenance programs to repair and replace infrastructure should be undertaken as indicated by detection results. Typical urban testing sites include atmospheres in confined spaces of utility infrastructure (e.g. sewer and water system manholes), as well as at openings in pavement and on streets and walkways. Areas of gas infrastructure subject to forces from heavy load traffic or physical land shifts should also be periodically monitored for leaks and ruptures;
- Comparisons of purchased and delivered gas amounts should be periodically examined for discrepancies and unaccounted for gas which may be an indicator of excessive system leakage;
- Regulating stations and vaults, both above and below ground, may contain equipment (e.g. safety valves, filters) that may emit fugitive emissions of gas. Pipelines, valves, and other component infrastructure should be regularly maintained, and ventilation and gas detection / alarm equipment installed in station buildings or vaults.

[2] The methane emission from the gas distribution sector is 26 percent of the total methane emissions in the US natural gas industry sector. United States Environment Protection Agency (US EPA) (1999).
[3] Steel and other ferrous metals used for gas pipelines may be subject to corrosion, a reaction between external and internal surfaces of the pipe and its surroundings in both below and above ground settings. Corrosion weakens the structural integrity of the pipe and may lead to leakage. The characteristics of the physical environment of the pipeline including soil resistivity, moisture, and presence of contaminants may encourage corrosive activity. US Department of Transportation, Office of Pipeline Safety (2002).
[4] For example, US 49 CFR Part 192—Transportation of Natural Gas and Other Gas by Pipeline: Minimum Federal Safety Standards subparts A to H, and European (EN) Standards: EN 12007-1:2000: Gas Supply Systems. Pipelines for maximum operating pressure up to and including 16 bar. General functional recommendations.
[5] Cathodic protection is a procedure by which an underground metallic pipe is protected against corrosion. There are two basic methods of cathodic protection: use of galvanic anode and impressed current systems. Galvanic systems rely on a sacrificial metal, such as zinc, to protect the pipe. For impressed current systems, a direct current is impressed onto the pipe by means of a rectifier, and corrosion is reduced where sufficient current flows onto the pipe. Testing of the electrical current for cathodic protection should be undertaken regularly. US Department of Transportation, Office of Pipeline Safety (2002).
[6] An example of the performance specifications for polyethylene gas pipe is the ASTM D 2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings or Standard EN 1555 Plastics Piping Systems.
[7] Leaks are indicated by the presence of gas odor and hissing sounds. Additional indicators may include changes in vegetation, insect activity, and the presence of fungal growths surrounding pipelines and components. Examples of leak detection equipment include specialized soap solutions, in addition to combustible gas indicators (CGI), flame ionization detectors (FI), and sonic detectors that use sound levels to locate leaks. US Department of Transportation, Office of Pipeline Safety (2002).

1.2 Occupational Health and Safety

Occupational health and safety (OHS) issues in the construction phase include potential exposures to dust, noise, physical strain, and trenching excavation hazards. Recommendations for the management of construction phase hazards are addressed in more detail in the **General EHS Guidelines.** Occupational health and safety hazards associated with the construction and operation of gas distribution systems may also include:

- Occupational exposure to gas leaks and explosions
- Confined spaces
- Electrocution

Additional recommendations for operational phase OHS issues also applicable to gas distribution activities are also addressed in the **General EHS Guidelines**.

Occupational exposure to gas leaks and explosions

Excavation, construction, and repair of gas distribution systems may result in accidental pipeline rupture or leakage and consequent exposure of workers to harmful gases and an explosive gas atmosphere. In addition, excavation by non-gas utility personnel may result in accidental ruptures and exposure of untrained workers to explosion hazards. Recommended techniques to prevent and control exposure to gases and explosive atmospheres caused by accidental gas line ruptures and / or leaks include:

- Training of employees and contractor personnel in safety procedures, together with provision of appropriate tools and equipment;
- Identification and location of existing gas and other buried utility infrastructure prior to excavation for installation or repair of gas pipelines. Installation of visual marking of gas lines as part of installation, and updating as necessary on an ongoing basis;
- Removal of sources of ignition prior to gas venting for maintenance and repair activities. Purging of gas from pipeline or pipe components prior to welding or cutting activities;
- Installation of gas lines and components using sufficient separation distance and appropriate pipe protection layering to minimize potential interference with other underground infrastructure. Separation of plastic pipes from sources of heat;
- Odorization of gas to facilitate detection of gas leakage;[8]
- Training of gas utility workers in procedures for emergency preparedness and response involving appropriate public authorities, in addition to emergency shutdown and pressure reduction in the pipeline system. Further recommendations for emergency preparedness and response are addressed in the **General EHS Guidelines**.

Confined spaces

Accumulation of natural gas in a confined space is a potentially fatal condition. Entry by workers into confined spaces and the associated potential for accidents may vary among gas distribution project phases and facilities. Specific and unique areas for confined space entry may include excavation trenches during construction and regulating stations and vaults, both above and below ground, which may also contain equipment (e.g. safety valves, filters) that may emit fugitive emissions of gas and create a potential for oxygen deficient and explosive atmospheres. Gas distribution companies should develop and implement confined space entry procedures as described the **General EHS Guidelines**, and including the following:

[8] A combustible gas in a distribution line must contain a natural odorant or be odorized so that at a concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell. See US 49 CFR Part 192.

- Requiring work permits for all confined space entries;
- Installation of appropriate access controls for unauthorized personnel including signage to alert workers to the hazards of confined spaces;
- Use of ventilation and oxygen / explosive level detection and alarm equipment prior to access.

Electrocution

Excavation, construction, and repair of gas distribution systems may result in workers' exposure to existing aboveground or underground utilities, including aerial or buried electric transmission lines. Identification and location of all relevant existing underground utilities should be undertaken prior to any construction and excavation activities.

1.3 Community Health and Safety

Community health and safety hazards associated with the construction and operation of gas distribution systems include public exposure to gas leaks and explosions. Additional recommendations for community health and safety issues common to most industry sectors are addressed in the **General EHS Guidelines**.

Public exposure to gas leaks and explosions

The presence of gas distribution systems within populated areas may expose the public to hazards from gas leaks and explosions. Gas leakage may result from accidental rupture of pipelines during installation and repair or from contact during excavation unrelated to the gas system. Gas utility operators should inform and advise affected communities, schools, businesses / commercial facilities, and residents about the potential hazards presented by gas infrastructure. Gas distribution system operators should establish an emergency preparedness and response plan and communicate this plan to the public as necessary.

As part of the plan, gas system operators should implement a telephone notification system to respond to reports of leaks or questions of general safety from the affected community and other interested parties. Operators should also provide a pipe location service to assist outside contractors and the general public to determine the location of gas infrastructure prior to construction works proximate to gas pipelines.

Improper operation of natural gas fuelled appliances and equipment may expose the user and the public to gas leakage and explosion hazards. Gas distribution system operators should make information available to customers (e.g. through flyers and internet-based information) regarding the safe operation of gas fueled appliances and equipment. This information should address issues of proper and safe use of gas-fired appliances, which in the case of residential use, may include the following issues:

- Proper location, installation, and maintenance of appliances and equipment such as natural gas fired heating units. For example, installation in areas with adequate ventilation to ensure dispersion of residual carbon monoxide. Poor combustion in a natural gas fired appliance or piece of equipment may expose the user and the public to carbon monoxide exposure, especially in confined spaces;
- Recognition of potential hazards or operating problems. For example, recognition of the hazards of poor ventilation or identification of gas surges requiring action by the gas utility (identifiable when flame color in natural gas burning appliances is orange or yellow rather than blue), and how to respond to possible accumulation of gas vapors when odor is detected with instructions on proper response procedures. These procedures may include avoiding

sources of ignition (e.g. electrical switches, lighters), ventilating area of gas accumulation, and calling the emergency contact number of the local gas utility from a safe location.

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

Although there are no significant point source emissions or effluents for the gas distribution sector, fugitive emissions (from city gate and regulating stations, underground piping, and third party damage) from gas distribution systems constitute a significant portion of the overall atmospheric losses from the natural gas transmission and distribution industry. Gas distribution system operators should conduct volume reconciliation programs as an indicator of leakages by comparing delivered gas amounts against sales to customers.[9] Operators should also implement inspection and maintenance programs to maintain and upgrade infrastructure and minimize fugitive gas emissions.

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project.

Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[10] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[11] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[12] Indicative Occupational Exposure Limit Values published by European Union member states,[13] or other similar sources.

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to

[9] Supervisory Control and Data Acquisition (SCADA) systems may be another useful means of monitoring system volume flows, especially in new system installations.

[10] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/
[11] Available at: http://www.cdc.gov/niosh/npg/
[12] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992
[13] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/

a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)[14].

Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals[15] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

[14] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm
[15] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

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Annex A: General Description of Industry Activities

Gas distribution systems deliver natural gas to residential, commercial, and industrial clients for use in appliances, heating applications, and industrial process equipment. The distribution system typically begins at the 'city gate' where natural gas from high pressure transmission pipelines (typically at 50 to 70 bar[16]) is depressurized, metered and odorized (to facilitate leak detection). City gates are secure, above ground facilities, typically less than 1 ha in area and containing equipment belonging to both the transmission and distribution companies. Once metered and odorized, gas is fed into distribution mains and service lines for delivery of low pressure gas to end users through underground, small diameter steel or plastic pipe systems. Pressure is further lowered, often in stages, for delivery to the customer.

Gas supplied to distribution systems is normally referred to as "pipeline quality natural gas", which has been processed to remove water vapor and other contaminants and has predictable burning characteristics and heat content. Processed natural gas typically contains 75 to 90+ percent methane, 3 to 4 percent nitrogen, and 2 percent carbon dioxide, but these fractions may vary in different countries. In exceptional cases, gas distribution systems may need to include additional processing if supplied gas is not of pipeline quality, such as gas produced locally from landfills, biomass, or manure.

Gas distribution systems are often a mix of new construction and old infrastructure that may contain legacy issues such as old gas meters that contain mercury, obsolete gas processing facilities, and plants that were used for manufacture of synthetic gas. Special attention should be paid to leak management when old and new infrastructure is combined or when the source of gas is changed.

The construction and installation of natural gas distribution pipeline systems involves planning and design for the right-of-way, including use of existing utility corridors (e.g. co-location with sewer, water, telecommunication, and power systems) where possible. Establishment of the right-of-way may involve clearing of vegetation and grading of surfaces. Pipe is laid following trenching activities using a backhoe, and, where appropriate, the use of directional drilling to minimize land disturbance. Guided drilling may be particularly useful when crossing under roadways, waterways or wetland habitats. Trenches are then backfilled and the right-of-way is restored using existing vegetation. Distribution pipes are typically of steel or plastic materials. Various coating and cathodic protection techniques are employed to protect steel piping from corrosive reactions, both above and below ground.

Gas distribution systems typically involve the use of regulating stations to adjust the pressure of gas throughout the distribution network. These installations are typically located above ground and occupy approximately 20 m^2 of land area. Regulating stations are located after the 'city gate' and may operate in a sequential fashion to reduce gas pressure during distribution to end users. Final pressure adjustment is undertaken at the individual residential customer (to about 0.1 bar), and at commercial, and industrial meters (to from 1 to 15 bar).

Activities by the gas distribution system during operation and maintenance include overall systems operation and monitoring of infrastructure components, such as valves, regulating stations, and pipes through flow meter data analysis and onsite inspection. Operators regularly undertake inspections for gas leaks, corrosion, and overall system integrity. Ongoing connection of new subscribers within the distribution market is a regular operational activity, and is typically undertaken while the distribution pipes are pressurized, so as not to interrupt service

[16] 1 bar is approximately 1 atmosphere, or 14.5 lb/in^2.

to other customers. Repair activities involve all parts of the distribution system and typical tasks include repair and replacement of pipes and valves, in particular after accidental damage due to excavation near pipeline infrastructure.

Gas distribution operators are also typically responsible for training their employees, and ensuring that contractors are trained, in the procedures and actions necessary for effective emergency response to leaks, ruptures, and other incidents caused by the operators themselves, third parties, or natural hazards. Effective emergency response requires that gas distribution operators integrate with local government and municipal authorities, in addition to residential, commercial and industrial partners to ensure coordinated actions in the event of an emergency.

Decommissioning of distribution lines typically involves the closure and securing of valves to impede flow of gas to the customer and disconnection and sealing of the distribution mains and service line piping after purging of residual gas. Above ground structures such as regulating stations may be removed. Below ground pipelines, vaults and other components may be removed or left in place depending on site specific considerations.

EIA ANNEX 1-7

IFC/WB Environmental, Health, and Safety
General Guidelines, 2007

Environmental, Health, and Safety General Guidelines

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These **General EHS Guidelines** are designed to be used together with the relevant **Industry Sector EHS Guidelines** which provide guidance to users on EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment[2] in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

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[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

[2] For IFC, such assessment is carried out consistent with Performance Standard 1, and for the World Bank, with Operational Policy 4.01.

General Approach to the Management of EHS Issues at the Facility or Project Level

Effective management of environmental, health, and safety (EHS) issues entails the inclusion of EHS considerations into corporate- and facility-level business processes in an organized, hierarchical approach that includes the following steps:

- Identifying EHS project hazards[3] and associated risks[4] as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans.
- Involving EHS professionals, who have the experience, competence, and training necessary to assess and manage EHS impacts and risks, and carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures that incorporate the technical recommendations presented in this document that are relevant to the project.
- Understanding the likelihood and magnitude of EHS risks, based on:
    - The nature of the project activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes;
    - The potential consequences to workers, communities, or the environment if hazards are not adequately managed, which may depend on the proximity of project activities to people or to the environmental resources on which they depend.
- Prioritizing risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and / or significant impacts.
- Favoring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for EHS controls.
- When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences, for example, with the application of pollution controls to reduce the levels of emitted contaminants to workers or environments.
- Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.
- Improving EHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

[3] Defined as "threats to humans and what they value" (Kates, et al., 1985).

[4] Defined as "quantitative measures of hazard consequences, usually expressed as conditional probabilities of experiencing harm" (Kates, et. al., 1985)

1.0 Environmental

1.1 Air Emissions and Ambient Air Quality

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Applicability and Approach

This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for emissions management that may be applied to a range of industry sectors. This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. It is also intended to provide additional information on approaches to emissions management in projects located in areas of poor air quality, where it may be necessary to establish project-specific emissions standards.

Emissions of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of a project. These activities can be categorized based on the spatial characteristic of the source including point sources, fugitive sources, and mobile sources and, further, by process, such as combustion, materials storage, or other industry sector-specific processes.

Where possible, facilities and projects should avoid, minimize, and control adverse impacts to human health, safety, and the environment from emissions to air. Where this is not possible, the generation and release of emissions of any type should be managed through a combination of:

- Energy use efficiency
- Process modification
- Selection of fuels or other materials, the processing of which may result in less polluting emissions
- Application of emissions control techniques

The selected prevention and control techniques may include one or more methods of treatment depending on:

- Regulatory requirements
- Significance of the source
- Location of the emitting facility relative to other sources
- Location of sensitive receptors
- Existing ambient air quality, and potential for degradation of the airshed from a proposed project
- Technical feasibility and cost effectiveness of the available options for prevention, control, and release of emissions

Ambient Air Quality

General Approach

Projects with significant[5,6] sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards[9] by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[10] (see Table 1.1.1), or other internationally recognized sources[11];
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.[12]

At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic, and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes, or eddy effects of the source, nearby[13] structures, and terrain features. The dispersion model applied should be internationally recognized, or comparable. Examples of acceptable emission estimation and dispersion modeling approaches for point and fugitive sources are

Table 1.1.1: WHO Ambient Air Quality Guidelines[7],[8]

	Averaging Period	Guideline value in $\mu g/m^3$
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

[5] Significant sources of point and fugitive emissions are considered to be general sources which, for example, can contribute a net emissions increase of one or more of the following pollutants within a given airshed: PM10: 50 tons per year (tpy); NOx: 500 tpy; SO2: 500 tpy; or as established through national legislation; and combustion sources with an equivalent heat input of 50 MWth or greater. The significance of emissions of inorganic and organic pollutants should be established on a project-specific basis taking into account toxic and other properties of the pollutant.

[6] United States Environmental Protection Agency, Prevention of Significant Deterioration of Air Quality, 40 CFR Ch. 1 Part 52.21. Other references for establishing significant emissions include the European Commission. 2000. "Guidance Document for EPER implementation." http://ec.europa.eu/environment/ippc/eper/index.htm ; and Australian Government. 2004. "National Pollutant Inventory Guide." http://www.npi.gov.au/handbooks/pubs/npiguide.pdf

[7] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

[8] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

[9] Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization).

[10] Available at World Health Organization (WHO). http://www.who.int/en

[11] For example the United States National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/air/criteria.html) and the relevant European Council Directives (Council Directive 1999/30/EC of 22 April 1999 / Council Directive 2002/3/EC of February 12 2002).

[12] US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds.

included in Annex 1.1.1. These approaches include screening models for single source evaluations (SCREEN3 or AIRSCREEN), as well as more complex and refined models (AERMOD OR ADMS). Model selection is dependent on the complexity and geo-morphology of the project site (e.g. mountainous terrain, urban or rural area).

Projects Located in Degraded Airsheds or Ecologically Sensitive Areas

Facilities or projects located within poor quality airsheds[14], and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed.

Specific provisions for minimizing emissions and their impacts in poor air quality or ecologically sensitive airsheds should be established on a project-by-project or industry-specific basis. Offset provisions outside the immediate control of the project sponsor or buy-downs should be monitored and enforced by the local agency responsible for granting and monitoring emission permits. Such provisions should be in place prior to final commissioning of the facility / project.

Point Sources

Point sources are discrete, stationary, identifiable sources of emissions that release pollutants to the atmosphere. They are typically located in manufacturing or production plants. Within a given point source, there may be several individual 'emission points' that comprise the point source.[15]

Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities.

Emissions from point sources should be avoided and controlled according to good international industry practice (GIIP) applicable to the relevant industry sector, depending on ambient conditions, through the combined application of process modifications and emissions controls, examples of which are provided in Annex 1.1.2. Additional recommendations regarding stack height and emissions from small combustion facilities are provided below.

Stack Height

The stack height for all point sources of emissions, whether 'significant' or not, should be designed according to GIIP (see Annex 1.1.3) to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts. For projects where there are multiple sources of emissions, stack heights should be established with due consideration to emissions from all other project sources, both point and fugitive. Non-significant sources of emissions,

[13] "Nearby" generally considers an area within a radius of up to 20 times the stack height.

[14] An airshed should be considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly.

[15] Emission points refer to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterization of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

including small combustion sources,[16] should also use GIIP in stack design.

Small Combustion Facilities Emissions Guidelines

Small combustion processes are systems designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type, with a total, rated heat input capacity of between three Megawatt thermal (MWth) and 50 MWth.

The emissions guidelines in Table 1.1.2 are applicable to small combustion process installations operating more than 500 hours per year, and those with an annual capacity utilization of more than 30 percent. Plants firing a mixture of fuels should compare emissions performance with these guidelines based on the sum of the relative contribution of each applied fuel[17]. Lower emission values may apply if the proposed facility is located in an ecologically sensitive airshed, or airshed with poor air quality, in order to address potential cumulative impacts from the installation of more than one small combustion plant as part of a distributed generation project.

[16] Small combustion sources are those with a total rated heat input capacity of 50MWth or less.

[17] The contribution of a fuel is the percentage of heat input (LHV) provided by this fuel multiplied by its limit value.

Table 1.1.2 - Small Combustion Facilities Emissions Guidelines (3MWth – 50MWth) – (in mg/Nm^3 or as indicated)				
Combustion Technology / Fuel	**Particulate Matter (PM)**	**Sulfur Dioxide (SO_2)**	**Nitrogen Oxides (NOx)**	**Dry Gas, Excess O_2 Content (%)**
Engine				
Gas	N/A	N/A	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)	15
Liquid	50 or up to 100 if justified by project specific considerations (e.g. Economic feasibility of using lower ash content fuel, or adding secondary treatment to meet 50, and available environmental capacity of the site)	1.5 percent Sulfur or up to 3.0 percent Sulfur if justified by project specific considerations (e.g. Economic feasibility of using lower S content fuel, or adding secondary treatment to meet levels of using 1.5 percent Sulfur, and available environmental capacity of the site)	If bore size diameter [mm] < 400: 1460 (or up to 1,600 if justified to maintain high energy efficiency.) If bore size diameter [mm] > or = 400: 1,850	15
Turbine				
Natural Gas =3MWth to < 15MWth	N/A	N/A	42 ppm (Electric generation) 100 ppm (Mechanical drive)	15
Natural Gas =15MWth to < 50MWth	N/A	N/A	25 ppm	15
Fuels other than Natural Gas =3MWth to < 15MWth	N/A	0.5 percent Sulfur or lower percent Sulfur (e.g. 0.2 percent Sulfur) if commercially available without significant excess fuel cost	96 ppm (Electric generation) 150 ppm (Mechanical drive)	15
Fuels other than Natural Gas =15MWth to < 50MWth	N/A	0.5% S or lower % S (0.2%S) if commercially available without significant excess fuel cost	74 ppm	15
Boiler				
Gas	N/A	N/A	320	3
Liquid	50 or up to 150 if justified by environmental assessment	2000	460	3
Solid	50 or up to 150 if justified by environmental assessment	2000	650	6

Notes: -N/A/ - no emissions guideline; Higher performance levels than these in the Table should be applicable to facilities located in urban / industrial areas with degraded airsheds or close to ecologically sensitive areas where more stringent emissions controls may be needed.; MWth is heat input on HHV basis; Solid fuels include biomass; Nm^3 is at one atmosphere pressure, 0°C.; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack except for NOx and PM limits for turbines and boilers. Guidelines values apply to facilities operating more than 500 hours per year with an annual capacity utilization factor of more than 30 percent.

Fugitive Sources

Fugitive source air emissions refer to emissions that are distributed spatially over a wide area and not confined to a specific discharge point. They originate in operations where exhausts are not captured and passed through a stack. Fugitive emissions have the potential for much greater ground-level impacts per unit than stationary source emissions, since they are discharged and dispersed close to the ground. The two main types of fugitive emissions are Volatile Organic Compounds (VOCs) and particulate matter (PM). Other contaminants (NO_x, SO_2 and CO) are mainly associated with combustion processes, as described above. Projects with potentially significant fugitive sources of emissions should establish the need for ambient quality assessment and monitoring practices.

Open burning of solid wastes, whether hazardous or non-hazardous, is not considered good practice and should be avoided, as the generation of polluting emissions from this type of source cannot be controlled effectively.

Volatile Organic Compounds (VOCs)

The most common sources of fugitive VOC emissions are associated with industrial activities that produce, store, and use VOC-containing liquids or gases where the material is under pressure, exposed to a lower vapor pressure, or displaced from an enclosed space. Typical sources include equipment leaks, open vats and mixing tanks, storage tanks, unit operations in wastewater treatment systems, and accidental releases. Equipment leaks include valves, fittings, and elbows which are subject to leaks under pressure. The recommended prevention and control techniques for VOC emissions associated with equipment leaks include:

- Equipment modifications, examples of which are presented in Annex 1.1.4;
- Implementing a leak detection and repair (LDAR) program that controls fugitive emissions by regularly monitoring to detect leaks, and implementing repairs within a predefined time period.[18]

For VOC emissions associated with handling of chemicals in open vats and mixing processes, the recommended prevention and control techniques include:

- Substitution of less volatile substances, such as aqueous solvents;
- Collection of vapors through air extractors and subsequent treatment of gas stream by removing VOCs with control devices such as condensers or activated carbon absorption;
- Collection of vapors through air extractors and subsequent treatment with destructive control devices such as:
  - Catalytic Incinerators: Used to reduce VOCs from process exhaust gases exiting paint spray booths, ovens, and other process operations
  - Thermal Incinerators: Used to control VOC levels in a gas stream by passing the stream through a combustion chamber where the VOCs are burned in air at temperatures between 700º C to 1,300º C
  - Enclosed Oxidizing Flares: Used to convert VOCs into CO_2 and H_2O by way of direct combustion
- Use of floating roofs on storage tanks to reduce the opportunity for volatilization by eliminating the headspace present in conventional storage tanks.

Particulate Matter (PM)

The most common pollutant involved in fugitive emissions is dust or particulate matter (PM). This is released during certain operations, such as transport and open storage of solid materials, and from exposed soil surfaces, including unpaved roads.

[18] For more information, see Leak Detection and Repair Program (LDAR), at: http://www.ldar.net

Recommended prevention and control of these emissions sources include:

- Use of dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles, or controls, including air extraction and treatment through a baghouse or cyclone for material handling sources, such as conveyors and bins;
- Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust. Examples of additional control options for unpaved roads include those summarized in Annex 1.1.5.

Ozone Depleting Substances (ODS)

Several chemicals are classified as ozone depleting substances (ODSs) and are scheduled for phase-out under the Montreal Protocol on Substances that Deplete the Ozone Layer.[19] No new systems or processes should be installed using CFCs, halons, 1,1,1-trichloroethane, carbon tetrachloride, methyl bromide or HBFCs. HCFCs should only be considered as interim / bridging alternatives as determined by the host country commitments and regulations.[20]

Mobile Sources – Land-based

Similar to other combustion processes, emissions from vehicles include CO, NO_x, SO_2, PM and VOCs. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following approach should be considered:

- Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs;
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Operators with fleets of 120 or more units of heavy duty vehicles (buses and trucks), or 540 or more light duty vehicles[21] (cars and light trucks) within an airshed should consider additional ways to reduce potential impacts including:
  - Replacing older vehicles with newer, more fuel efficient alternatives
  - Converting high-use vehicles to cleaner fuels, where feasible
  - Installing and maintaining emissions control devices, such as catalytic converters
  - Implementing a regular vehicle maintenance and repair program

Greenhouse Gases (GHGs)

Sectors that may have potentially significant emissions of greenhouse gases (GHGs)[22] include energy, transport, heavy industry (e.g. cement production, iron / steel manufacturing, aluminum smelting, petrochemical industries, petroleum refining, fertilizer manufacturing), agriculture, forestry and waste management. GHGs may be generated from direct emissions

[19] Examples include: chlorofluorocarbons (CFCs); halons; 1,1,1-trichloroethane (methyl chloroform); carbon tetrachloride; hydrochlorofluorocarbons (HCFCs); hydrobromofluorocarbons (HBFCs); and methyl bromide. They are currently used in a variety of applications including: domestic, commercial, and process refrigeration (CFCs and HCFCs); domestic, commercial, and motor vehicle air conditioning (CFCs and HCFCs); for manufacturing foam products (CFCs); for solvent cleaning applications (CFCs, HCFCs, methyl chloroform, and carbon tetrachloride); as aerosol propellants (CFCs); in fire protection systems (halons and HBFCs); and as crop fumigants (methyl bromide).

[20] Additional information is available through the Montreal Protocol Secretariat web site available at: http://ozone.unep.org/

[21] The selected fleet size thresholds are assumed to represent potentially significant sources of emissions based on individual vehicles traveling 100,000 km / yr using average emission factors.

[22] The six greenhouse gases that form part of the Kyoto Protocol to the United Nations Framework Convention on Climate Change include carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF_6).

from facilities within the physical project boundary and indirect emissions associated with the off-site production of power used by the project.

Recommendations for reduction and control of greenhouse gases include:

- Carbon financing;[23]
- Enhancement of energy efficiency (see section on 'Energy Conservation');
- Protection and enhancement of sinks and reservoirs of greenhouse gases;
- Promotion of sustainable forms of agriculture and forestry;
- Promotion, development and increased use of renewable forms of energy;
- Carbon capture and storage technologies;[24]
- Limitation and / or reduction of methane emissions through recovery and use in waste management, as well as in the production, transport and distribution of energy (coal, oil, and gas).

Monitoring

Emissions and air quality monitoring programs provide information that can be used to assess the effectiveness of emissions management strategies. A systematic planning process is recommended to ensure that the data collected are adequate for their intended purposes (and to avoid collecting unnecessary data). This process, sometimes referred to as a data quality objectives process, defines the purpose of collecting the data, the decisions to be made based on the data and the consequences of making an incorrect decision, the time and geographic boundaries, and the quality of data needed to make a correct decision.[25] The air quality monitoring program should consider the following elements:

- *Monitoring parameters*: The monitoring parameters selected should reflect the pollutants of concern associated with project processes. For combustion processes, indicator parameters typically include the quality of inputs, such as the sulfur content of fuel.
- *Baseline calculations*: Before a project is developed, baseline air quality monitoring at and in the vicinity of the site should be undertaken to assess background levels of key pollutants, in order to differentiate between existing ambient conditions and project-related impacts.
- *Monitoring type and frequency*: Data on emissions and ambient air quality generated through the monitoring program should be representative of the emissions discharged by the project over time. Examples of time-dependent variations in the manufacturing process include batch process manufacturing and seasonal process variations. Emissions from highly variable processes may need to be sampled more frequently or through composite methods. Emissions monitoring frequency and duration may also range from continuous for some combustion process operating parameters or inputs (e.g. the quality of fuel) to less frequent, monthly, quarterly or yearly stack tests.
- *Monitoring locations*: Ambient air quality monitoring may consists of off-site or fence line monitoring either by the project sponsor, the competent government agency, or by collaboration between both. The location of ambient air

[23] Carbon financing as a carbon emissions reduction strategy may include the host government-endorsed Clean Development Mechanism or Joint Implementation of the United Nations Framework Convention on Climate Change.

[24] Carbon dioxide capture and storage (CCS) is a process consisting of the separation of CO_2 from industrial and energy-related sources; transport to a storage location; and long-term isolation from the atmosphere, for example in geological formations, in the ocean, or in mineral carbonates (reaction of CO_2 with metal oxides in silicate minerals to produce stable carbonates). It is the object of intensive research worldwide (Intergovernmental Panel on Climate Change (IPCC), Special Report, Carbon Dioxide Capture and Storage (2006).

[25] See, for example, United States Environmental Protection Agency, Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4, EPA/240/B-06/001 February 2006.

quality monitoring stations should be established based on the results of scientific methods and mathematical models to estimate potential impact to the receiving airshed from an emissions source taking into consideration such aspects as the location of potentially affected communities and prevailing wind directions.

- *Sampling and analysis methods*: Monitoring programs should apply national or international methods for sample collection and analysis, such as those published by the International Organization for Standardization,[26] the European Committee for Standardization,[27] or the U.S. Environmental Protection Agency.[28] Sampling should be conducted by, or under, the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and analysis Quality Assurance / Quality Control (QA/QC) plans should be applied and documented to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). Monitoring reports should include QA/QC documentation.

Monitoring of Small Combustion Plants Emissions

- Additional recommended monitoring approaches for **boilers**:

  Boilers with capacities between =3 MWth and < 20 MWth:

  - Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification if no SO_2 control equipment is used.
  - If Annual Stack Emission Testing demonstrates results consistently and significantly better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
  - Emission Monitoring: None

  Boilers with capacities between =20 MWth and < 50 MWth

  - Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification (if no SO_2 control equipment is used)
  - Emission Monitoring: SO_2. Plants with SO_2 control equipment: Continuous. NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. PM: Continuous monitoring of either PM emissions, opacity, or indicative PM emissions using combustion parameters / visual monitoring.

- Additional recommended monitoring approaches for **turbines**:
  - Annual Stack Emission Testing: NO_x and SO_2 (NO_x only for gaseous fuel-fired turbines).
  - If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
  - Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters.SO_2: Continuous monitoring if SO_2 control equipment is used.

- Additional recommended monitoring approaches for **engines**:
  - Annual Stack Emission Testing: NO_x ,SO_2 and PM (NO_x only for gaseous fuel-fired diesel engines).

[26] An on-line catalogue of ISO standards relating to the environment, health protection, and safety is available at: http://www.iso.org/iso/en/CatalogueListPage.CatalogueList?ICS1=13&ICS2=&ICS3=&scopelist=

[27] An on-line catalogue of European Standards is available at: http://www.cen.eu/catweb/cwen.htm .

[28] The National Environmental Methods Index provides a searchable clearinghouse of U.S. methods and procedures for both regulatory and non-regulatory monitoring purposes for water, sediment, air and tissues, and is available at http://www.nemi.gov/.

- If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
- Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. SO_2: Continuous monitoring if SO_2 control equipment is used. PM: Continuous monitoring of either PM emissions or indicative PM emissions using operating parameters.

Annex 1.1.1 – Air Emissions Estimation and Dispersion Modeling Methods

The following is a partial list of documents to aid in the estimation of air emissions from various processes and air dispersion models:

Australian Emission Estimation Technique Manuals
http://www.npi.gov.au/handbooks/

Atmospheric Emission Inventory Guidebook, UN / ECE / EMEP and the European Environment Agency
http://www.aeat.co.uk/netcen/airqual/TFEI/unece.htm

Emission factors and emission estimation methods, US EPA Office of Air Quality Planning & Standards
http://www.epa.gov/ttn/chief

Guidelines on Air Quality Models (Revised), US Environmental Protection Agency (EPA), 2005
http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

Frequently Asked Questions, Air Quality Modeling and Assessment Unit (AQMAU), UK Environment Agency
http://www.environment-agency.gov.uk/subjects/airquality/236092/?version=1&lang=_e

OECD Database on Use and Release of Industrial Chemicals
http://www.olis.oecd.org/ehs/urchem.nsf/

Annex 1.1.2 – Illustrative Point Source Air Emissions Prevention and Control Technologies

Principal Sources and Issues	General Prevention / Process Modification Approach	Control Options	Reduction Efficiency (%)	Gas Condition	Comments
Particulate Matter (PM)					
Main sources are the combustion of fossil fuels and numerous manufacturing processes that collect PM through air extraction and ventilation systems. Volcanoes, ocean spray, forest fires and blowing dust (most prevalent in dry and semiarid climates) contribute to background levels.	Fuel switching (e.g. selection of lower sulfur fuels) or reducing the amount of fine particulates added to a process.	Fabric Filters	99 - 99.7%	Dry gas, temp <400F	Applicability depends on flue gas properties including temperature, chemical properties, abrasion and load. Typical air to cloth ratio range of 2.0 to 3.5 cfm/ft^2 Achievable outlet concentrations of 23 mg/Nm^3
		Electrostatic Precipitator (ESP)	97 – 99%	Varies depending of particle type	Precondition gas to remove large particles. Efficiency dependent on resistivity of particle. Achievable outlet concentration of 23 mg/Nm^3
		Cyclone	74 – 95%	None	Most efficient for large particles. Achievable outlet concentrations of 30 - 40 mg/Nm^3
		Wet Scrubber	93 – 95%	None	Wet sludge may be a disposal problem depending on local infrastructure. Achievable outlet concentrations of 30 - 40 mg/Nm3
Sulfur Dioxide (SO_2)					
Mainly produced by the combustion of fuels such as oil and coal and as a by-product from some chemical production or wastewater treatment processes.	Control system selection is heavily dependent on the inlet concentration. For SO2 concentrations in excess of 10%, the stream is passed through an acid plant not only to lower the SO2 emissions but also to generate high grade sulfur for sale. Levels below 10% are not rich enough for this process and should therefore utilize absorption or 'scrubbing,' where SO2 molecules are captured into a liquid phase or adsorption, where SO2 molecules are captured on the surface of a solid adsorbent.	Fuel Switching	>90%		Alternate fuels may include low sulfur coal, light diesel or natural gas with consequent reduction in particulate emissions related to sulfur in the fuel. Fuel cleaning or beneficiation of fuels prior to combustion is another viable option but may have economic consequences.
		Sorbent Injection	30% - 70%		Calcium or lime is injected into the flue gas and the SO_2 is adsorbed onto the sorbent
		Dry Flue Gas Desulfurization	70%-90%		Can be regenerable or throwaway.
		Wet Flue Gas Desulfurization	>90%		Produces gypsum as a by-product

Annex 1.1.2: Illustrative Point Source Air Emissions Prevention and Control Technologies (continued)

Oxides of Nitrogen (NOx)		Percent Reduction by Fuel Type			Comments
Associated with combustion of fuel. May occur in several forms of nitrogen oxide; namely nitric oxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O), which is also a greenhouse gas. The term NOx serves as a composite between NO and NO_2 and emissions are usually reported as NOx. Here the NO is multiplied by the ratio of molecular weights of NO_2 to NO and added to the NO_2 emissions. Means of reducing NOx emissions are based on the modification of operating conditions such as minimizing the resident time at peak temperatures, reducing the peak temperatures by increasing heat transfer rates or minimizing the availability of oxygen.	**Combustion modification** (Illustrative of boilers)	**Coal**	**Oil**	**Gas**	These modifications are capable of reducing NOx emissions by 50 to 95%. The method of combustion control used depends on the type of boiler and the method of firing fuel.
	Low-excess-air firing	10–30	10–30	10–30	
	Staged Combustion	20–50	20–50	20–50	
	Flue Gas Recirculation	N/A	20–50	20–50	
	Water/Steam Injection	N/A	10–50	N/A.	
	Low-NOx Burners	30–40	30–40	30–40	
	Flue Gas Treatment	**Coal**	**Oil**	**Gas**	Flue gas treatment is more effective in reducing NOx emissions than are combustion controls. Techniques can be classified as SCR, SNCR, and adsorption. SCR involves the injection of ammonia as a reducing agent to convert NOx to nitrogen in the presence of a catalyst in a converter upstream of the air heater. Generally, some ammonia slips through and is part of the emissions. SNCR also involves the injection of ammonia or urea based products without the presence of a catalyst.
	Selective Catalytic Reduction (SCR)	60–90	60–90	60–90	
	Selective Non-Catalytic Reduction (SNCR)	N/A	30–70	30–70	

Note: Compiled by IFC based on inputs from technical experts.

Annex 1.1.3 - Good International Industry Practice (GIIP)

Stack Height

(Based on United States 40 CFR, part 51.100 (ii)).

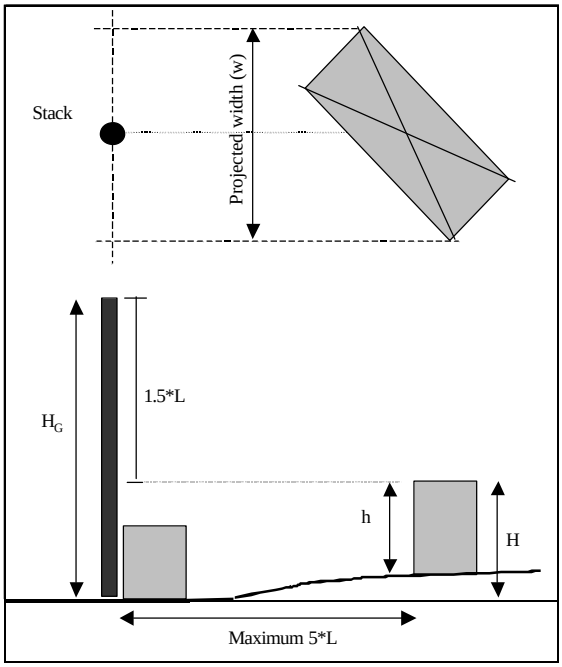
$H_G = H + 1.5L$; where

H_G = GEP stack height measured from the ground level elevation at the base of the stack

H = Height of nearby structure(s) above the base of the stack.

L = Lesser dimension, height (h) or width (w), of nearby structures

"Nearby structures" = Structures within/touching a radius of 5L but less than 800 m.



Annex 1.1.4 - Examples of VOC Emissions Controls

Equipment Type	Modification	Approximate Control Efficiency (%)
Pumps	Seal-less design	100[29]
	Closed-vent system	90[30]
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the pumped fluid	100
Compressors	Closed-vent system	90
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the compressed gas	100
Pressure Relief Devices	Closed-vent system	Variable[31]
	Rupture disk assembly	100
Valves	Seal-less design	100
Connectors	Weld together	100
Open-ended Lines	Blind, cap, plug, or second valve	100
Sampling Connections	Closed-loop sampling	100
Note: Examples of technologies are provided for illustrative purposes. The availability and applicability of any particular technology will vary depending on manufacturer specifications.		

29 Seal-less equipment can be a large source of emissions in the event of equipment failure.
30 Actual efficiency of a closed-vent system depends on percentage of vapors collected and efficiency of control device to which the vapors are routed.
31 Control efficiency of closed vent-systems installed on a pressure relief device may be lower than other closed-vent systems.

Annex 1.1.5 - Fugitive PM Emissions Controls

Control Type	Control Efficiency
Chemical Stabilization	0% - 98%
Hygroscopic salts Bitumens/adhesives	60% - 96%
Surfactants	0% - 68%
Wet Suppression – Watering	12% - 98%
Speed Reduction	0% - 80%
Traffic Reduction	Not quantified
Paving (Asphalt / Concrete)	85% - 99%
Covering with Gravel, Slag, or "Road Carpet"	30% - 50%
Vacuum Sweeping	0% - 58%
Water Flushing/Broom Sweeping	0% - 96%

1.2 Energy Conservation

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Applicability and Approach

This guideline applies to facilities or projects that consume energy in process heating and cooling; process and auxiliary systems, such as motors, pumps, and fans; compressed air systems and heating, ventilation and air conditioning systems (HVAC); and lighting systems. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for energy conservation that may be applied to a range of industry sectors.

Energy management at the facility level should be viewed in the context of overall consumption patterns, including those associated with production processes and supporting utilities, as well as overall impacts associated with emissions from power sources. The following section provides guidance on energy management with a focus on common utility systems often representing technical and financially feasible opportunities for improvement in energy conservation. However, operations should also evaluate energy conservation opportunities arising from manufacturing process modifications.

Energy Management Programs

Energy management programs should include the following elements:

- Identification, and regular measurement and reporting of principal energy flows within a facility at unit process level
- Preparation of mass and energy balance;
- Definition and regular review of energy performance targets, which are adjusted to account for changes in major influencing factors on energy use
- Regular comparison and monitoring of energy flows with performance targets to identify where action should be taken to reduce energy use
- Regular review of targets, which may include comparison with benchmark data, to confirm that targets are set at appropriate levels

Energy Efficiency

For any energy-using system, a systematic analysis of energy efficiency improvements and cost reduction opportunities should include a hierarchical examination of opportunities to**:**

- Demand/Load Side Management by reducing loads on the energy system
- Supply Side Management by:
  - Reduce losses in energy distribution
  - Improve energy conversion efficiency
  - Exploit energy purchasing opportunities
  - Use lower-carbon fuels

Common opportunities in each of these areas are summarized below.[32]

Process Heating

Process heating is vital to many manufacturing processes, including heating for fluids, calcining, drying, heat treating, metal heating, melting, melting agglomeration, curing, and forming[33].

In process heating systems, a system heat and mass balance will show how much of the system's energy input provides true process heating, and quantify fuel used to satisfy energy losses caused by excessive parasitic loads, distribution, or conversion losses. Examination of savings opportunities should be directed by the results of the heat and mass balance, though the following techniques are often valuable and cost-effective.

Heating Load Reduction

- Ensure adequate insulation to reduce heat losses through furnace/oven etc. structure
- Recover heat from hot process or exhaust streams to reduce system loads
- In intermittently-heated systems, consider use of low thermal mass insulation to reduce energy required to heat the system structure to operating temperature
- Control process temperature and other parameters accurately to avoid, for example, overheating or overdrying
- Examine opportunities to use low weight and/or low thermal mass product carriers, such as heated shapers, kiln cars etc.
- Review opportunities to schedule work flow to limit the need for process reheating between stages
- Operate furnaces/ovens at slight positive pressure, and maintain air seals to reduce air in-leakage into the heated system, thereby reducing the energy required to heat unnecessary air to system operating temperature
- Reduce radiant heat losses by sealing structural openings and keep viewing ports closed when not in use
- Where possible, use the system for long runs close to or at operating capacity
- Consider use of high emissivity coatings of high temperature insulation, and consequent reduction in process temperature
- Near net weight and shape heat designs
- Robust Quality assurance on input material
- Robust Scheduled maintenance programs

Heat Distribution Systems

Heat distribution in process heating applications typically takes place through steam, hot water, or thermal fluid systems. Losses can be reduced through the following actions:

- Promptly repair distribution system leaks
- Avoid steam leaks despite a perceived need to get steam through the turbine. Electricity purchase is usually cheaper overall, especially when the cost to treat turbine-quality boiler feed water is included. If the heat-power ratio of the distribution process is less than that of power systems, opportunities should be considered to increase the ratio; for example, by using low-pressure steam to drive absorption cooling systems rather than using electrically-driven vapor-compression systems.
- Regularly verify correct operation of steam traps in steam systems, and ensure that traps are not bypassed. Since

[32] Additional guidance on energy efficiency is available from sources such as Natural Resources Canada (NRCAN http://oee.nrcan.gc.ca/commercial/financial-assistance/new-buildings/mnecb.cfm?attr=20); the European Union (EUROPA. http://europa.eu.int/scadplus/leg/en/s15004.htm), and United States Department of Energy (US DOE, http://www.eere.energy.gov/consumer/industry/process.html).

[33] US DOE. http://www.eere.energy.gov/consumer/industry/process.html

steam traps typically last approximately 5 years, 20% should be replaced or repaired annually

- Insulate distribution system vessels, such as hot wells and de-aerators, in steam systems and thermal fluid or hot water storage tanks
- Insulate all steam, condensate, hot water and thermal fluid distribution pipework, down to and including 1" (25 mm) diameter pipe, in addition to insulating all hot valves and flanges
- In steam systems, return condensate to the boiler house for re-use, since condensate is expensive boiler-quality water and valuable beyond its heat content alone
- Use flash steam recovery systems to reduce losses due to evaporation of high-pressure condensate
- Consider steam expansion through a back-pressure turbine rather than reducing valve stations
- Eliminate distribution system losses by adopting point-of-use heating systems

Energy Conversion System Efficiency Improvements

The following efficiency opportunities should be examined for process furnaces or ovens, and utility systems, such as boilers and fluid heaters:

- Regularly monitor CO, oxygen or CO2 content of flue gases to verify that combustion systems are using the minimum practical excess air volumes
- Consider combustion automation using oxygen-trim controls
- Minimize the number of boilers or heaters used to meet loads. It is typically more efficient to run one boiler at 90% of capacity than two at 45%. Minimize the number of boilers kept at hot–standby
- Use flue dampers to eliminate ventilation losses from hot boilers held at standby
- Maintain clean heat transfer surfaces; in steam boilers, flue gases should be no more than 20 K above steam temperature)
- In steam boiler systems, use economizers to recover heat from flue gases to pre-heat boiler feed water or combustion air
- Consider reverse osmosis or electrodialysis feed water treatment to minimize the requirement for boiler blowdown
- Adopt automatic (continuous) boiler blowdown
- Recover heat from blowdown systems through flash steam recovery or feed-water preheat
- Do not supply excessive quantities of steam to the de-aerator
- With fired heaters, consider opportunities to recover heat to combustion air through the use of recuperative or regenerative burner systems
- For systems operating for extended periods (> 6000 hours/year), cogeneration of electrical power, heat and /or cooling can be cost effective
- Oxy Fuel burners
- Oxygen enrichment/injection
- Use of turbolators in boilers
- Sizing design and use of multiple boilers for different load configurations
- Fuel quality control/fuel blending

Process Cooling

The general methodology outlined above should be applied to process cooling systems. Commonly used and cost-effective measures to improve process cooling efficiency are described below.

Load Reduction

- Ensure adequate insulation to reduce heat gains through cooling system structure and to below-ambient temperature refrigerant pipes and vessels
- Control process temperature accurately to avoid overcooling
- Operate cooling tunnels at slight positive pressure and maintain air seals to reduce air in-leakage into the cooled system, thus reducing the energy required to cool this unnecessary air to system operating temperature
- Examine opportunities to pre-cool using heat recovery to a process stream requiring heating, or by using a higher temperature cooling utility
- In cold and chill stores, minimize heat gains to the cooled space by use of air curtains, entrance vestibules, or rapidly opening/closing doors. Where conveyors carry products into chilled areas, minimize the area of transfer openings, for example, by using strip curtains
- Quantify and minimize "incidental" cooling loads, for example, those due to evaporator fans, other machinery, defrost systems and lighting in cooled spaces, circulation fans in cooling tunnels, or secondary refrigerant pumps (e.g. chilled water, brines, glycols)
- Do not use refrigeration for auxiliary cooling duties, such as compressor cylinder head or oil cooling
- While not a thermal load, ensure there is no gas bypass of the expansion valve since this imposes compressor load while providing little effective cooling
- In the case of air conditioning applications, energy efficiency techniques include:
  - Placing air intakes and air-conditioning units in cool, shaded locations
  - Improving building insulation including seals, vents, windows, and doors
  - Planting trees as thermal shields around buildings
  - Installing timers and/or thermostats and/or enthalpy-based control systems
  - Installing ventilation heat recovery systems[34]

Energy Conversion

The efficiency of refrigeration service provision is normally discussed in terms of Coefficient of Performance ("COP"), which is the ratio of cooling duty divided by input power. COP is maximized by effective refrigeration system design and increased refrigerant compression efficiency, as well as minimization of the temperature difference through which the system works and of auxiliary loads (i.e. those in addition to compressor power demand) used to operate the refrigeration system.

System Design

- If process temperatures are above ambient for all, or part, of the year, use of ambient cooling systems, such as provided by cooling towers or dry air coolers, may be appropriate, perhaps supplemented by refrigeration in summer conditions.
- Most refrigeration systems are electric-motor driven vapor compression systems using positive displacement or centrifugal compressors. The remainder of this guideline relates primarily to vapor-compression systems. However, when a cheap or free heat source is available (e.g. waste heat from an engine-driven generator—low-pressure steam

[34] More information on HVAC energy efficiency can be found at the British Columbia Building Corporation (Woolliams, 2002. http://www.greenbuildingsbc.com/new_buildings/pdf_files/greenbuild_strategies_guide.pdf), NRCAN's EnerGuide (http://oee.nrcan.gc.ca/equipment/english/index.cfm?PrintView=N&Text=N) and NRCAN's Energy Star Programs (http://oee.nrcan.gc.ca/energystar/english/consumers/heating.cfm?text=N&printview=N#AC), and the US Energy Star Program (http://www.energystar.gov/index.cfm?c=guidelines.download_guidelines).

that has passed through a back-pressure turbine), absorption refrigeration may be appropriate.

- Exploit high cooling temperature range: precooling by ambient and/or 'high temperature' refrigeration before final cooling can reduce refrigeration capital and running costs. High cooling temperature range also provides an opportunity for countercurrent (cascade) cooling, which reduces refrigerant flow needs.
- Keep 'hot' and 'cold' fluids separate, for example, do not mix water leaving the chiller with water returning from cooling circuits.
- In low-temperature systems where high temperature differences are inevitable, consider two-stage or compound compression, or economized screw compressors, rather than single-stage compression.

Minimizing Temperature Differences

A vapor-compression refrigeration system raises the temperature of the refrigerant from somewhat below the lowest process temperature (the evaporating temperature) to provide process cooling, to a higher temperature (the condensing temperature), somewhat above ambient, to facilitate heat rejection to the air or cooling water systems. Increasing evaporating temperature typically increases compressor cooling capacity without greatly affecting power consumption. Reducing condensing temperature increases evaporator cooling capacity and substantially reduces compressor power consumption.

Elevating Evaporating Temperature

- Select a large evaporator to permit relatively low temperature differences between process and evaporating temperatures. Ensure that energy use of auxiliaries (e.g. evaporator fans) does not outweigh compression savings. In air-cooling applications, a design temperature difference of 6-10 K between leaving air temperature and evaporating temperature is indicative of an appropriately sized evaporator. When cooling liquids, 2K between leaving liquid and evaporating temperatures can be achieved, though a 4K difference is generally indicative of a generously-sized evaporator.
- Keep the evaporator clean. When cooling air, ensure correct defrost operation. In liquid cooling, monitor refrigerant/process temperature differences and compare with design expectations to be alert to heat exchanger contamination by scale or oil.
- Ensure oil is regularly removed from the evaporator, and that oil additions and removals balance.
- Avoid the use of back-pressure valves.
- Adjust expansion valves to minimize suction superheat consistent with avoidance of liquid carry-over to compressors.
- Ensure that an appropriate refrigerant charge volume is present.

Reducing Condensing Temperature

- Consider whether to use air-cooled or evaporation-based cooling (e.g. evaporative or water cooled condensers and cooling towers). Air-cooled evaporators usually have higher condensing temperatures, hence higher compressor energy use, and auxiliary power consumption, especially in low humidity climates. If a wet system is used, ensure adequate treatment to prevent growth of *legionella* bacteria.
- Whichever basic system is chosen, select a relatively large condenser to minimize differences between condensing and the heat sink temperatures. Condensing temperatures with air cooled or evaporative condensers should not be more than 10K above design ambient condition, and a 4K approach in a liquid-cooled condenser is possible.

- Avoid accumulation of non-condensable gases in the condenser system. Consider the installation of refrigerated non-condensable purgers, particularly for systems operating below atmospheric pressure.
- Keep condensers clean and free from scale. Monitor refrigerant/ambient temperature differences and compare with design expectations to be alert to heat exchanger contamination.
- Avoid liquid backup, which restricts heat transfer area in condensers. This can be caused by installation errors such as concentric reducers in horizontal liquid refrigerant pipes, or "up and over" liquid lines leading from condensers.
- In multiple condenser applications, refrigerant liquid lines should be connected via drop-leg traps to the main liquid refrigerant line to ensure that hot gases flow to all condensers.
- Avoid head pressure control to the extent possible. Head pressure control maintains condensing temperature at, or near, design levels. It therefore prevents reduction in compressor power consumption, which accompanies reduced condensing temperature, by restricting condenser capacity (usually by switching off the condenser, or cooling tower fans, or restricting cooling water flow) under conditions of less severe than design load or ambient temperature conditions. Head pressure is often kept higher than necessary to facilitate hot gas defrost or adequate liquid refrigerant circulation. Use of electronic rather than thermostatic expansion valves, and liquid refrigerant pumps can permit effective refrigerant circulation at much reduced condensing temperatures.
- Site condensers and cooling towers with adequate spacing so as to prevent recirculation of hot air into the tower.

Refrigerant Compression Efficiency

- Some refrigerant compressors and chillers are more efficient than others offered for the same duty. Before purchase, identify the operating conditions under which the compressor or chiller is likely to operate for substantial parts of its annual cycle. Check operating efficiency under these conditions, and ask for estimates of annual running cost. Note that refrigeration and HVAC systems rarely run for extended periods at design conditions, which are deliberately extreme. Operational efficiency under the most commonly occurring off-design conditions is likely to be most important.
- Compressors lose efficiency when unloaded. Avoid operation of multiple compressors at part-load conditions. Note that package chillers can gain coefficient of performance (COP) when slightly unloaded, as loss of compressor efficiency can be outweighed by the benefits of reduced condensing and elevated evaporating temperature. However, it is unlikely to be energy efficient to operate a single compressor-chiller at less than 50% of capacity.
- Consider turndown efficiency when specifying chillers. Variable speed control or multiple compressor chillers can be highly efficient at part loads.
- Use of thermal storage systems (e.g., ice storage) can avoid the need for close load-tracking and, hence, can avoid part-loaded compressor operation.

Refrigeration System Auxiliaries

Many refrigeration system auxiliaries (e.g. evaporator fans and chilled water pumps) contribute to refrigeration system load, so reductions in their energy use have a double benefit. General energy saving techniques for pumps and fans, listed in the next section of these guidelines, should be applied to refrigeration auxiliaries.

Additionally, auxiliary use can be reduced by avoidance of part-load operation and in plant selection (e.g. axial fan evaporative condensers generally use less energy than equivalent centrifugal fan towers).

Under extreme off-design conditions, reduction in duty of cooling system fans and pumps can be worthwhile, usually when the lowest possible condensing pressure has been achieved.

Compressed Air Systems

Compressed air is the most commonly found utility service in industry, yet in many compressed air systems, the energy contained in compressed air delivered to the user is often 10% or less of energy used in air compression. Savings are often possible through the following techniques:

Load reduction

- Examine each true user of compressed air to identify the air volume needed and the pressure at which this should be delivered.
- Do not mix high volume low pressure and low volume high pressure loads. Decentralize low volume high-pressure applications or provide dedicated low-pressure utilities, for example, by using fans rather than compressed air.
- Review air use reduction opportunities, for example:
    - Use air amplifier nozzles rather than simple open-pipe compressed air jets
    - Consider whether compressed air is needed at all
    - Where air jets are required intermittently (e.g. to propel product), consider operating the jet via a process-related solenoid valve, which opens only when air is required
    - Use manual or automatically operated valves to isolate air supply to individual machines or zones that are not in continuous use
    - Implement systems for systematic identification and repair of leaks
    - All condensate drain points should be trapped. Do not leave drain valves continuously 'cracked open'
    - Train workers never to direct compressed air against their bodies or clothing to dust or cool themselves down.

Distribution

- Monitor pressure losses in filters and replace as appropriate
- Use adequately sized distribution pipework designed to minimize pressure losses

1.3 Wastewater and Ambient Water Quality

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Applicability and Approach

This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or stormwater to the environment. These guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. Process wastewater may include contaminated wastewater from utility operations, stormwater, and sanitary sewage. It provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. This guideline is meant to be complemented by the industry-specific effluent guidelines presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or stormwater should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.

In the context of their overall ESHS management system, facilities should:

- Understand the quality, quantity, frequency and sources of liquid effluents in its installations. This includes knowledge about the locations, routes and integrity of internal drainage systems and discharge points
- Plan and implement the segregation of liquid effluents principally along industrial, utility, sanitary, and stormwater categories, in order to limit the volume of water requiring specialized treatment. Characteristics of individual streams may also be used for source segregation.
- Identify opportunities to prevent or reduce wastewater pollution through such measures as recycle/reuse within their facility, input substitution, or process modification (e.g. change of technology or operating conditions/modes).
- Assess compliance of their wastewater discharges with the applicable: (i) discharge standard (if the wastewater is discharged to a surface water or sewer), and (ii) water quality standard for a specific reuse (e.g. if the wastewater is reused for irrigation).

Additionally, the generation and discharge of wastewater of any type should be managed through a combination of:

- Water use efficiency to reduce the amount of wastewater generation
- Process modification, including waste minimization, and reducing the use of hazardous materials to reduce the load of pollutants requiring treatment
- If needed, application of wastewater treatment techniques to further reduce the load of contaminants prior to discharge, taking into consideration potential impacts of cross-media transfer of contaminants during treatment (e.g., from water to air or land)

When wastewater treatment is required prior to discharge, the level of treatment should be based on:

- Whether wastewater is being discharged to a sanitary sewer system, or to surface waters
- National and local standards as reflected in permit requirements and sewer system capacity to convey and treat wastewater if discharge is to sanitary sewer
- Assimilative capacity of the receiving water for the load of contaminant being discharged wastewater if discharge is to surface water
- Intended use of the receiving water body (e.g. as a source of drinking water, recreation, irrigation, navigation, or other)
- Presence of sensitive receptors (e.g., endangered species) or habitats
- Good International Industry Practice (GIIP) for the relevant industry sector

General Liquid Effluent Quality

Discharge to Surface Water

Discharges of process wastewater, sanitary wastewater, wastewater from utility operations or stormwater to surface water should not result in contaminant concentrations in excess of local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality.[35] Receiving water use[36] and assimilative capacity[37], taking other sources of discharges to the receiving water into consideration, should also influence the acceptable pollution loadings and effluent discharge quality. Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- Process wastewater treatment standards consistent with applicable Industry Sector EHS Guidelines. Projects for which there are no industry-specific guidelines should reference the effluent quality guidelines of an industry sector with suitably analogous processes and effluents;
- Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1 below;
- Temperature of wastewater prior to discharge does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

Discharge to Sanitary Sewer Systems

Discharges of industrial wastewater, sanitary wastewater, wastewater from utility operations or stormwater into public or private wastewater treatment systems should:

- Meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges.
- Not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact

[35] An example is the US EPA National Recommended Water Quality Criteria http://www.epa.gov/waterscience/criteria/wqcriteria.html

[36] Examples of receiving water uses as may be designated by local authorities include: drinking water (with some level of treatment), recreation, aquaculture, irrigation, general aquatic life, ornamental, and navigation. Examples of health-based guideline values for receiving waters include World Health Organization (WHO) guidelines for recreational use (http://www.who.int/water_sanitation_health/dwq/guidelines/en/index.html)

[37] The assimilative capacity of the receiving water body depends on numerous factors including, but not limited to, the total volume of water, flow rate, flushing rate of the water body and the loading of pollutants from other effluent sources in the area or region. A seasonally representative baseline assessment of ambient water quality may be required for use with established scientific methods and mathematical models to estimate potential impact to the receiving water from an effluent source.

characteristics of residuals from wastewater treatment operations.

- Be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the project. Pretreatment of wastewater to meet regulatory requirements before discharge from the project site is required if the municipal or centralized wastewater treatment system receiving wastewater from the project does not have adequate capacity to maintain regulatory compliance.

Land Application of Treated Effluent

The quality of treated process wastewater, wastewater from utility operations or stormwater discharged on land, including wetlands, should be established based on local regulatory requirements. . Where land is used as part of the treatment system and the ultimate receptor is surface water, water quality guidelines for surface water discharges specific to the industry sector process should apply.[38] Potential impact on soil, groundwater, and surface water, in the context of protection, conservation and long term sustainability of water and land resources should be assessed when land is used as part of any wastewater treatment system.

Septic Systems

Septic systems are commonly used for treatment and disposal of domestic sanitary sewage in areas with no sewerage collection networks, Septic systems should only be used for treatment of sanitary sewage, and unsuitable for industrial wastewater treatment. When septic systems are the selected form of wastewater disposal and treatment, they should be:

- Properly designed and installed in accordance with local regulations and guidance to prevent any hazard to public health or contamination of land, surface or groundwater.
- Well maintained to allow effective operation.
- Installed in areas with sufficient soil percolation for the design wastewater loading rate.
- Installed in areas of stable soils that are nearly level, well drained, and permeable, with enough separation between the drain field and the groundwater table or other receiving waters.

Wastewater Management

Wastewater management includes water conservation, wastewater treatment, stormwater management, and wastewater and water quality monitoring.

Industrial Wastewater

Industrial wastewater generated from industrial operations includes process wastewater, wastewater from utility operations,, runoff from process and materials staging areas, and miscellaneous activities including wastewater from laboratories, equipment maintenance shops, etc.. The pollutants in an industrial wastewater may include acids or bases (exhibited as low or high pH), soluble organic chemicals causing depletion of dissolved oxygen, suspended solids, nutrients (phosphorus, nitrogen), heavy metals (e.g. cadmium, chromium, copper, lead, mercury, nickel, zinc), cyanide, toxic organic chemicals, oily materials, and volatile materials. , as well as from thermal characteristics of the discharge (e.g., elevated temperature). Transfer of pollutants to another phase, such as air, soil, or the sub-surface, should be minimized through process and engineering controls.

Process Wastewater – – Examples of treatment approaches typically used in the treatment of industrial wastewater are summarized in Annex 1.3.1. While the choice of treatment

[38] Additional guidance on water quality considerations for land application is available in the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume 2: Wastewater Use in Agriculture http://www.who.int/water_sanitation_health/wastewater/gsuweg2/en/index.html

technology is driven by wastewater characteristics, the actual performance of this technology depends largely on the adequacy of its design, equipment selection, as well as operation and maintenance of its installed facilities. Adequate resources are required for proper operation and maintenance of a treatment facility, and performance is strongly dependent on the technical ability and training of its operational staff. One or more treatment technologies may be used to achieve the desired discharge quality and to maintain consistent compliance with regulatory requirements. The design and operation of the selected wastewater treatment technologies should avoid uncontrolled air emissions of volatile chemicals from wastewaters. Residuals from industrial wastewater treatment operations should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Wastewater from Utilities Operations - Utility operations such as cooling towers and demineralization systems may result in high rates of water consumption, as well as the potential release of high temperature water containing high dissolved solids, residues of biocides, residues of other cooling system anti-fouling agents, etc. Recommended water management strategies for utility operations include:

- Adoption of water conservation opportunities for facility cooling systems as provided in the Water Conservation section below;
- Use of heat recovery methods (also energy efficiency improvements) or other cooling methods to reduce the temperature of heated water prior to discharge to ensure the discharge water temperature does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations;
- Minimizing use of antifouling and corrosion inhibiting chemicals by ensuring appropriate depth of water intake and use of screens. Least hazardous alternatives should be used with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential. Dose applied should accord with local regulatory requirements and manufacturer recommendations;
- Testing for residual biocides and other pollutants of concern should be conducted to determine the need for dose adjustments or treatment of cooling water prior to discharge.

Stormwater Management - Stormwater includes any surface runoff and flows resulting from precipitation, drainage or other sources. Typically stormwater runoff contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated stormwater, also degrades the quality of the receiving water by eroding stream beds and banks. In order to reduce the need for stormwater treatment, the following principles should be applied:

- Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge
- Surface runoff from process areas or potential sources of contamination should be prevented
- Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff
- Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should

be reduced (e.g. by using vegetated swales and retention ponds);

- Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present;
- When water quality criteria allow, stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility;
- Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.
- Sludge from stormwater catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Sanitary Wastewater

Sanitary wastewater from industrial facilities may include effluents from domestic sewage, food service, and laundry facilities serving site employees. Miscellaneous wastewater from laboratories, medical infirmaries, water softening etc. may also be discharged to the sanitary wastewater treatment system. Recommended sanitary wastewater management strategies include:

- Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g. septic system which can only accept domestic sewage);
- Segregation and pretreatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into sewer systems;
- If sewage from the industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1;
- If sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet applicable national or local standards for sanitary wastewater discharges is required.
- Sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges[a]

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b] / 100 ml	400[a]

Notes:
[a] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
[b] MPN = Most Probable Number

Emissions from Wastewater Treatment Operations

Air emissions from wastewater treatment operations may include hydrogen sulfide, methane, ozone (in the case of ozone disinfection), volatile organic compounds (e.g., chloroform generated from chlorination activities and other volatile organic compounds (VOCs) from industrial wastewater), gaseous or volatile chemicals used for disinfection processes (e.g., chlorine and ammonia), and bioaerosols. Odors from treatment facilities can also be a nuisance to workers and the surrounding community. Recommendations for the management of emissions are presented in the Air Emissions and Ambient Air Quality section of this document and in the EHS Guidelines for Water and Sanitation.

Residuals from Wastewater Treatment Operations

Sludge from a waste treatment plant needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste and managed accordingly as described in the Waste Management section of this document.

Occupational Health and Safety Issues in Wastewater Treatment Operations

Wastewater treatment facility operators may be exposed to physical, chemical, and biological hazards depending on the design of the facilities and the types of wastewater effluents managed. Examples of these hazards include the potential for trips and falls into tanks, confined space entries for maintenance operations, and inhalation of VOCs, bioaerosols, and methane, contact with pathogens and vectors, and use of potentially hazardous chemicals, including chlorine, sodium and calcium hypochlorite, and ammonia. Detailed recommendations for the management of occupational health and safety issues are presented in the relevant section of this document. Additional guidance specifically applicable to wastewater treatment systems is provided in the EHS Guidelines for Water and Sanitation.

Monitoring

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring program should consider the following elements:

- *Monitoring parameters*: The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements;

- *Monitoring type and frequency*: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Monitoring of discharges from processes with batch manufacturing or seasonal process variations should take into consideration of time-dependent

variations in discharges and, therefore, is more complex than monitoring of continuous discharges. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period. Composite samplers may not be appropriate where analytes of concern are short-lived (e.g., quickly degraded or volatile).

- *Monitoring locations*: The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges. Process discharges should not be diluted prior or after treatment with the objective of meeting the discharge or ambient water quality standards.

- *Data quality*: Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and Analysis Quality Assurance/Quality Control (QA/QC) plans should be prepared and, implemented. QA/QC documentation should be included in monitoring reports.

Annex 1.3.1 - Examples of Industrial Wastewater Treatment Approaches

Pollutant/Parameter	Control Options / Principle	Common End of Pipe Control Technology
pH	Chemical, Equalization	Acid/Base addition, Flow equalization
Oil and Grease / TPH	Phase separation	Dissolved Air Floatation, oil water separator, grease trap
TSS - Settleable	Settling, Size Exclusion	Sedimentation basin, clarifier, centrifuge, screens
TSS - Non-Settleable	Floatation, Filtration - traditional and tangential	Dissolved air floatation, Multimedia filter, sand filter, fabric filter, ultrafiltration, microfiltration
Hi - BOD (> 2 Kg/m^3)	Biological - Anaerobic	Suspended growth, attached growth, hybrid
Lo - BOD (< 2 Kg/m^3)	Biological - Aerobic, Facultative	Suspended growth, attached growth, hybrid
COD - Non-Biodegradable	Oxidation, Adsorption, Size Exclusion	Chemical oxidation, Thermal oxidation, Activated Carbon, Membranes
Metals - Particulate and Soluble	Coagulation, flocculation, precipitation, size exclusion	Flash mix with settling, filtration - traditional and tangential
Inorganics / Non-metals	Coagulation, flocculation, precipitation, size exclusion, Oxidation, Adsorption	Flash mix with settling, filtration - traditional and tangential, Chemical oxidation, Thermal oxidation, Activated Carbon, Reverse Osmosis, Evaporation
Organics - VOCs and SVOCs	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological : Suspended growth, attached growth, hybrid; Chemical oxidation, Thermal oxidation, Activated Carbon
Emissions – Odors and VOCs	Capture – Active or Passive; Biological; Adsorption, Oxidation	Biological : Attached growth; Chemical oxidation, Thermal oxidation, Activated Carbon
Nutrients	Biological Nutrient Removal, Chemical, Physical, Adsorption	Aerobic/Anoxic biological treatment, chemical hydrolysis and air stripping, chlorination, ion exchange
Color	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological Aerobic, Chemical oxidation, Activated Carbon
Temperature	Evaporative Cooling	Surface Aerators, Flow Equalization
TDS	Concentration, Size Exclusion	Evaporation, crystallization, Reverse Osmosis
Active Ingredients/Emerging Contaminants	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Radionuclides	Adsorption,Size Exclusion, Concentration	Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Pathogens	Disinfection, Sterilization	Chlorine, Ozone, Peroxide, UV, Thermal
Toxicity	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Evaporation, crystallization, Reverse Osmosis

1.4 Water Conservation

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Applicability and Approach

Water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs. Water conservation measures may include water monitoring/management techniques; process and cooling/heating water recycling, reuse, and other techniques; and sanitary water conservation techniques.

General recommendations include:

- Storm/Rainwater harvesting and use
- Zero discharge design/Use of treated waste water to be included in project design processes
- Use of localized recirculation systems in plant/facility/shops (as opposed to centralized recirculation system), with provision only for makeup water
- Use of dry process technologies e.g. dry quenching
- Process water system pressure management
- Project design to have measures for adequate water collection, spill control and leakage control system

Water Monitoring and Management

The essential elements of a water management program involve:

- Identification, regular measurement, and recording of principal flows within a facility;
- Definition and regular review of performance targets, which are adjusted to account for changes in major factors affecting water use (e.g. industrial production rate);
- Regular comparison of water flows with performance targets to identify where action should be taken to reduce water use.

Water measurement (metering) should emphasize areas of greatest water use. Based on review of metering data, 'unaccounted' use–indicating major leaks at industrial facilities–could be identified.

Process Water Reuse and Recycling

Opportunities for water savings in industrial processes are highly industry-specific. However, the following techniques have all been used successfully, and should be considered in conjunction with the development of the metering system described above.

- *Washing Machines:* Many washing machines use large quantities of hot water. Use can increase as nozzles become enlarged due to repeated cleaning and /or wear. Monitor machine water use, compare with specification, and replace nozzles when water and heat use reaches levels warranting such work.
- *Water reuse:* Common water reuse applications include countercurrent rinsing, for example in multi-stage washing

and rinsing processes, or reusing waste water from one process for another with less exacting water requirements. For example, using bleaching rinse water for textile washing, or bottle-washer rinse water for bottle crate washing, or even washing the floor. More sophisticated reuse projects requiring treatment of water before reuse are also sometimes practical.

- *Water jets/sprays:* If processes use water jets or sprays (e.g. to keep conveyors clean or to cool product) review the accuracy of the spray pattern to prevent unnecessary water loss.
- *Flow control optimization:* Industrial processes sometimes require the use of tanks, which are refilled to control losses. It is often possible to reduce the rate of water supply to such tanks, and sometimes to reduce tank levels to reduce spillage. If the process uses water cooling sprays, it may be possible to reduce flow while maintaining cooling performance. Testing can determine the optimum balance.
    - If hoses are used in cleaning, use flow controls to restrict wasteful water flow
    - Consider the use of high pressure, low volume cleaning systems rather than using large volumes of water sprayed from hosepipes
    - Using flow timers and limit switches to control water use
    - Using 'clean-up' practices rather than hosing down

Building Facility Operations

Consumption of building and sanitary water is typically less than that used in industrial processes. However, savings can readily be identified, as outlined below:

- Compare daily water use per employee to existing benchmarks taking into consideration the primary use at the facility, whether sanitary or including other activities such as showering or catering
- Regularly maintain plumbing, and identify and repair leaks
- Shut off water to unused areas
- Install self-closing taps, automatic shut-off valves, spray nozzles, pressure reducing valves, and water conserving fixtures (e.g. low flow shower heads, faucets, toilets, urinals; and spring loaded or sensored faucets)
- Operate dishwashers and laundries on full loads, and only when needed
- Install water-saving equipment in lavatories, such as low-flow toilets

Cooling Systems

Water conservation opportunities in cooling systems include:

- Use of closed circuit cooling systems with cooling towers rather than once-through cooling systems
- Limiting condenser or cooling tower blowdown to the minimum required to prevent unacceptable accumulation of dissolved solids
- Use of air cooling rather than evaporative cooling, although this may increase electricity use in the cooling system
- Use of treated waste water for cooling towers
- Reusing/recycling cooling tower blowdown

Heating Systems

Heating systems based on the circulation of low or medium pressure hot water (which do not consume water) should be closed. If they do consume water, regular maintenance should be conducted to check for leaks. However, large quantities of water may be used by steam systems, and this can be reduced by the following measures:

- Repair of steam and condensate leaks, and repair of all failed steam traps
- Return of condensate to the boilerhouse, and use of heat exchangers (with condensate return) rather than direct steam injection where process permits
- Flash steam recovery
- Minimizing boiler blowdown consistent with maintaining acceptably low dissolved solids in boiler water. Use of reverse osmosis boiler feed water treatment substantially reduces the need for boiler blowdown
- Minimizing deaerator heating

1.5 Hazardous Materials Management

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Applicability and Approach

These guidelines apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazmats can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; radioactive material; and corrosive substances. Guidance on the transport of hazardous materials is covered in Section 3 of this document.

When a hazardous material is no longer usable for its original purpose and is intended for disposal, but still has hazardous properties, it is considered a *hazardous waste* (see Section 1.4).

This guidance is intended to be applied in conjunction with traditional occupational health and safety and emergency preparedness programs which are included in Section 2.0 on Occupational Health and Safety Management, and Section 3.7 on Emergency Preparedness and Response. Guidance on the Transport of Hazardous Materials is provided in Section 3.5.

This section is divided into two main subsections:

General Hazardous Materials Management: Guidance applicable to all projects or facilities that handle or store any quantity of hazardous materials.

Management of Major Hazards: Additional guidance for projects or facilities that store or handle hazardous materials at, or above, threshold quantities[39], and thus require special treatment to prevent accidents such as fire, explosions, leaks or spills, and to prepare and respond to emergencies.

The overall objective of hazardous materials management is to avoid or, when avoidance is not feasible, minimize uncontrolled releases of hazardous materials or accidents (including explosion and fire) during their production, handling, storage and use. This objective can be achieved by:

[39] For examples, threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

- Establishing hazardous materials management priorities based on hazard analysis of risky operations identified through Social and Environmental Assessment;
- Where practicable, avoiding or minimizing the use of hazardous materials. For example, non-hazardous materials have been found to substitute asbestos in building materials, PCBs in electrical equipment, persistent organic pollutants (POPs) in pesticides formulations, and ozone depleting substances in refrigeration systems;
- Preventing uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion;
- Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard;
- Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures.

General Hazardous Materials Management

Projects which manufacture, handle, use, or store hazardous materials should establish management programs that are commensurate with the potential risks present. The main objectives of projects involving hazardous materials should be the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day-to-day business activities. Potentially applicable elements of a management program include the following:

Hazard Assessment

The level of risk should be established through an on-going assessment process based on:

- The types and amounts of hazardous materials present in the project. This information should be recorded and should include a summary table with the following information:
  - Name and description (e.g. composition of a mixture) of the Hazmat
  - Classification (e.g. code, class or division) of the Hazmat
  - Internationally accepted regulatory reporting threshold quantity or national equivalent[40] of the Hazmat
  - Quantity of Hazmat used per month
  - Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity)
- Analysis of potential spill and release scenarios using available industry statistics on spills and accidents where available
- Analysis of the potential for uncontrolled reactions such as fire and explosions
- Analysis of potential consequences based on the physical-geographical characteristics of the project site, including aspects such as its distance to settlements, water resources, and other environmentally sensitive areas

Hazard assessment should be performed by specialized professionals using internationally-accepted methodologies such as Hazardous Operations Analysis (HAZOP), Failure Mode and Effects Analysis (FMEA), and Hazard Identification (HAZID).

Management Actions

The management actions to be included in a Hazardous Materials Management Plan should be commensurate with the level of

[40] Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

potential risks associated with the production, handling, storage, and use of hazardous materials.

Release Prevention and Control Planning

Where there is risk of a spill of uncontrolled hazardous materials, facilities should prepare a spill control, prevention, and countermeasure plan as a specific component of their Emergency Preparedness and Response Plan (described in more detail in Section 3.7). The plan should be tailored to the hazards associated with the project, and include:

- Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training
- Implementation of inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment
- Preparation of written Standard Operating Procedures (SOPs) for filling USTs, ASTs or other containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response
- SOPs for the management of secondary containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated
- Identification of locations of hazardous materials and associated activities on an emergency plan site map
- Documentation of availability of specific personal protective equipment and training needed to respond to an emergency
- Documentation of availability of spill response equipment sufficient to handle at least initial stages of a spill and a list of external resources for equipment and personnel, if necessary, to supplement internal resources
- Description of response activities in the event of a spill, release, or other chemical emergency including:
  - Internal and external notification procedures
  - Specific responsibilities of individuals or groups
  - Decision process for assessing severity of the release, and determining appropriate actions
  - Facility evacuation routes
  - Post-event activities such as clean-up and disposal, incident investigation, employee re-entry, and restoration of spill response equipment.

Occupational Health and Safety

The Hazardous Materials Management Plan should address applicable, essential elements of occupational health and safety management as described in Section 2.0 on Occupational Health and Safety, including:

- Job safety analysis to identify specific potential occupational hazards and industrial hygiene surveys, as appropriate, to monitor and verify chemical exposure levels, and compare with applicable occupational exposure standards[41]
- Hazard communication and training programs to prepare workers to recognize and respond to workplace chemical hazards. Programs should include aspects of hazard identification, safe operating and materials handling procedures, safe work practices, basic emergency procedures, and special hazards unique to their jobs.

[41] Including: Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®), American Conference of Governmental Industrial Hygienists (ACGIH), http://www.acgih.org/TLV/; U.S. National Institute for Occupational Health and Safety (NIOSH), http://www.cdc.gov/niosh/npg/; Permissible Exposure Limits (PELs), U.S. Occupational Safety and Health Administration (OSHA), http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992; Indicative Occupational Exposure Limit Values, European Union, http://europe.osha.eu.int/good_practice/risks/ds/oel/; and other similar sources.

Training should incorporate information from Material Safety Data Sheets[42] (MSDSs) for hazardous materials being handled. MSDSs should be readily accessible to employees in their local language.

- Definition and implementation of permitted maintenance activities, such as hot work or confined space entries
- Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities
- Monitoring and record-keeping activities, including audit procedures designed to verify and record the effectiveness of prevention and control of exposure to occupational hazards, and maintaining accident and incident investigation reports on file for a period of at least five years

Process Knowledge and Documentation

The Hazardous Materials Management Plan should be incorporated into, and consistent with, the other elements of the facility ES/OHS MS and include:

- Written process safety parameters (i.e., hazards of the chemical substances, safety equipment specifications, safe operation ranges for temperature, pressure, and other applicable parameters, evaluation of the consequences of deviations, etc.)
- Written operating procedures
- Compliance audit procedures

[42] MSDSs are produced by the manufacturer, but might not be prepared for chemical intermediates that are not distributed in commerce. In these cases, employers still need to provide workers with equivalent information.

Preventive Measures

Hazardous Materials Transfer

Uncontrolled releases of hazardous materials may result from small cumulative events, or from more significant equipment failure associated with events such as manual or mechanical transfer between storage systems or process equipment. Recommended practices to prevent hazardous material releases from processes include:

- Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks
- Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer
- Regular inspection, maintenance and repair of fittings, pipes and hoses
- Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points.

Overfill Protection

Overfills of vessels and tanks should be prevented as they are among the most common causes of spills resulting in soil and water contamination, and among the easiest to prevent. Recommended overfill protection measures include:

- Prepare written procedures for transfer operations that includes a checklist of measures to follow during filling operations and the use of filling operators trained in these procedures
- Installation of gauges on tanks to measure volume inside
- Use of dripless hose connections for vehicle tank and fixed connections with storage tanks

- Provision of automatic fill shutoff valves on storage tanks to prevent overfilling
- Use of a catch basin around the fill pipe to collect spills
- Use of piping connections with automatic overfill protection (float valve)
- Pumping less volume than available capacity into the tank or vessel by ordering less material than its available capacity
- Provision of overfill or over pressure vents that allow controlled release to a capture point

Reaction, Fire, and Explosion Prevention

Reactive, flammable, and explosive materials should also be managed to avoid uncontrolled reactions or conditions resulting in fire or explosion. Recommended prevention practices include:

- Storage of incompatible materials (acids, bases, flammables, oxidizers, reactive chemicals) in separate areas, and with containment facilities separating material storage areas
- Provision of material-specific storage for extremely hazardous or reactive materials
- Use of flame arresting devices on vents from flammable storage containers
- Provision of grounding and lightning protection for tank farms, transfer stations, and other equipment that handles flammable materials
- Selection of materials of construction compatible with products stored for all parts of storage and delivery systems, and avoiding reuse of tanks for different products without checking material compatibility
- Storage of hazardous materials in an area of the facility separated from the main production works. Where proximity is unavoidable, physical separation should be provided using structures designed to prevent fire, explosion, spill, and other emergency situations from affecting facility operations
- Prohibition of all sources of ignition from areas near flammable storage tanks

Control Measures

Secondary Containment (Liquids)

A critical aspect for controlling accidental releases of liquid hazardous materials during storage and transfer is the provision of secondary containment. It is not necessary for secondary containment methods to meet long term material compatibility as with primary storage and piping, but their design and construction should hold released materials effectively until they can be detected and safely recovered. Appropriate secondary containment structures consist of berms, dikes, or walls capable of containing the larger of 110 percent of the largest tank or 25% percent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters and will be made of impervious, chemically resistant material. Secondary containment design should also consider means to prevent contact between incompatible materials in the event of a release.

Other secondary containment measures that should be applied depending on site-specific conditions include:

- Transfer of hazardous materials from vehicle tanks to storage in areas with surfaces sufficiently impervious to avoid loss to the environment and sloped to a collection or a containment structure not connected to municipal wastewater/stormwater collection system
- Where it is not practical to provide permanent, dedicated containment structures for transfer operations, one or more alternative forms of spill containment should be provided, such as portable drain covers (which can be deployed for the duration of the operations), automatic shut-off valves on storm water basins, or shut off valves in drainage or sewer facilities, combined with oil-water separators

- Storage of drummed hazardous materials with a total volume equal or greater than 1,000 liters in areas with impervious surfaces that are sloped or bermed to contain a minimum of 25 percent of the total storage volume
- Provision of secondary containment for components (tanks, pipes) of the hazardous material storage system, to the extent feasible
- Conducting periodic (e.g. daily or weekly) reconciliation of tank contents, and inspection of visible portions of tanks and piping for leaks;
- Use of double-walled, composite, or specially coated storage and piping systems particularly in the use of underground storage tanks (USTs) and underground piping. If double-walled systems are used, they should provide a means of detecting leaks between the two walls.

Storage Tank and Piping Leak Detection

Leak detection may be used in conjunction with secondary containment, particularly in high-risk locations[43]. Leak detection is especially important in situations where secondary containment is not feasible or practicable, such as in long pipe runs. Acceptable leak detection methods include:

- Use of automatic pressure loss detectors on pressurized or long distance piping
- Use of approved or certified integrity testing methods on piping or tank systems, at regular intervals
- Considering the use of SCADA[44] if financially feasible

[43] High-risk locations are places where the release of product from the storage system could result in the contamination of drinking water source or those located in water resource protection areas as designated by local authorities.

[44] Supervisory Control and Data Acquisition

Underground Storage Tanks (USTs)[45]

Although there are many environmental and safety advantages of underground storage of hazardous materials, including reduced risk of fire or explosion, and lower vapor losses into the atmosphere, leaks of hazardous materials can go undetected for long periods of time with potential for soil and groundwater contamination. Examples of techniques to manage these risks include:

- Avoiding use of USTs for storage of highly soluble organic materials
- Assessing local soil corrosion potential, and installing and maintaining cathodic protection (or equivalent rust protection) for steel tanks
- For new installations, installing impermeable liners or structures (e.g., concrete vaults) under and around tanks and lines that direct any leaked product to monitoring ports at the lowest point of the liner or structure
- Monitoring the surface above any tank for indications of soil movement
- Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store
- Testing integrity by volumetric, vacuum, acoustic, tracers, or other means on all tanks at regular intervals
- Considering the monitoring groundwater of quality down gradient of locations where multiple USTs are in use
- Evaluating the risk of existing UST in newly acquired facilities to determine if upgrades are required for USTs that will be continued to be used, including replacement with new systems or permanent closure of abandoned USTs. Ensuring that new USTs are sited away from wells,

[45] Additional details on the management of USTs is provided in the EHS Guidelines for Retail Petroleum Stations.

reservoirs and other source water protection areas and floodplains, and maintained so as to prevent corrosion.

Management of Major Hazards

In addition to the application of the above-referenced guidance on prevention and control of releases of hazardous materials, projects involving production, handling, and storage of hazardous materials *at or above threshold limits*[46] should prepare a Hazardous Materials Risk Management Plan, in the context of its overall ES/OHS MS, containing all of the elements presented below.[47] The objective of this guidance is the prevention and control of catastrophic releases of toxic, reactive, flammable, or explosive chemicals that may result in toxic, fire, or explosion hazards.[48]

Management Actions

- *Management of Change:* These procedures should address:
  - The technical basis for changes in processes and operations
  - The impact of changes on health and safety
  - Modification to operating procedures
  - Authorization requirements
  - Employees affected
  - Training needs
- *Compliance Audit*: A compliance audit is a way to evaluate compliance with the prevention program requirements for each process. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years and should include:
  - Preparation of a report of the findings
  - Determination and documentation of the appropriate response to each finding
  - Documentation that any deficiency has been corrected
- *Incident Investigation:* Incidents can provide valuable information about site hazards and the steps needed to prevent accidental releases. An incident investigation mechanism should include procedures for:
  - Initiation of the investigation promptly
  - Summarizing the investigation in a report
  - Addressing the report findings and recommendations
  - A review of the report with staff and contractors
- *Employee Participation:* A written plan of action should describe an active employee participation program for the prevention of accidents.
- *Contractors:* There should be a mechanism for contractor control which should include a requirement for them to develop hazard materials management procedures that meet the requirements of the hazardous materials management plan. Their procedures should be consistent with those of the contracting company and the contractor workforce should undergo the same training. Additionally, procedures should require that contractors are:
  - Provided with safety performance procedures and safety and hazard information
  - Observe safety practices
  - Act responsibly
  - Have access to appropriate training for their employees
  - Ensure that their employees know process hazards and applicable emergency actions

[46] Threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 300-399 and 700 to 789).

[47] For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Risk Management Manual. Washington, D.C. December 2000.

[48] The approach to the management of major hazards is largely based on an approach to Process Safety Management developed by the American Institute of Chemical Engineers.

- Prepare and submit training records for their employees to the contracting company
- Inform their employees about the hazards presented by their work
- Assess trends of repeated similar incidents
- Develop and implement procedures to manage repeated similar incidents

- *Training*: Project employees should be provided training on Hazmat management. The training program should include:
  - A list of employees to be trained
  - Specific training objectives
  - Mechanisms to achieve the objectives (i.e., hands-on workshops, videos, etc.)
  - The means to determine whether the training program is effective
  - Training procedures for new hires and refresher courses for existing employees

Preventive Measures

The purpose of preventive measures is to ensure that safety-related aspects of the process and equipment are considered, limits to be placed on the operations are well known, and accepted standards and codes are adopted, where they apply.

- *Process Safety Information:* Procedures should be prepared for each hazardous materials and include:
  - Compilation of Material Safety Data Sheets (MSDS)
  - Identification of maximum intended inventories and safe upper/lower parameters
  - Documentation of equipment specifications and of codes and standards used to design, build and operate the process

- *Operating Procedures:* SOPs should be prepared for each step of all processes or operations within the project (e.g. initial startup, normal operations, temporary operations, emergency shutdown, emergency operations, normal shutdown, and start-up following a normal or emergency shutdown or major change). These SOPs should include special considerations for Mazmats used in the process or operations (e.g. temperature control to prevent emissions of a volatile hazardous chemical; diversion of gaseous discharges of hazardous pollutants from the process to a temporary storage tank in case of emergency).

Other procedures to be developed include impacts of deviations, steps to avoid deviations, prevention of chemical exposure, exposure control measures, and equipment inspections.

Mechanical Integrity of process equipment, piping and instrumentation: Inspection and maintenance procedures should be developed and documented to ensure mechanical integrity of equipment, piping, and instrumentation and prevent uncontrolled releases of hazardous materials from the project. These procedures should be included as part of the project SOPs. The specific process components of major interest include pressure vessels and storage tanks, piping systems, relief and vent systems and devices, emergency shutdown systems, controls, and pumps. Recommended aspects of the inspection and maintenance program include:

- Developing inspection and maintenance procedures
- Establishing a quality assurance plan for equipment, maintenance materials, and spare parts
- Conducting employee training on the inspection and maintenance procedures
- Conducting equipment, piping, and instrumentation inspections and maintenance
- Identifying and correcting identified deficiencies

- Evaluating the inspection and maintenance results and, if necessary, updating the inspection and maintenance procedures
- Reporting the results to management.

- *Hot Work Permit:* Hot work operations – such as brazing, torch-cutting, grinding, soldering, and welding – are associated with potential health, safety, and property hazards resulting from the fumes, gases, sparks, and hot metal and radiant energy produced during hot work. Hot work permit is required for any operation involving open flames or producing heat and/or sparks. The section of SOPs on hot work should include the responsibility for hot work permitting, personal protection equipment (PPE), hot work procedures, personnel training, and recordkeeping.
- *Pre-Start Review:* Procedures should be prepared to carry out pre-start reviews when a modification is significant enough to require a change in safety information under the management of change procedure. The procedures should:
  - Confirm that the new or modified construction and/or equipment meet design specifications
  - Ensure that procedures for safety, operation, maintenance, and emergency are adequate
  - Include a process hazard assessment, and resolve or implement recommendations for new process
  - Ensure that training for all affected employees is being conducted

Emergency Preparedness and Response

When handling hazardous materials, procedures and practices should be developed allowing for quick and efficient responses to accidents that could result in human injury or damage to the environment. An Emergency Preparedness and Response Plan, incorporated into and consistent with, the facility's overall ES/OHS MS, should be prepared to cover the following:[49]

- *Planning Coordination:* Procedures should be prepared for:
  - Informing the public and emergency response agencies
  - Documenting first aid and emergency medical treatment
  - Taking emergency response actions
  - Reviewing and updating the emergency response plan to reflect changes, and ensuring that employees are informed of such changes
- *Emergency Equipment:* Procedures should be prepared for using, inspecting, testing, and maintaining the emergency response equipment.
- *Training:* Employees and contractors should be trained on emergency response procedures.

Community Involvement and Awareness

When hazardous materials are in use above threshold quantities, the management plan should include a system for community awareness, notification and involvement that should be commensurate with the potential risks identified for the project during the hazard assessment studies. This should include mechanisms for sharing the results of hazard and risk assessment studies in a timely, understandable and culturally sensitive manner with potentially affected communities that provides a means for public feedback. Community involvement activities should include:

- Availability of general information to the potentially affected community on the nature and extent of project operations, and the prevention and control measures in place to ensure no effects to human health

[49] For a comprehensive treatment of the development of emergency response plans in conjunction with communities refer to the Awareness and Preparedness for Emergencies at Local Level (APELL) Guidelines available at: http://www.uneptie.org/pc/apell/publications/handbooks.html

- The potential for off-site effects to human health or the environment following an accident at planned or existing hazardous installations
- Specific and timely information on appropriate behavior and safety measures to be adopted in the event of an accident including practice drills in locations with higher risks
- Access to information necessary to understand the nature of the possible effect of an accident and an opportunity to contribute effectively, as appropriate, to decisions concerning hazardous installations and the development of community emergency preparedness plans.

1.6 Waste Management

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Applicability and Approach

These guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors. It is not intended to apply to projects or facilities where the primary business is the collection, transportation, treatment, or disposal of wastes. Specific guidance for these types of facilities is presented in the Environmental Health and Safety (EHS) Guidelines for Waste Management Facilities.

A *waste* is any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, burning or incineration. It can be byproduct of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal.

Solid (non-hazardous) wastes generally include any garbage, refuse. Examples of such waste include domestic trash and garbage; inert construction / demolition materials; refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste); and residual waste from industrial operations, such as boiler slag, clinker, and fly ash.

Hazardous waste shares the properties of a hazardous material (e.g. ignitability, corrosivity, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. Wastes may also be defined as "hazardous" by local regulations or international conventions, based on the origin of the waste and its inclusion on hazardous waste lists, or based on its characteristics.

Sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste.

Facilities that generate and store wastes should practice the following:

- Establishing waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences
- Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.
- Avoiding or minimizing the generation waste materials, as far as practicable
- Where waste generation cannot be avoided but has been minimized, recovering and reusing waste

- Where waste can not be recovered or reused, treating, destroying, and disposing of it in an environmentally sound manner

General Waste Management

The following guidance applies to the management of non-hazardous and hazardous waste. Additional guidance specifically applicable to hazardous wastes is presented below. Waste management should be addressed through a Waste management system that addresses issues linked to waste minimization, generation, transport, disposal, and monitoring.

Waste Management Planning

Facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to local regulatory requirements. Effective planning and implementation of waste management strategies should include:

- Review of new waste sources during planning, siting, and design activities, including during equipment modifications and process alterations, to identify expected waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure
- Collection of data and information about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition
- Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner
- Definition of opportunities for source reduction, as well as reuse and recycling
- Definition of procedures and operational controls for on-site storage
- Definition of options / procedures / operational controls for treatment and final disposal

Waste Prevention

Processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes
- Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls[50]
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs
- Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials
- Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed

[50] Examples of waste prevention strategies include the concept of Lean Manufacturing found at http://www.epa.gov/epaoswer/hazwaste/minimize/lean.htm

Recycling and Reuse

In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements:

- Evaluation of waste production processes and identification of potentially recyclable materials
- Identification and recycling of products that can be reintroduced into the manufacturing process or industry activity at the site
- Investigation of external markets for recycling by other industrial processing operations located in the neighborhood or region of the facility (e.g., waste exchange)
- Establishing recycling objectives and formal tracking of waste generation and recycling rates
- Providing training and incentives to employees in order to meet objectives

Treatment and Disposal

If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment. Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include one or more of the following:

- On-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal
- Treatment or disposal at permitted facilities specially designed to receive the waste. Examples include: composting operations for organic non-hazardous wastes; properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; or other methods known to be effective in the safe, final disposal of waste materials such as bioremediation.

Hazardous Waste Management

Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste can not be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment, according to the following additional principles:

- Understanding potential impacts and risks associated with the management of any generated hazardous waste during its complete life cycle
- Ensuring that contractors handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled
- Ensuring compliance with applicable local and international regulations[51]

Waste Storage

Hazardous waste should be stored so as to prevent or control accidental releases to air, soil, and water resources in area location where:

[51] International requirements may include host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (http://www.basel.int/) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/)

- Waste is stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. Examples include sufficient space between incompatibles or physical separation such as walls or containment curbs
- Store in closed containers away from direct sunlight, wind and rain
- Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment
- Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location
- Provide adequate ventilation where volatile wastes are stored.

Hazardous waste storage activities should also be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes:

- Provision of readily available information on chemical compatibility to employees, including labeling each container to identify its contents
- Limiting access to hazardous waste storage areas to employees who have received proper training
- Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan
- Conducting periodic inspections of waste storage areas and documenting the findings
- Preparing and implementing spill response and emergency plans to address their accidental release (additional information on Emergency Plans in provided in Section 3 of this document)
- Avoiding underground storage tanks and underground piping of hazardous waste

Transportation

On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public. All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards, consistent with the guidance provided in Section 3.4 on the Transport of Hazardous Materials.

Treatment and Disposal

In addition to the recommendations for treatment and disposal applicable to general wastes, the following issues specific to hazardous wastes should be considered:

Commercial or Government Waste Contractors

In the absence of qualified commercial or government-owned waste vendors (taking into consideration proximity and transportation requirements), facilities generating waste should consider using:

- Have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment
- Have all required permits, certifications, and approvals, of applicable government authorities

- Have been secured through the use of formal procurement agreements

In the absence of qualified commercial or government-owned waste disposal operators (taking into consideration proximity and transportation requirements), project sponsors should consider using:

- Installing on-site waste treatment or recycling processes
- As a final option, constructing facilities that will provide for the environmental sound long-term storage of wastes on-site (as described elsewhere in the General EHS Guidelines) or at an alternative appropriate location up until external commercial options become available

Small Quantities of Hazardous Waste

Hazardous waste materials are frequently generated in small quantities by many projects through a variety of activities such as equipment and building maintenance activities. Examples of these types of wastes include: spent solvents and oily rags, empty paint cans, chemical containers; used lubricating oil; used batteries (such as nickel-cadmium or lead acid); and lighting equipment, such as lamps or lamp ballasts. These wastes should be managed following the guidance provided in the above sections.

Monitoring

Monitoring activities associated with the management of hazardous and non-hazardous waste should include:

- Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored. When significant quantities of hazardous wastes are generated and stored on site, monitoring activities should include:
  - Inspection of vessels for leaks, drips or other indications of loss
  - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors
  - Verification of locks, emergency valves, and other safety devices for easy operation (lubricating if required and employing the practice of keeping locks and safety equipment in standby position when the area is not occupied)
  - Checking the operability of emergency systems
  - Documenting results of testing for integrity, emissions, or monitoring stations (air, soil vapor, or groundwater)
  - Documenting any changes to the storage facility, and any significant changes in the quantity of materials in storage
- Regular audits of waste segregation and collection practices
- Tracking of waste generation trends by type and amount of waste generated, preferably by facility departments
- Characterizing waste at the beginning of generation of a new waste stream, and periodically documenting the characteristics and proper management of the waste, especially hazardous wastes
- Keeping manifests or other records that document the amount of waste generated and its destination
- Periodic auditing of third party treatment, and disposal services including re-use and recycling facilities when significant quantities of hazardous wastes are managed by third parties. Whenever possible, audits should include site visits to the treatment storage and disposal location

- Regular monitoring of groundwater quality in cases of Hazardous Waste on site storage and/or pretreatment and disposal
- Monitoring records for hazardous waste collected, stored, or shipped should include:
  - Name and identification number of the material(s) composing the hazardous waste
  - Physical state (i.e., solid, liquid, gaseous or a combination of one, or more, of these)
  - Quantity (e.g., kilograms or liters, number of containers)
  - Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported and date received, record of the originator, the receiver and the transporter
  - Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the hazardous waste
  - Location of each hazardous waste within the facility, and the quantity at each location

1.7 Noise

Applicability

This section addresses impacts of noise beyond the property boundary of the facilities. Worker exposure to noise is covered in Section 2.0 on Occupational Health and Safety.

Prevention and Control

Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception.[52] The preferred method for controlling noise from stationary sources is to implement noise control measures at source.[53] Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors. Noise reduction options that should be considered include:

- Selecting equipment with lower sound power levels
- Installing silencers for fans
- Installing suitable mufflers on engine exhausts and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Improving the acoustic performance of constructed buildings, apply sound insulation
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective
- Installing vibration isolation for mechanical equipment
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding
- Siting permanent facilities away from community areas if possible
- Taking advantage of the natural topography as a noise buffer during facility design
- Reducing project traffic routing through community areas wherever possible
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas
- Developing a mechanism to record and respond to complaints

Noise Level Guidelines

Noise impacts should not exceed the levels presented in Table 1.7.1, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

[52] A point of reception or receptor may be defined as any point on the premises occupied by persons where extraneous noise and/or vibration are received. Examples of receptor locations may include: permanent or seasonal residences; hotels / motels; schools and daycares; hospitals and nursing homes; places of worship; and parks and campgrounds.

[53] At the design stage of a project, equipment manufacturers should provide design or construction specifications in the form of *"Insertion Loss Performance"* for silencers and mufflers, and "*Transmission Loss Performance"* for acoustic enclosures and upgraded building construction.

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

Highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels.

Monitoring

Noise monitoring[56] may be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility, or for verifying operational phase noise levels.

Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

[54] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

[55] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

[56] Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards.

1.8 Contaminated Land

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Applicability and Approach

This section provides a summary of management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil, including naturally occurring substances. Releases of these materials may be the result of historic or current site activities, including, but not limited to, accidents during their handling and storage, or due to their poor management or disposal.

Land is considered contaminated when it contains hazardous materials or oil concentrations above background or naturally occurring levels.

Contaminated lands may involve surficial soils or subsurface soils that, through leaching and transport, may affect groundwater, surface water, and adjacent sites. Where subsurface contaminant sources include volatile substances, soil vapor may also become a transport and exposure medium, and create potential for contaminant infiltration of indoor air spaces of buildings.

Contaminated land is a concern because of:

- The potential risks to human health and ecology (e.g. risk of cancer or other human health effects, loss of ecology);
- The liability that it may pose to the polluter/business owners (e.g., cost of remediation, damage of business reputation and/or business-community relations) or affected parties (e.g. workers at the site, nearby property owners).

Contamination of land should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated adverse impacts.

Contaminated lands should be managed to avoid the risk to human health and ecological receptors. The preferred strategy for land decontamination is to reduce the level of contamination at the site while preventing the human exposure to contamination.

To determine whether risk management actions are warranted, the following assessment approach should be applied to establish whether the three risk factors of 'Contaminants', 'Receptors', and 'Exposure Pathways' co-exist, or are likely to co-exist, at the project site under current or possible future land use:

- *Contaminant(s)*: Presence of hazardous materials, waste, or oil in any environmental media at potentially hazardous concentrations
- *Receptor(s)*: Actual or likely contact of humans, wildlife, plants, and other living organisms with the contaminants of concern
- *Exposure pathway(s)*: A combination of the route of migration of the contaminant from its point of release (e.g., leaching into potable groundwater) and exposure routes

(e.g., ingestion, transdermal absorption), which would allow receptor(s) to come into actual contact with contaminants

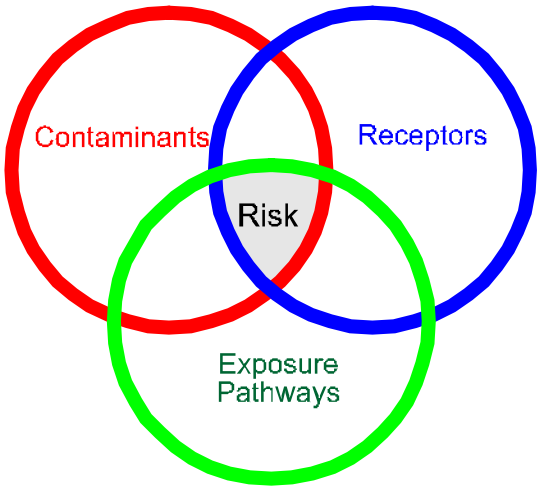


FIGURE 1.8.1: Inter-Relationship of Contaminant Risk Factors

When the three risk factors are considered to be present (in spite of limited data) under current or foreseeable future conditions, the following steps should be followed (as described in the remaining parts of this section):

1) Risk screening;
2) Interim risk management;
3) Detailed quantitative risk assessment; and
4) Permanent risk reduction measures.

Risk Screening

This step is also known as "problem formulation" for environmental risk assessment. Where there is potential evidence of contamination at a site, the following steps are recommended:

- Identification of the location of suspected highest level of contamination through a combination of visual and historical operational information;
- Sampling and testing of the contaminated media (soils or water) according to established technical methods applicable to suspected type of contaminant[57,58];
- Evaluation of the analytical results against the local and national contaminated sites regulations. In the absence of such regulations or environmental standards, other sources of risk-based standards or guidelines should be consulted to obtain comprehensive criteria for screening soil concentrations of pollutants.[59]
- Verification of the potential human and/or ecological receptors and exposure pathways relevant to the site in question

The outcome of risk-screening may reveal that there is no overlap between the three risk-factors as the contaminant levels identified are below those considered to pose a risk to human health or the environment. Alternatively, interim or permanent

[57] BC MOE. http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance

[58] Massachusetts Department of Environment. http://www.mass.gov/dep/cleanup

[59] These may include the USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm. These RBCs are considered acceptable for specific land use and contaminant exposure scenarios as they have been developed by governments using risk assessment techniques for use as general targets in the site remediation. Separate PRGs have been developed or adopted for soil, sediment or groundwater, and often a distinction is made between land uses (as noted earlier) because of the need for more stringent guidelines for residential and agricultural versus commercial/industrial landuse. The RBC Tables contains Reference Doses (RfDs) and Cancer Slope Factors (CSFs) for about 400 chemicals. These toxicity factors have been combined with "standard" exposure scenarios to calculate RBCs--chemical concentrations corresponding to fixed levels of risk (i.e., a Hazard Quotient (HQ) of 1, or lifetime cancer risk of 1E-6, whichever occurs at a lower concentration) in water, air, fish tissue, and soil for individual chemical substances. The primary use of RBCs is for chemical screening during baseline risk assessment (see EPA Regional Guidance EPA/903/R-93-001, "Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening"). Additional useful soil quality guidelines can also be obtained from Lijzen et al. 2001.

risk reduction measures may need to be taken with, or without, more detailed risk assessment activities, as described below.

Interim Risk Management

Interim risk management actions should be implemented at any phase of the project life cycle if the presence of land contamination poses an "imminent hazard", i.e., representing an immediate risk to human health and the environment if contamination were allowed to continue, even a short period of time. Examples of situations considered to involve imminent hazards include, but are not restricted to:

- Presence of an explosive atmosphere caused by contaminated land
- Accessible and excessive contamination for which short-term exposure and potency of contaminants could result in acute toxicity, irreversible long term effects, sensitization, or accumulation of persistent biocumulative and toxic substances
- Concentrations of pollutants at concentrations above the Risk Based Concentrations (RBCs[60]) or drinking water standards in potable water at the point of abstraction

Appropriate risk reduction should be implemented as soon as practicable to remove the condition posing the imminent hazard.

Detailed Risk Assessment

As an alternative to complying with numerical standards or preliminary remediation goals, and depending on local regulatory requirements, a detailed site-specific, environmental risk assessment may be used to develop strategies that yield acceptable health risks, while achieving low level contamination on-site. An assessment of contaminant risks needs to be considered in the context of current and future land use, and development scenarios (e.g., residential, commercial, industrial, and urban parkland or wilderness use).

A detailed quantitative risk assessment builds on risk screening (problem formulation). It involves first, a detailed site investigation to identify the scope of contamination.[61] Site investigation programs should apply quality assurance/quality control (QA/QC) measures to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). The site investigation in turn should be used to develop a *conceptual site model* of how and where contaminants exist, how they are transported, and where routes of exposure occur to organisms and humans. The risk factors and conceptual site model provide a framework for assessing contaminant risks.

Human or ecological risk assessments facilitate risk management decisions at contaminated sites. Specific risk assessment objectives include:

- Identifying relevant human and ecological receptors (e.g., children, adults, fish, wildlife)
- Determining if contaminants are present at levels that pose potential human health and/or ecological concerns (e.g., levels above applicable regulatory criteria based on health or environmental risk considerations)
- Determining how human or ecological receptors are exposed to the contaminants (e.g., ingestions of soil, dermal contact, inhalation of dust)

[60] For example, USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm.

[61] Examples include processes defined by the American Society of Testing and Materials (ASTM) Phase II ESA Process; the British Columbia Ministry of Environment Canada (BC MOE) http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance); and the Massachusetts Department of Environment http://www.mass.gov/dep/cleanup.

- Identifying the types of adverse effects that might result from exposure to the contaminants (e.g., effect on target organ, cancer, impaired growth or reproduction) in the absence of regulatory standards
- Quantifying the magnitude of health risks to human and ecological receptors based on a quantitative analysis of contaminant exposure and toxicity (e.g. calculate lifetime cancer risk or ratios of estimated exposure rates compared to safe exposure rates)
- Determining how current and proposed future land use influence the predicted risks (e.g. change of land use from industrial to residential with more sensitive receptors such as children)
- Quantifying the potential environmental and/or human health risks from off-site contaminant migration (e.g., consider if leaching and groundwater transport, or surface water transport results in exposure at adjacent lands/receptors)
- Determining if the risk is likely to remain stable, increase, or decrease with time in the absence of any remediation (e.g., consider if the contaminant is reasonably degradable and likely to remain in place, or be transported to other media)[62]

Addressing these objectives provides a basis to develop and implement risk reduction measures (e.g., clean-up, on-site controls) at the site. If such a need exists, the following additional objectives become relevant:

- Determining where, and in what conceptual manner, risk reduction measures should be implemented
- Identifying the preferred technologies (including engineering controls) needed to implement the conceptual risk reduction measures
- Developing a monitoring plan to ascertain whether risk reduction measures are effective
- Considering the need and appropriateness for institutional controls (e.g. deed restriction, land use restrictions) as part of a comprehensive approach

Permanent Risk Reduction Measures

The *risk factors* and *conceptual site model* within the contaminant risk approach described also provide a basis to manage and mitigate environmental contaminant health risks. The underlying principle is to reduce, eliminate, or control any or all of the three risk factors illustrated in Figure 1.8.1. A short list of examples of risk mitigation strategies is provided below, although actual strategies should be developed based on site-specific conditions, and the practicality of prevailing factors and site constraints. Regardless of the management options selected, the action plan should include, whenever possible, *contaminant source reduction* (i.e., net improvement of the site) as part of the overall strategy towards managing health risks at contaminated sites, as this alone provides for improved environmental quality.

Figure 1.8.2 presents a schematic of the inter-relationship of risk factors and example strategies to mitigate contaminant health risk by modifying the conditions of one or more risk factors to ultimately reduce contaminant exposure to the receptor. The selected approach should take into consideration the technical and financial feasibility (e.g. operability of a selected technology given the local availability of technical expertise and equipment and its associated costs).

Example risk mitigation strategies for contaminant source and exposure concentrations include:

[62] An example of a simplified quantitative risk assessment method is the ASTM E1739-95(2002) Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites and the ASTM E2081-00(2004)e1 Standard Guide for Risk-Based Corrective Action (at chemical release sites).

- Soil, sediment, and sludge:
  - In situ biological treatment (aerobic or anaerobic)
  - In situ physical/chemical treatment (e.g., soil vapor extraction with off-gas treatment, chemical oxidation)
  - In situ thermal treatment (e.g., steam injection, 6-phase heating)
  - Ex situ biological treatment (e.g., excavation and composting)
  - Ex situ physical/chemical treatment (e.g., excavation and stabilization)
  - Ex situ thermal treatment (e.g., excavation and thermal desorption or incineration)
  - Containment (e.g. landfill)
  - Natural attenuation
  - Other treatment processes
- Groundwater, surface water, and leachate:
  - In situ biological treatment (aerobic and/or aerobic)
  - In situ physical/chemical treatment (e.g., air sparging, zero-valent iron permeable reactive barrier)
  - Ex situ biological, physical, and or chemical treatment (i.e., groundwater extraction and treatment)
  - Containment (e.g., slurry wall or sheet pile barrier)
  - Natural attenuation
  - Other treatment processes
- Soil vapor intrusion:
  - Soil vapor extraction to reduce VOC contaminant source in soil
  - Installation of a sub-slab depressurization system to prevent migration of soil vapor into the building
  - Creating a positive pressure condition in buildings
  - Installation (during building construction) of an impermeable barrier below the building and/or an alternative flow pathway for soil vapor beneath building foundations (e.g., porous media and ventilation to shunt vapors away from building)

Example risk mitigation strategies for receptors include:

- Limiting or preventing access to contaminant by receptors (actions targeted at the receptor may include signage with instructions, fencing, or site security)
- Imposing health advisory or prohibiting certain practices leading to exposure such as fishing, crab trapping, shellfish collection
- Educating receptors (people) to modify behavior in order to reduce exposure (e.g., improved work practices, and use of protective clothing and equipment)

Example risk mitigation strategies for exposure pathways include:

- Providing an alternative water supply to replace, for example, a contaminated groundwater supply well
- Capping contaminated soil with at least 1m of clean soil to prevent human contact, as well as plant root or small mammal penetration into contaminated soils
- Paving over contaminated soil as an interim measure to negate the pathway of direct contact or dust generation and inhalation
- Using an interception trench and pump, and treat technologies to prevent contaminated groundwater from discharging into fish streams

The above-reference containment measures should also be considered for immediate implementation in situations where source reduction measures are expected to take time.

Occupational Health and Safety Considerations

Investigation and remediation of contaminated lands requires that workers be mindful of the occupational exposures that could arise from working in close contact with contaminated soil or other environmental media (e.g., groundwater, wastewater, sediments, and soil vapor). Occupational health and safety precautions should be exercised to minimize exposure, as described in Section 2 on Occupational Health and Safety. In addition, workers on contaminated sites should receive special health and safety training specific to contaminated site investigation and remediation activities.[63]

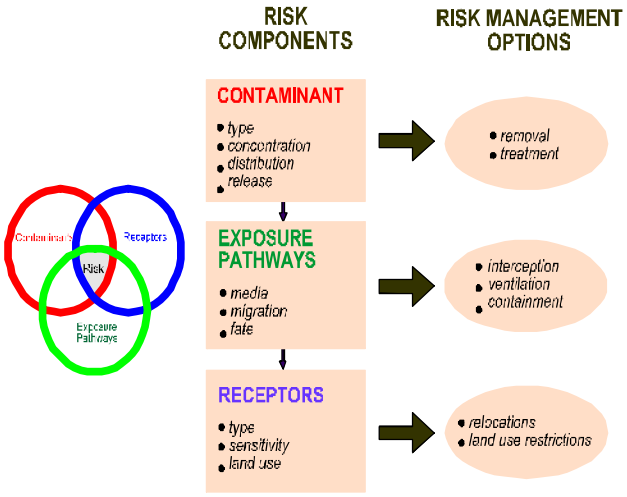


FIGURE 1.8.2: Inter-Relationship of Risk Factors and Management Options

[63] For example, US Occupational Safety and Health Agency (OSHA) regulations found at 40 CFR 1910.120. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765

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Applicability and Approach

Employers and supervisors are obliged to implement all reasonable precautions to protect the health and safety of workers. This section provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Although the focus is placed on the operational phase of projects, much of the guidance also applies to construction and decommissioning activities. Companies should hire contractors that have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements.

Preventive and protective measures should be introduced according to the following order of priority:

- *Eliminating the hazard* by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc;
- *Controlling the hazard* at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc;
- *Minimizing the hazard* through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- *Providing appropriate personal protective equipment (PPE)* in conjunction with training, use, and maintenance of the PPE.

The application of prevention and control measures to occupational hazards should be based on comprehensive job

safety or job hazard analyses. The results of these analyses should be prioritized as part of an action plan based on the likelihood and severity of the consequence of exposure to the identified hazards. An example of a qualitative risk ranking or analysis matrix to help identify priorities is described in Table 2.1.1.

Table 2.1.1. Risk Ranking Table to Classify Worker Scenarios Based on Likelihood and Consequence

Likelihood	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catas-trophic 5
A. Almost certain	L	M	E	E	E
B. Likely	L	M	H	E	E
C. Moderate	L	M	H	E	E
D. Unlikely	L	L	M	H	E
E. Rare	L	L	M	H	H

Legend
E: extreme risk; immediate action required
H: high risk; senior management attention needed
M: moderate risk; management responsibility should be specified
L: low risk; manage by routine procedures

2.1 General Facility Design and Operation

Integrity of Workplace Structures

Permanent and recurrent places of work should be designed and equipped to protect OHS:

- Surfaces, structures and installations should be easy to clean and maintain, and not allow for accumulation of hazardous compounds.
- Buildings should be structurally safe, provide appropriate protection against the climate, and have acceptable light and noise conditions.
- Fire resistant, noise-absorbing materials should, to the extent feasible, be used for cladding on ceilings and walls.
- Floors should be level, even, and non-skid.
- Heavy oscillating, rotating or alternating equipment should be located in dedicated buildings or structurally isolated sections.

Severe Weather and Facility Shutdown

- Work place structures should be designed and constructed to withstand the expected elements for the region and have an area designated for safe refuge, if appropriate.
- Standard Operating Procedures (SOPs) should be developed for project or process shut-down, including an evacuation plan. Drills to practice the procedure and plan should also be undertaken annually.

Workspace and Exit

- The space provided for each worker, and in total, should be adequate for safe execution of all activities, including transport and interim storage of materials and products.
- Passages to emergency exits should be unobstructed at all times. Exits should be clearly marked to be visible in total darkness. The number and capacity of emergency exits should be sufficient for safe and orderly evacuation of the greatest number of people present at any time, and there should be a minimum two exits from any work area.

- Facilities also should be designed and built taking into account the needs of disabled persons.

Fire Precautions

The workplace should be designed to prevent the start of fires through the implementation of fire codes applicable to industrial settings. Other essential measures include:

- Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present.
- Provision of manual firefighting equipment that is easily accessible and simple to use
- Fire and emergency alarm systems that are both audible and visible

The IFC Life and Fire Safety Guideline should apply to buildings accessible to the public (See Section 3.3).

Lavatories and Showers

- Adequate lavatory facilities (toilets and washing areas) should be provided for the number of people expected to work in the facility and allowances made for segregated facilities, or for indicating whether the toilet facility is "In Use" or "Vacant". Toilet facilities should also be provided with adequate supplies of hot and cold running water, soap, and hand drying devices.
- Where workers may be exposed to substances poisonous by ingestion and skin contamination may occur, facilities for showering and changing into and out of street and work clothes should be provided.

Potable Water Supply

- Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking
- Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards

Clean Eating Area

- Where there is potential for exposure to substances poisonous by ingestion, suitable arrangements are to be made for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances

Lighting

- Workplaces should, to the degree feasible, receive natural light and be supplemented with sufficient artificial illumination to promote workers' safety and health, and enable safe equipment operation. Supplemental 'task lighting' may be required where specific visual acuity requirements should be met.
- Emergency lighting of adequate intensity should be installed and automatically activated upon failure of the principal artificial light source to ensure safe shut-down, evacuation, etc.

Safe Access

- Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access
- Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted, and ready access
- Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.

- Openings should be sealed by gates or removable chains
- Covers should, if feasible, be installed to protect against falling items
- Measures to prevent unauthorized access to dangerous areas should be in place

First Aid

- The employer should ensure that qualified first-aid can be provided at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work
- Eye-wash stations and/or emergency showers should be provided close to all workstations where immediate flushing with water is the recommended first-aid response
- Where the scale of work or the type of activity being carried out so requires, dedicated and appropriately equipped first-aid room(s) should be provided. First aid stations and rooms should be equipped with gloves, gowns, and masks for protection against direct contact with blood and other body fluids
- Remote sites should have written emergency procedures in place for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.

Air Supply

- Sufficient fresh air should be supplied for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process-related emissions. Air distribution systems should be designed so as not to expose workers to draughts
- Mechanical ventilation systems should be maintained in good working order. Point-source exhaust systems required for maintaining a safe ambient environment should have local indicators of correct functioning.
- Re-circulation of contaminated air is not acceptable. Air inlet filters should be kept clean and free of dust and microorganisms. Heating, ventilation and air conditioning (HVAC) and industrial evaporative cooling systems should be equipped, maintained and operated so as to prevent growth and spreading of disease agents (e.g. *Legionnella pneumophilia*) or breeding of vectors (e.g. mosquitoes and flies) of public health concern.

Work Environment Temperature

- The temperature in work, rest room and other welfare facilities should, during service hours, be maintained at a level appropriate for the purpose of the facility.

2.2 Communication and Training

OHS Training

- Provisions should be made to provide OHS orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.
- Training should consist of basic hazard awareness, site-specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.

Visitor Orientation

- If visitors to the site can gain access to areas where hazardous conditions or substances may be present, a visitor orientation and control program should be established to ensure visitors do not enter hazard areas unescorted.

New Task Employee and Contractor Training

- The employer should ensure that workers and contractors, prior to commencement of new assignments, have received adequate training and information enabling them to

understand work hazards and to protect their health from hazardous ambient factors that may be present.
The training should adequately cover:

- Knowledge of materials, equipment, and tools
- Known hazards in the operations and how they are controlled
- Potential risks to health
- Precautions to prevent exposure
- Hygiene requirements
- Wearing and use of protective equipment and clothing
- Appropriate response to operation extremes, incidents and accidents

Basic OHS Training

- A basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training should generally be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.
- Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Training would include the risks of becoming infected with blood–borne pathogens through contact with bodily fluids and tissue.
- Through appropriate contract specifications and monitoring, the employer should ensure that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.

Area Signage

- Hazardous areas (electrical rooms, compressor rooms, etc), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately.
- Signage should be in accordance with international standards and be well known to, and easily understood by workers, visitors and the general public as appropriate.

Labeling of Equipment

- All vessels that may contain substances that are hazardous as a result of chemical or toxicological properties, or temperature or pressure, should be labeled as to the contents and hazard, or appropriately color coded.
- Similarly, piping systems that contain hazardous substances should be labeled with the direction of flow and contents of the pipe, or color coded whenever the pipe passing through a wall or floor is interrupted by a valve or junction device.

Communicate Hazard Codes

- Copies of the hazard coding system should be posted outside the facility at emergency entrance doors and fire emergency connection systems where they are likely to come to the attention of emergency services personnel.
- Information regarding the types of hazardous materials stored, handled or used at the facility, including typical maximum inventories and storage locations, should be shared proactively with emergency services and security personnel to expedite emergency response when needed.
- Representatives of local emergency and security services should be invited to participate in periodic (annual) orientation tours and site inspections to ensure familiarity with potential hazards present.

2.3 Physical Hazards

Physical hazards represent potential for accident or injury or illness due to repetitive exposure to mechanical action or work activity. Single exposure to physical hazards may result in a wide range of injuries, from minor and medical aid only, to disabling, catastrophic, and/or fatal. Multiple exposures over prolonged

periods can result in disabling injuries of comparable significance and consequence.

Rotating and Moving Equipment

Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Recommended protective measures include:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. Examples of proper design considerations include two-hand operated machines to prevent amputations or the availability of emergency stops dedicated to the machine and placed in strategic locations. Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards should be designed and installed in conformance with appropriate machine safety standards.[64]
- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance, in conformance with a standard such as CSA Z460 Lockout or equivalent ISO or ANSI standard
- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms

[64] For example: CSA Z432.04 Safe Guarding of Machinery, CSA Z434 Robot Safety, ISO 11161 Safety of Machinery – Integrated Manufacturing Systems or ISO 14121 Safety of Machinery – Principals of Risk Management or equivalent ANSI standard.

Noise

Noise limits for different working environments are provided in Table 2.3.1.

- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.[65]
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible
- Periodic medical hearing checks should be performed on workers exposed to high noise levels

Vibration

Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and

[65] The American Conference of Governmental Industrial Hygienists (ACGIH), 2006

action values, (i.e. the level of exposure at which remediation should be initiated) are provided by the ACGIH[66]. Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers.

Electrical

Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

Table 2.3.1. Noise Limits for Various Working Environments

Location /activity	Equivalent level LA_{eq},8h	Maximum LA_{max},fast
Heavy Industry (no demand for oral communication)	85 dB(A)	110 dB(A)
Light industry (decreasing demand for oral communication)	50-65 dB(A)	110 dB(A)
Open offices, control rooms, service counters or similar	45-50 dB(A)	-
Individual offices (no disturbing noise)	40-45 dB(A)	-
Classrooms, lecture halls	35-40 dB(A)	-
Hospitals	30-35 dB(A)	40 dB(A)

- Marking all energized electrical devices and lines with warning signs
- Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance
- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools
- Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits
- Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas
- Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited (see also Section 3 on Planning, Siting, and Design);
- Establishing "No Approach" zones around or under high voltage power lines in conformance with Table 2.3.2
- Rubber tired construction or other vehicles that come into direct contact with, or arcing between, high voltage wires may need to be taken out of service for periods of 48 hours and have the tires replaced to prevent catastrophic tire and wheel assembly failure, potentially causing serious injury or death;
- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work

[66] ACGIH, 2005

Table 2.3.2. No Approach Zones for High Voltage Power Lines	
Nominal phase-to-phase voltage rating	Minimum distance
750 or more volts, but no more than 150,000 volts	3 meters
More than 150,000 volts, but no more than 250,000 volts	4.5 meters
More than 250,000 volts	6 meters

Eye Hazards

Solid particles from a wide variety of industrial operations, and / or a liquid chemical spray may strike a worker in the eye causing an eye injury or permanent blindness. Recommended measures include:

- Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding should conform to standards published by organizations such as CSA, ANSI and ISO (see also Section 2.3 on Rotating and Moving Equipment and 2.7 on Personal Protective Equipment).
- Moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted (e.g. discharge of sparks from a metal cutting station, pressure relief valve discharge) away from places expected to be occupied or transited by workers or visitors. Where machine or work fragments could present a hazard to transient workers or passers-by, extra area guarding or proximity restricting systems should be implemented, or PPE required for transients and visitors.
- Provisions should be made for persons who have to wear prescription glasses either through the use overglasses or prescription hardened glasses.

Welding / Hot Work

Welding creates an extremely bright and intense light that may seriously injur a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes to which prolonged exposure can cause serious chronic diseases. Recommended measures include:

- Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required.
- Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hotwork on tanks or vessels that have contained flammable materials.

Industrial Vehicle Driving and Site Traffic

Poorly trained or inexperienced industrial vehicle drivers have increased risk of accident with other vehicles, pedestrians, and equipment. Industrial vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Industrial vehicle driving and site traffic safety practices include:

- Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits
- Ensuring drivers undergo medical surveillance
- Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms
- Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction
- Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate

Working Environment Temperature

Exposure to hot or cold working conditions in indoor or outdoor environments can result temperature stress-related injury or death. Use of personal protective equipment (PPE) to protect against other occupational hazards can accentuate and aggravate heat-related illnesses. Extreme temperatures in permanent work environments should be avoided through implementation of engineering controls and ventilation. Where this is not possible, such as during short-term outdoor work, temperature-related stress management procedures should be implemented which include:

- Monitoring weather forecasts for outdoor work to provide advance warning of extreme weather and scheduling work accordingly
- Adjustment of work and rest periods according to temperature stress management procedures provided by ACGIH[67], depending on the temperature and workloads
- Providing temporary shelters to protect against the elements during working activities or for use as rest areas
- Use of protective clothing
- Providing easy access to adequate hydration such as drinking water or electrolyte drinks, and avoiding consumption of alcoholic beverages

Ergonomics, Repetitive Motion, Manual Handling

Injuries due to ergonomic factors, such as repetitive motion, over-exertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems should be minimized or eliminated to maintain a productive workplace. Controls may include:

- Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind
- Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds
- Selecting and designing tools that reduce force requirements and holding times, and improve postures
- Providing user adjustable work stations
- Incorporating rest and stretch breaks into work processes, and conducting job rotation
- Implementing quality control and maintenance programs that reduce unnecessary forces and exertions
- Taking into consideration additional special conditions such as left handed persons

Working at Heights

Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. Fall prevention / protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:

[67] ACGIH, 2005

- Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area
- Proper use of ladders and scaffolds by trained employees
- Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines
- Appropriate training in use, serviceability, and integrity of the necessary PPE
- Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall

Illumination

Work area light intensity should be adequate for the general purpose of the location and type of activity, and should be supplemented with dedicated work station illumination, as needed. The minimum limits for illumination intensity for a range of locations/activities appear in Table 2.3.3.

Table 2.3.3. Minimum Limits For Workplace Illumination Intensity

Location / Activity	Light Intensity
Emergency light	10 lux
Outdoor non working areas	20 lux
Simple orientation and temporary visits (machine storage, garage, warehouse)	50 lux
Workspace with occasional visual tasks only (corridors, stairways, lobby, elevator, auditorium, etc.)	100 lux
Medium precision work (simple assembly, rough machine works, welding, packing, etc.)	200 lux
Precision work (reading, moderately difficult assembly, sorting, checking, medium bench and machine works, etc.), offices.	500 lux
High precision work (difficult assembly, sewing, color inspection, fine sorting etc.)	1,000 – 3,000 lux

Controls should include:

- Use of energy efficient light sources with minimum heat emission
- Undertaking measures to eliminate glare / reflections and flickering of lights
- Taking precautions to minimize and control optical radiation including direct sunlight. Exposure to high intensity UV and IR radiation and high intensity visible light should also be controlled
- Controlling laser hazards in accordance with equipment specifications, certifications, and recognized safety standards. The lowest feasible class Laser should be applied to minimize risks.

2.4 Chemical Hazards

Chemical hazards represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. They also represent a risk of uncontrolled reaction, including the risk of fire and explosion, if incompatible chemicals are inadvertently mixed. Chemical hazards can most effectively be prevented through a hierarchical approach that includes:

- Replacement of the hazardous substance with a less hazardous substitute
- Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits
- Keeping the number of employees exposed, or likely to become exposed, to a minimum

- Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Any means of written communication should be in an easily understood language and be readily available to exposed workers and first-aid personnel
- Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE

Air Quality

Poor air quality due to the release of contaminants into the work place can result in possible respiratory irritation, discomfort, or illness to workers. Employers should take appropriate measures to maintain air quality in the work area. These include:

- Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended by the ACGIH[68] as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after-week), without sustaining adverse health effects.
- Developing and implementing work practices to minimize release of contaminants into the work environment including:
  - Direct piping of liquid and gaseous materials
  - Minimized handling of dry powdered materials;
  - Enclosed operations
  - Local exhaust ventilation at emission / release points
  - Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
  - Indoor secure storage, and sealed containers rather than loose storage
- Where ambient air contains several materials that have similar effects on the same body organs (additive effects), taking into account combined exposures using calculations recommended by the ACGIH[69]
- Where work shifts extend beyond eight (8) hours, calculating adjusted workplace exposure criteria recommended by the ACGIH[70]

Fire and Explosions

Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:
  - Remote from entry and exit points into buildings
  - Away from facility ventilation intakes or vents
  - Have natural or passive floor and ceiling level ventilation and explosion venting
  - Use spark-proof fixtures
  - Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time
- Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area
- Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems

[68] ACGIH, 2005

[69] ACGIH, 2005.

[70] ACGIH, 2005.

- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression

Corrosive, oxidizing, and reactive chemicals

Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases, and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The following controls should be observed in the work environment when handling such chemicals:

- Corrosive, oxidizing and reactive chemicals should be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills
- Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc).
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water

Asbestos Containing Materials (ACM)

The use of asbestos containing materials (ACM) should be avoided in new buildings or as a new material in remodeling or renovation activities. Existing facilities with ACM should develop an asbestos management plan which clearly identifies the locations where the ACM is present, its condition (e.g. whether it is in friable form with the potential to release fibers), procedures for monitoring its condition, procedures to access the locations where ACM is present to avoid damage, and training of staff who can potentially come into contact with the material to avoid damage and prevent exposure. The plan should be made available to all persons involved in operations and maintenance activities. Repair or removal and disposal of existing ACM in buildings should only be performed by specially trained personnel[71] following host country requirements, or in their absence, internationally recognized procedures.[72]

2.5 Biological Hazards

Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures:

- If the nature of the activity permits, use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers. If use of harmful agents can not be avoided, precautions should be taken to keep the risk of exposure as low as possible and maintained below internationally established and recognized exposure limits.

[71] Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe (examples of North American training standards are available at: http://www.osha.gov/SLTC/asbestos/training.html)

[72] Examples include the American Society for Testing and Materials (ASTM) E 1368 - Standard Practice for Visual Inspection of Asbestos Abatement Projects; E 2356 - Standard Practice for Comprehensive Building Asbestos Surveys; and E 2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos Cement Products.

- Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum.
- The employer should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs.
- Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.

Biological agents should be classified into four groups[73]:

- ***Group 1:*** Biological agents unlikely to cause human disease, and consequently only require controls similar to those required for hazardous or reactive chemical substances;
- ***Group 2:*** Biological agents that can cause human disease and are thereby likely to require additional controls, but are unlikely to spread to the community;
- ***Group 3***: Biological agents that can cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community, for which there usually is effective prophylaxis or treatment available and are thereby likely to require extensive additional controls;
- ***Group 4:*** Biological agents that can cause severe human disease, are a serious hazard to workers, and present a high risk of spreading to the community, for which there is usually no effective prophylaxis or treatment available and are thereby likely to require very extensive additional controls.

The employer should at all times encourage and enforce the highest level of hygiene and personal protection, especially for activities employing biological agents of Groups 3 and 4 above. Work involving agents in Groups 3 and 4 should be restricted only to those persons who have received specific verifiable training in working with and controlling such materials.

Areas used for the handling of Groups 3 and 4 biological agents should be designed to enable their full segregation and isolation in emergency circumstances, include independent ventilation systems, and be subject to SOPs requiring routine disinfection and sterilization of the work surfaces.

HVAC systems serving areas handling Groups 3 and 4 biological agents should be equipped with High Efficiency Particulate Air (HEPA) filtration systems. Equipment should readily enable their disinfection and sterilization, and maintained and operated so as to prevent growth and spreading of disease agents, amplification of the biological agents, or breeding of vectors e.g. mosquitoes and flies of public health concern.

[73] World Health Organization (WHO) Classification of Infective Microorganisms by Risk Group (2004).

2.6 Radiological Hazards

Radiation exposure can lead to potential discomfort, injury or serious illness to workers. Prevention and control strategies include:

- Places of work involving occupational and/or natural exposure to ionizing radiation should be established and operated in accordance with recognized international safety standards and guidelines.[74] The acceptable effective dose limits appear Table 2.6.1.
- Exposure to non-ionizing radiation (including static magnetic fields; sub-radio frequency magnetic fields; static electric fields; radio frequency and microwave radiation; light and near-infrared radiation; and ultraviolet radiation) should be controlled to internationally recommended limits[75].

Table 2.6.1. Acceptable Effective Dose Limits for Workplace Radiological Hazards

Exposure	Workers (min.19 years of age)	Apprentices and students (16-18 years of age)
Five consecutive year average – effective dose	20 mSv/year	
Single year exposure – effective dose	50 mSv/year	6 mSv/year
Equivalent dose to the lens of the eye	150 mSv/year	50 mSv/year
Equivalent dose to the extremities (hands, feet) or the skin	500 mSv/year	150 mSv/year

- In the case of both ionizing and non-ionizing radiation, the preferred method for controlling exposure is shielding and limiting the radiation source. Personal protective equipment is supplemental only or for emergency use. Personal protective equipment for near-infrared, visible and ultraviolet range radiation can include appropriate sun block creams, with or without appropriate screening clothing.

2.7 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems.

PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of personal protection. Table 2.7.1 presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

- Active use of PPE if alternative technologies, work plans or procedures cannot eliminate, or sufficiently reduce, a hazard or exposure
- Identification and provision of appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual
- Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees

[74] International Basic Safety Standard for protection against Ionizing Radiation and for the Safety of Radiation Sources and its three interrelated Safety Guides.

IAEA. http://www-ns.iaea.org/standards/documents/default.asp?sub=160

[75] For example ACGIH (2005) and International Commission for Non-Ionizing Radiation (ICNIRP).

- Selection of PPE should be based on the hazard and risk ranking described earlier in this section, and selected according to criteria on performance and testing established by recognized organizations[76].

Table 2.7.1. Summary of Recommended Personal Protective Equipment According to Hazard

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.

2.8 Special Hazard Environments

Special hazard environments are work situations where all of the previously described hazards may exist under unique or especially hazardous circumstances. Accordingly, extra precautions or rigor in application of precautions is required.

Confined Space

A confined space is defined as a wholly or partially enclosed space not designed or intended for human occupancy and in which a hazardous atmosphere could develop as a result of the contents, location or construction of the confined space or due to work done in or around the confined space. A "permit-required" confined space is one that also contains physical or atmospheric hazards that could trap or engulf the person.[77]

Confined spaces can occur in enclosed or open structures or locations. Serious injury or fatality can result from inadequate preparation to enter a confined space or in attempting a rescue from a confined space. Recommended management approaches include:

- Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.
- Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space should provide ample room for emergency and rescue operations.

[76] Examples include the American National Standards Institute (ANSI), http://www.ansi.org/; National Institute for Occupational Safety and Health[76] (NIOSH), http://www.cdc.gov/niosh/homepage.html; Canadian Standards Association[76] (CSA), http://www.csa.ca/Default.asp?language=english; Mine Safety and Health Administration[76] (MSHA), http://www.msha.gov.

[77] US OSHA CFR 1910.146

- Access hatches should accommodate 90% of the worker population with adjustments for tools and protective clothing. The most current ISO and EN standards should be consulted for design specifications;
- Prior to entry into a permit-required confined space:
  - Process or feed lines into the space should be disconnected or drained, and blanked and locked-out.
  - Mechanical equipment in the space should be disconnected, de-energized, locked-out, and braced, as appropriate.
  - The atmosphere within the confined space should be tested to assure the oxygen content is between 19.5 percent and 23 percent, and that the presence of any flammable gas or vapor does not exceed 25 percent of its respective Lower Explosive Limit (LEL).
  - If the atmospheric conditions are not met, the confined space should be ventilated until the target safe atmosphere is achieved, or entry is only to be undertaken with appropriate and additional PPE.
- Safety precautions should include Self Contained Breathing Apparatus (SCBA), life lines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available.
- Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE should be verified. Further, adequate and appropriate rescue and / or recovery plans and equipment should be in place before the worker enters the confined space.

Lone and Isolated Workers

A lone and isolated worker is a worker out of verbal and line of sight communication with a supervisor, other workers, or other persons capable of providing aid and assistance, for continuous periods exceeding one hour. The worker is therefore at increased risk should an accident or injury occur.

- Where workers may be required to perform work under lone or isolated circumstances, Standard Operating Procedures (SOPs) should be developed and implemented to ensure all PPE and safety measures are in place before the worker starts work. SOPs should establish, at a minimum, verbal contact with the worker at least once every hour, and ensure the worker has a capability for summoning emergency aid.
- If the worker is potentially exposed to highly toxic or corrosive chemicals, emergency eye-wash and shower facilities should be equipped with audible and visible alarms to summon aid whenever the eye-wash or shower is activated by the worker and without intervention by the worker.

2.9 Monitoring

Occupational health and safety monitoring programs should verify the effectiveness of prevention and control strategies. The selected indicators should be representative of the most significant occupational, health, and safety hazards, and the implementation of prevention and control strategies. The occupational health and safety monitoring program should include:

- *Safety inspection, testing and calibration:* This should include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained.
- *Surveillance of the working environment:* Employers should document compliance using an appropriate combination of

portable and stationary sampling and monitoring instruments. Monitoring and analyses should be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters should be established individually for each project following a review of the hazards. Generally, monitoring should be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.

- *Surveillance of workers health:* When extraordinary protective measures are required (for example, against biological agents Groups 3 and 4, and/or hazardous compounds), workers should be provided appropriate and relevant health surveillance prior to first exposure, and at regular intervals thereafter. The surveillance should, if deemed necessary, be continued after termination of the employment.
- *Training:* Training activities for employees and visitors should be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, should be documented adequately. Service providers and contractors should be contractually required to submit to the employer adequate training documentation before start of their assignment.

Accidents and Diseases monitoring

- The employer should establish procedures and systems for reporting and recording:
  - Occupational accidents and diseases
  - Dangerous occurrences and incidents

  These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a serious danger to life or health.
- The systems and the employer should further enable and encourage workers to report to management all:
  - Occupational injuries and near misses
  - Suspected cases of occupational disease
  - Dangerous occurrences and incidents
- All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation should:
  - Establish what happened
  - Determine the cause of what happened
  - Identify measures necessary to prevent a recurrence
- Occupational accidents and diseases should, at a minimum, be classified according to Table 2.10.1. Distinction is made between fatal and non-fatal injuries. The two main categories are divided into three sub-categories according to time of death or duration of the incapacity to work. The total work hours during the specified reporting period should be reported to the appropriate regulatory agency.

Table 2.9.1. Occupational Accident Reporting

a. Fatalities (number)	**b. Non-fatal injuries** (number) [78]	**c. Total time lost** non-fatal injuries (days)
a.1 Immediate	**b.1** Less than one day	
a.2 Within a month	**b.2** Up to 3 days	**c.1** Category b.2
a.3 Within a year	**b.3** More than 3 days	**c.2** Category b.3

[78] The day on which an incident occurs is not included in b.2 and b.3.

3.0 Community Health and Safety

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This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis. These issues may arise at any stage of a project life cycle and can have an impact beyond the life of the project.

3.1 Water Quality and Availability

Groundwater and surface water represent essential sources of drinking and irrigation water in developing countries, particularly in rural areas where piped water supply may be limited or unavailable and where available resources are collected by the consumer with little or no treatment. Project activities involving wastewater discharges, water extraction, diversion or impoundment should prevent adverse impacts to the quality and availability of groundwater and surface water resources.

Water Quality

Drinking water sources, whether public or private, should at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality. Air emissions, wastewater effluents, oil and hazardous materials, and wastes should be managed according to the guidance provided in the respective sections of the General EHS Guidelines with the objective of protecting soil and water resources.

Where the project includes the delivery of water to the community or to users of facility infrastructure (such as hotel hosts and hospital patients), where water may be used for drinking, cooking, washing, and bathing, water quality should comply with national acceptability standards or in their absence the current edition of with WHO Drinking Water Guidelines. Water quality for more sensitive well-being-related demands such as water used in health care facilities or food production may require more stringent, industry-specific guidelines or standards, as applicable. Any dependency factors associated with the deliver of water to the local community should be planned for and managed to ensure the sustainability of the water supply by involving the community in its management to minimize the dependency in the long-term.

Water Availability

The potential effect of groundwater or surface water abstraction for project activities should be properly assessed through a combination of field testing and modeling techniques, accounting for seasonal variability and projected changes in demand in the project area.

Project activities should not compromise the availability of water for personal hygiene needs and should take account of potential future increases in demand. The overall target should be the availability of 100 liters per person per day although lower levels may be used to meet basic health requirements.[79] Water volume requirements for well-being-related demands such as water use in health care facilities may need to be higher.

3.2 Structural Safety of Project Infrastructure

Hazards posed to the public while accessing project facilities may include:

- Physical trauma associated with failure of building structures
- Burns and smoke inhalation from fires
- Injuries suffered as a consequence of falls or contact with heavy equipment
- Respiratory distress from dust, fumes, or noxious odors
- Exposure to hazardous materials

Reduction of potential hazards is best accomplished during the design phase when the structural design, layout and site modifications can be adapted more easily. The following issues should be considered and incorporated as appropriate into the planning, siting, and design phases of a project:

- Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions
- Incorporation of siting and safety engineering criteria to prevent failures due to natural risks posed by earthquakes, tsunamis, wind, flooding, landslides and fire. To this end, all project structures should be designed in accordance with engineering and design criteria mandated by site-specific risks, including but not limited to seismic activity, slope stability, wind loading, and other dynamic loads
- Application of locally regulated or internationally recognized building codes[80] to ensure structures are designed and constructed in accordance with sound architectural and engineering practice, including aspects of fire prevention and response
- Engineers and architects responsible for designing and constructing facilities, building, plants and other structures should certify the applicability and appropriateness of the structural criteria employed.

International codes, such as those compiled by the International Code Council (ICC)[81], are intended to regulate the design, construction, and maintenance of a built environment and contain detailed guidance on all aspects of building safety, encompassing methodology, best practices, and documenting compliance. Depending on the nature of a project, guidance provided in the ICC or comparable codes should be followed, as appropriate, with respect to:

- Existing structures
- Soils and foundations
- Site grading
- Structural design
- Specific requirements based on intended use and occupancy
- Accessibility and means of egress
- Types of construction
- Roof design and construction
- Fire-resistant construction
- Flood-resistant construction

[79] World Health Organization (WHO) defines 100 liters/capita/day as the amount required to meet all consumption and hygiene needs. Additional information on lower service levels and potential impacts on health are described in "Domestic Water Quantity, Service Level and Health" 2003. http://www.who.int/water_sanitation_health/diseases/wsh0302/en/index.html

[80] ILO-OSH, 2001. http://www.ilo.org/public/english/protection/safework/cops/english/download/e000013.pdf

[81] ICC, 2006.

- Construction materials
- Interior environment
- Mechanical, plumbing and electrical systems
- Elevators and conveying systems
- Fire safety systems
- Safeguards during construction
- Encroachments into public right-of-way

Although major design changes may not be feasible during the operation phase of a project, hazard analysis can be undertaken to identify opportunities to reduce the consequences of a failure or accident. Illustrative management actions, applicable to hazardous materials storage and use, include:

- Reducing inventories of hazardous materials through inventory management and process changes to greatly reduce or eliminate the potential off-site consequences of a release
- Modifying process or storage conditions to reduce the potential consequences of an accidental off-site release
- Improving shut-down and secondary containment to reduce the amount of material escaping from containment and to reduce the release duration
- Reducing the probability that releases will occur through improved site operations and control, and through improvements in maintenance and inspection
- Reducing off-site impacts of releases through measures intended to contain explosions and fires, alert the public, provide for evacuation of surrounding areas, establish safety zones around a site, and ensure the provision of emergency medical services to the public

3.3 Life and Fire Safety (L&FS)

Applicability and Approach

All new buildings accessible to the public should be designed, constructed, and operated in full compliance with local building codes, local fire department regulations, local legal/insurance requirements, and in accordance with an internationally accepted life and fire safety (L&FS) standard. The Life Safety Code[82], which provides extensive documentation on life and fire safety provisions, is one example of an internationally accepted standard and may be used to document compliance with the Life and Fire Safety objectives outlined in these guidelines. With regard to these objectives:

- Project sponsors' architects and professional consulting engineers should demonstrate that affected buildings meet these life and fire safety objectives.
- Life and fire safety systems and equipment should be designed and installed using appropriate prescriptive standards and/or performance based design, and sound engineering practices.
- Life and fire safety design criteria for all existing buildings should incorporate all local building codes and fire department regulations.

These guidelines apply to buildings that are accessible to the public. Examples of such buildings include:

- Health and education facilities
- Hotels, convention centers, and leisure facilities
- Retail and commercial facilities
- Airports, other public transport terminals, transfer facilities

Specific Requirements for New Buildings

The nature and extent of life and fire safety systems required will depend on the building type, structure, construction, occupancy, and exposures. Sponsors should prepare a Life and Fire Safety Master Plan identifying major fire risks, applicable codes, standards and regulations, and mitigation measures. The Master

[82] US NFPA. http://www.nfpa.org/catalog/product.asp?category%5Fname=&pid=10106&target%5Fpid=10106&src%5Fpid=&link%5Ftype=search

Plan should be prepared by a suitably qualified professional, and adequately cover, but not be limited to, the issues addressed briefly in the following points. The suitably qualified professional selected to prepare the Master Plan is responsible for a detailed treatment of the following illustrative, and all other required, issues.

Fire Prevention

Fire prevention addresses the identification of fire risks and ignition sources, and measures needed to limit fast fire and smoke development. These issues include:

- Fuel load and control of combustibles
- Ignition sources
- Interior finish flame spread characteristics
- Interior finish smoke production characteristics
- Human acts, and housekeeping and maintenance

Means of Egress

Means of Egress includes all design measures that facilitate a safe evacuation by residents and/or occupants in case of fire or other emergency, such as:

- Clear, unimpeded escape routes
- Accessibility to the impaired/handicapped
- Marking and signing
- Emergency lighting

Detection and Alarm Systems

These systems encompass all measures, including communication and public address systems needed to detect a fire and alert:

- Building staff
- Emergency response teams
- Occupants
- Civil defense

Compartmentation

Compartmentation involves all measures to prevent or slow the spread of fire and smoke, including:

- Separations
- Fire walls
- Floors
- Doors
- Dampers
- Smoke control systems

Fire Suppression and Control

Fire suppression and control includes all automatic and manual fire protection installations, such as:

- Automatic sprinkler systems
- Manual portable extinguishers
- Fire hose reels

Emergency Response Plan

An Emergency Response Plan is a set of scenario–based procedures to assist staff and emergency response teams during real life emergency and training exercises. This chapter of the Fire and Life Safety Master Plan should include an assessment of local fire prevention and suppression capabilities.

Operation and Maintenance

Operation and Maintenance involves preparing schedules for mandatory regular maintenance and testing of life and fire safety features to ensure that mechanical, electrical, and civil structures and systems are at all times in conformance with life and fire safety design criteria and required operational readiness.

L&FS Master Plan Review and Approval

- A suitably qualified professional prepares and submits a Life and Fire Safety (L&FS) Master Plan, including preliminary drawings and specifications, and certifies that the design

meets the requirements of these L&FS guidelines. The findings and recommendations of the review are then used to establish the conditions of a Corrective Action Plan and a time frame for implementing the changes.

- The suitably qualified professional conducts a review as part of the project completion test at the time of life and fire safety systems testing and commissioning, and certifies that construction of these systems has been carried out in accordance with the accepted design. The findings and recommendations of the review are used as the basis for establishing project completion or to establish the conditions of a Pre-Completion Corrective Action Plan and a time frame for implementing the changes.

Specific Requirements for Existing Buildings

- All life and fire safety guideline requirements for new buildings apply to existing buildings programmed for renovation. A suitably qualified professional conducts a complete life and fire safety review of existing buildings slated for renovation. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.
- If it becomes apparent that life and fire safety conditions are deficient in an existing building that is not part of the project or that has not been programmed for renovation, a life and fire safety review of the building may be conducted by a suitably qualified professional. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.

Other Hazards

- Facilities, buildings, plants, and structures should be situated to minimize potential risks from forces of nature (e.g. earthquakes, tsunamis, floods, windstorms, and fires from surrounding areas).
- All such structures should be designed in accordance with the criteria mandated by situation-, climatic-, and geology-specific location risks (e.g. seismic activity, wind loading, and other dynamic loads).
- Structural engineers and architects responsible for facilities, buildings, plants and structures should certify the applicability and appropriateness of the design criteria employed.
- National or regional building regulations typically contain fire safety codes and standards[83] or these standards are found in separate Fire Codes.[84,85] Generally, such codes and regulations incorporate further compliance requirements with respect to methodology, practice, testing, and other codes and standards[86]. Such nationally referenced material constitutes the acceptable fire life safety code.

3.4 Traffic Safety

Traffic accidents have become one of the most significant causes of injuries and fatalities among members of the public worldwide. Traffic safety should be promoted by all project personnel during displacement to and from the workplace, and during operation of project equipment on private or public roads. Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of project workers and of road users, including those who are most vulnerable to road traffic accidents[87]. Road safety initiatives proportional to the scope and nature of project activities should include:

[83] For example, Australia, Canada, South Africa, United Kingdom

[84] Réglementation Incendie [des ERP]

[85] USA NFPA, 2006.

[86] Prepared by National Institutes and Authorities such as American Society for Testing and Materials (ASTM), British Standards (BS), German Institute of Standardization (DIN), and French Standards (NF)

[87] Additional information on vulnerable users of public roads in developing countries is provided by Peden et al., 2004.

- Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include:
  - Emphasizing safety aspects among drivers
  - Improving driving skills and requiring licensing of drivers
  - Adopting limits for trip duration and arranging driver rosters to avoid overtiredness
  - Avoiding dangerous routes and times of day to reduce the risk of accidents
  - Use of speed control devices (governors) on trucks, and remote monitoring of driver actions
- Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

Where the project may contribute to a significant increase in traffic along existing roads, or where road transport is a significant component of a project, recommended measures include:

- Minimizing pedestrian interaction with construction vehicles
- Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns)[88]
- Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents
- Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic
- Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions

3.5 Transport of Hazardous Materials

General Hazardous Materials Transport

- Projects should have procedures in place that ensure compliance with local laws and international requirements applicable to the transport of hazardous materials, including:
  - IATA requirements[89] for air transport
  - IMDG Code[90] sea transport
  - UN Model Regulations[91] of other international standards as well as local requirements for land transport
  - Host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, if applicable to the project activities
- The procedures for transportation of hazardous materials (Hazmats) should include:
  - Proper labeling of containers, including the identify and quantity of the contents, hazards, and shipper contact information
  - Providing a shipping document (e.g. shipping manifest) that describes the contents of the load and its associated hazards in addition to the labeling of the containers. The shipping document should establish a chain-of-custody using multiple signed copies to show that the waste was properly shipped, transported and received by the recycling or treatment/disposal facility

[88] Additional sources of information for implementation of road safety measures is available at WHO, 1989, Ross et al., 1991, Tsunokawa and Hoban, 1997, and OECD, 1999

[89] IATA, 2005. www.iata.org

[90] IMO. www.imo.org/safety

[91] United Nations. Transport of Dangerous Goods - Model Regulations. 14th Revised Edition. Geneva 2005. http://www.unece.org/trans/danger/publi/unrec/rev14/14files_e.html

- Ensuring that the volume, nature, integrity and protection of packaging and containers used for transport are appropriate for the type and quantity of hazardous material and modes of transport involved
- Ensuring adequate transport vehicle specifications
- Training employees involved in the transportation of hazardous materials regarding proper shipping procedures and emergency procedures
- Using labeling and placarding (external signs on transport vehicles), as required
- Providing the necessary means for emergency response on call 24 hours/day

Major Transportation Hazards

Guidance related to major transportation hazards should be implemented in addition to measures presented in the preceding section for preventing or minimizing the consequences of catastrophic releases of hazardous materials, which may result in toxic, fire, explosion, or other hazards during transportation.

In addition to these aforementioned procedures, projects which transport hazardous materials *at or above the threshold quantities*[92] should prepare a Hazardous Materials Transportation Plan containing all of the elements presented below[93].

Hazard Assessment

The hazard assessment should identify the potential hazard involved in the transportation of hazardous materials by reviewing:

- The hazard characteristics of the substances identified during the screening stage
- The history of accidents, both by the company and its contractors, involving hazardous materials transportation
- The existing criteria for the safe transportation of hazardous materials, including environmental management systems used by the company and its contractors

This review should cover the management actions, preventive measures and emergency response procedures described below. The hazard assessment helps to determine what additional measures may be required to complete the plan.

Management Actions

- *Management of Change:* These procedures should address:
  - The technical basis for changes in hazardous materials offered for transportation, routes and/or procedures
  - The potential impact of changes on health and safety
  - Modification required to operating procedures
  - Authorization requirements
  - Employees affected
  - Training needs
- *Compliance Audit:* A compliance audit evaluates compliance with prevention requirements for each transportation route or for each hazardous material, as appropriate. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years. The audit program should include:
  - Preparation of a report of the findings
  - Determination and documentation of the appropriate response to each finding
  - Documentation that any deficiency has been corrected.
- *Incident Investigation:* Incidents can provide valuable information about transportation hazards and the steps needed to prevent accidental releases. The implementation of incident investigation procedures should ensure that:
  - Investigations are initiated promptly
  - Summaries of investigations are included in a report
  - Report findings and recommendations are addressed

[92] Threshold quantities for the transport of hazardous materials are found in the UN – Transport of Dangerous Goods – Model Regulations cited above.

[93] For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Transportation Manual. Washington, D.C. December 2000.

- Reports are reviewed with staff and contractors

- *Employee Participation:* There should be a written plan of action regarding the implementation of active employee participation in the prevention of accidents.

- *Contractors:* The plan should include procedures to ensure that:
  - The contractor is provided with safety performance procedures and safety and hazard information
  - Contractors observe safety practices
  - Verify that the contractor acts responsibly

  The plan should also include additional procedures to ensure the contractors will:
  - Ensure appropriate training for their employees
  - Ensure their employees know process hazards and applicable emergency actions
  - Prepare and submit training records
  - Inform employees about the hazards presented by their work

- *Training:* Good training programs on operating procedures will provide the employees with the necessary information to understand how to operate safely and why safe operations are needed. The training program should include:
  - The list of employees to be trained
  - Specific training objectives
  - Mechanisms to achieve objectives (i.e. hands-on workshops, videos, etc.)
  - Means to determine the effectiveness of the training program
  - Training procedures for new hires and refresher programs

Preventive Measures

The plan should include procedures to implement preventive measures specific to each hazardous material offered for transportation, including:

- Classification and segregation of hazardous materials in warehouses and transport units
- Packaging and packaging testing
- Marking and labeling of packages containing hazardous materials
- Handling and securing packages containing hazardous materials in transport units
- Marking and placarding of transport units
- Documentation (e.g. bills of lading)
- Application of special provisions, as appropriate

Emergency Preparedness and Response

It is important to develop procedures and practices for the handling of hazardous materials that allow for quick and efficient responses to accidents that may result in injury or environmental damage. The sponsor should prepare an Emergency Preparedness and Response Plan that should cover:

- *Planning Coordination:* This should include procedures for:
  - Informing the public and emergency response agencies
  - Documenting first aid and emergency medical treatment
  - Taking emergency response actions
  - Reviewing and updating the emergency response plan to reflect changes and ensuring that the employees are informed of such changes

- *Emergency Equipment:* The plan should include procedures for using, inspecting, testing, and maintaining emergency response equipment.

- *Training:* Employees should be trained in any relevant procedures

3.6 Disease Prevention

Communicable Diseases

Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications.

Recommended interventions at the project level include[94]:

- Providing surveillance and active screening and treatment of workers
- Preventing illness among workers in local communities by:
  - Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use
  - Training health workers in disease treatment
  - Conducting immunization programs for workers in local communities to improve health and guard against infection
  - Providing health services
- Providing treatment through standard case management in on-site or community health care facilities. Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers
- Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization

Vector-Borne Diseases

Reducing the impact of vector-borne disease on the long-term health of workers is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease. Project sponsors, in close collaboration with community health authorities, can implement an integrated control strategy for mosquito and other arthropod-borne diseases that might involve:

- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements
- Elimination of unusable impounded water
- Increase in water velocity in natural and artificial channels
- Considering the application of residual insecticide to dormitory walls
- Implementation of integrated vector control programs
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites
- Use of chemoprophylaxis drugs by non-immune workers and collaborating with public health officials to help eradicate disease reservoirs
- Monitoring and treatment of circulating and migrating populations to prevent disease reservoir spread
- Collaboration and exchange of in-kind services with other control programs in the project area to maximize beneficial effects
- Educating project personnel and area residents on risks, prevention, and available treatment
- Monitoring communities during high-risk seasons to detect and treat cases

[94] Additional sources of information on disease prevention include IFC, 2006; UNDP, 2000, 2003; Walley et al., 2000; Kindhauser, 2003; Heymann, 2004.

- Distributing appropriate education materials
- Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure

3.7 Emergency Preparedness and Response

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety.

All projects should have an Emergency Preparedness and Response Plan that is commensurate with the risks of the facility and that includes the following basic elements:

- Administration (policy, purpose, distribution, definitions, etc)
- Organization of emergency areas (command centers, medical stations, etc)
- Roles and responsibilities
- Communication systems
- Emergency response procedures
- Emergency resources
- Training and updating
- Checklists (role and action list and equipment checklist)
- Business Continuity and Contingency

Additional information is provided for key components of the emergency plan, as follows below.

Communication Systems

Worker notification and communication

Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency. Related measures include:

- Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations
- Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency

Community Notification

If a local community may be at risk from a potential emergency arising at the facility, the company should implement communication measures to alert the community, such as:

- Audible alarms, such as fire bells or sirens
- Fan out telephone call lists
- Vehicle mounted speakers
- Communicating details of the nature of the emergency
- Communicating protection options (evacuation, quarantine)
- Providing advise on selecting an appropriate protection option

Media and Agency Relations

Emergency information should be communicated to the media through:

- A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies
- Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed

Emergency Resources

Finance and Emergency Funds

- A mechanism should be provided for funding emergency activities.

Fire Services

- The company should consider the level of local fire fighting capacity and whether equipment is available for use at the facility in the event of a major emergency or natural disaster. If insufficient capacity is available, fire fighting capacity should be acquired that may include pumps, water supplies, trucks, and training for personnel.

Medical Services

- The company should provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital.

Availability of Resources

Appropriate measures for managing the availability of resources in case of an emergency include:

- Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list should include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, environmental science, etc., or any of the functions required to adequately respond to the identified emergency
- Providing personnel who can readily call up resources, as required
- Tracking and managing the costs associated with emergency resources
- Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies
- Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site

Mutual Aid

Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers.

- Where appropriate, mutual aid agreements should be maintained with other organizations to allow for sharing of personnel and specialized equipment.

Contact List

- The company should develop a list of contact information for all internal and external resources and personnel. The list should include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.

Training and Updating

The emergency preparedness facilities and emergency response plans require maintenance, review, and updating to account for changes in equipment, personnel, and facilities. Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs should:

- Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency
- Develop a training plan to address needs, particularly for fire fighting, spill response, and evacuation

- Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated
- Provide training exercises to allow personnel the opportunity to test emergency preparedness, including:
  - Desk top exercises with only a few personnel, where the contact lists are tested and the facilities and communication assessed
  - Response exercises, typically involving drills that allow for testing of equipment and logistics
- Debrief upon completion of a training exercise to assess what worked well and what aspects require improvement
- Update the plan, as required, after each exercise. Elements of the plan subject to significant change (such as contact lists) should be replaced
- Record training activities and the outcomes of the training

Business Continuity and Contingency

Measures to address business continuity and contingency include:

- Identifying replacement supplies or facilities to allow business continuity following an emergency. For example, alternate sources of water, electricity, and fuel are commonly sought.
- Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity.
- Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

4.0 Construction and Decommissioning

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Applicability and Approach

This section provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. Cross referencing is made to various other sections of the General EHS Guidelines.

4.1 Environment{ TC "4.1 Environment" \f C \l "2" }

Noise and Vibration

During construction and decommissioning activities, noise and vibration may be caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. Some recommended noise reduction and control strategies to consider in areas close to community areas include:

- Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance
- Using noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines.
- Avoiding or minimizing project transportation through community areas

Soil Erosion

Soil erosion may be caused by exposure of soil surfaces to rain and wind during site clearing, earth moving, and excavation activities. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the quality of natural water systems and ultimately the biological systems that use these waters. Recommended soil erosion and water system management approaches include:

Sediment mobilization and transport

- Reducing or preventing erosion by:
  - Scheduling to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical
  - Contouring and minimizing length and steepness of slopes
  - Mulching to stabilize exposed areas
  - Re-vegetating areas promptly
  - Designing channels and ditches for post-construction flows
  - Lining steep channel and slopes (e.g. use jute matting)
- Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical.

Clean runoff management

- Segregating or diverting clean water runoff to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release

Road design

- Limiting access road gradients to reduce runoff-induced erosion
- Providing adequate road drainage based on road width, surface material, compaction, and maintenance

Disturbance to water bodies

- Depending on the potential for adverse impacts, installing free-spanning structures (e.g., single span bridges) for road watercourse crossings
- Restricting the duration and timing of in-stream activities to lower low periods, and avoiding periods critical to biological cycles of valued flora and fauna (e.g., migration, spawning, etc.)
- For in-stream works, using isolation techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water
- Consider using trenchless technology for pipeline crossings (e.g., suspended crossings) or installation by directional drilling

Structural (slope) stability

- Providing effective short term measures for slope stabilization, sediment control and subsidence control until long term measures for the operational phase can be implemented
- Providing adequate drainage systems to minimize and control infiltration

Air Quality

Construction and decommissioning activities may generate emission of fugitive dust caused by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind. A secondary source of emissions may include exhaust from diesel engines of earth moving equipment, as well as from open burning of solid waste on-site. Techniques to consider for the reduction and control of air emissions from construction and decommissioning sites include:

- Minimizing dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (water suppression, bag house, or cyclone)
- Minimizing dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content
- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- Selectively removing potential hazardous air pollutants, such as asbestos, from existing infrastructure prior to demolition
- Managing emissions from mobile sources according to Section 1.1
- Avoiding open burning of solid (refer to solid waste management guidance in Section 1.6)

Solid Waste

Non-hazardous solid waste generated at construction and decommissioning sites includes excess fill materials from grading and excavation activities, scrap wood and metals, and small concrete spills. Other non-hazardous solid wastes include office, kitchen, and dormitory wastes when these types of operations are part of construction project activities. *Hazardous solid waste* includes contaminated soils, which could potentially be encountered on-site due to previous land use activities, or small

amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil, as well as spill cleanup materials from oil and fuel spills. Techniques for preventing and controlling non-hazardous and hazardous construction site solid waste include those already discussed in Section 1.6.

Hazardous Materials

Construction and decommissioning activities may pose the potential for release of petroleum based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. These materials may also be encountered during decommissioning activities in building components or industrial process equipment. Techniques for prevention, minimization, and control of these impacts include:

- Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids,
- Using impervious surfaces for refueling areas and other fluid transfer areas
- Training workers on the correct transfer and handling of fuels and chemicals and the response to spills
- Providing portable spill containment and cleanup equipment on site and training in the equipment deployment
- Assessing the contents of hazardous materials and petroleum-based products in building systems (e.g. PCB containing electrical equipment, asbestos-containing building materials) and process equipment and removing them prior to initiation of decommissioning activities, and managing their treatment and disposal according to Sections 1.5 and 1.6 on Hazardous Materials and Hazardous Waste Management, respectively
- Assessing the presence of hazardous substances in or on building materials (e.g., polychlorinated biphenyls, asbestos-containing flooring or insulation) and decontaminating or properly managing contaminated building materials

Wastewater Discharges

Construction and decommissioning activities may include the generation of sanitary wastewater discharges in varying quantities depending on the number of workers involved. Adequate portable or permanent sanitation facilities serving all workers should be provided at all construction sites. Sanitary wastewater in construction and other sites should be managed as described in Section 1.3.

Contaminated Land

Land contamination may be encountered in sites under construction or decommissioning due to known or unknown historical releases of hazardous materials or oil, or due to the presence of abandoned infrastructure formerly used to store or handle these materials, including underground storage tanks. Actions necessary to manage the risk from contaminated land will depend on factors such as the level and location of contamination, the type and risks of the contaminated media, and the intended land use. However, a basic management strategy should include:

- Managing contaminated media with the objective of protecting the safety and health of occupants of the site, the surrounding community, and the environment post construction or post decommissioning
- Understanding the historical use of the land with regard to the potential presence of hazardous materials or oil prior to initiation of construction or decommissioning activities
- Preparing plans and procedures to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment consistent with the approach for Contaminated Land in Section 1.6
- Preparation of a management plan to manage obsolete, abandoned, hazardous materials or oil consistent with the approach to hazardous waste management described in Section 1.6.

Successful implementation of any management strategy may require identification and cooperation with whoever is responsible and liable for the contamination.

4.2 Occupational Health and Safety{ TC "4.2 Occupational Health and Safety" \f C \l "2" }

Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries in construction and decommissioning sites. Recommendations for their prevention and control include:

- Training of workers in lifting and materials handling techniques in construction and decommissioning projects, including the placement of weight limits above which mechanical assists or two-person lifts are necessary
- Planning work site layout to minimize the need for manual transfer of heavy loads
- Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations
- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks

Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction and decommissioning sites. Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Implementing good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths
- Cleaning up excessive waste debris and liquid spills regularly
- Locating electrical cords and ropes in common areas and marked corridors
- Use of slip retardant footwear

Work in Heights

Falls from elevation associated with working with ladders, scaffolding, and partially built or demolished structures are among the most common cause of fatal or permanent disabling injury at construction or decommissioning sites. If fall hazards exist, a fall protection plan should be in place which includes one or more of the following aspects, depending on the nature of the fall hazard[95]:

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as

[95] Additional information on identification of fall hazards and design of protection systems can be found in the United States Occupational Health and Safety Administration's (US OSHA) web site: http://www.osha.gov/SLTC/fallprotection/index.html

securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces

Struck By Objects

Construction and demolition activities may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities. Techniques for the prevention and control of these hazards include:

- Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels
- Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable
- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap
- Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged
- Evacuating work areas during blasting operations, and using blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures
- Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes

Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving. Techniques for the prevention and control of these impacts include:

- Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic
- Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle
- Ensuring moving equipment is outfitted with audible back-up alarms
- Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

Dust

- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- PPE, such as dusk masks, should be used where dust levels are excessive

Confined Spaces and Excavations

Examples of confined spaces that may be present in construction or demolition sites include: silos, vats, hoppers, utility vaults, tanks, sewers, pipes, and access shafts. Ditches and trenches may also be considered a confined space when access or egress is limited. In addition to the guidance provided in Section 2.8 the occupational hazards associated with confined spaces and excavations in construction and decommissioning sites should be prevented according to the following recommendations:

- Controlling site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning
- Providing safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders
- Avoiding the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated

Other Site Hazards

Construction and decommissioning sites may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms, which should be prevented through the implementation of project-specific plans and other applicable management practices, including:

- Use of specially trained personnel to identify and remove waste materials from tanks, vessels, processing equipment or contaminated land as a first step in decommissioning activities to allow for safe excavation, construction, dismantling or demolition
- Use of specially trained personnel to identify and selectively remove potentially hazardous materials in building elements prior to dismantling or demolition including, for example, insulation or structural elements containing asbestos and Polychlorinated Biphenyls (PCBs), electrical components containing mercury[96]
- Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection

[96] Additional information on the management and removal of asbestos containing building materials can be found in ASTM Standard E2356 and E1368

4.3 Community Health and Safety{ TC "4.3 Community Health and Safety" \f C \l "2" }

General Site Hazards

Projects should implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction and decommissioning. Risks may arise from inadvertent or intentional trespassing, including potential contact with hazardous materials, contaminated soils and other environmental media, buildings that are vacant or under construction, or excavations and structures which may pose falling and entrapment hazards. Risk management strategies may include:

- Restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community
- Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials

Disease Prevention

Increased incidence of communicable and vector-borne diseases attributable to construction activities represents a potentially serious health threat to project personnel and residents of local communities. Recommendations for the prevention and control of communicable and vector-borne diseases also applicable to

construction phase activities are provided in Section 3.6 (Disease Prevention).

Traffic Safety

Construction activities may result in a significant increase in movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local communities. The incidence of road accidents involving project vehicles during construction should be minimized through a combination of education and awareness-raising, and the adoption of procedures described in Section 3.4 (Traffic Safety).

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Chapter 2

Chapter 2

Description of the proposed Project

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2. Description of the proposed Project

2.1 Project Location

2.1.1 Power plant

Yashma Combined Cycle Gas Power Plant project site is located, as shown in Figure 2.1-1, 45km northwest of the capital Baku, 15km northeast of the existing Sumgayit CCGT power plant. The site location is at the north side of the base of Absheron Peninsula, with Caspian Sea on the east, Sumgayit city and residential area in the south, residential area in the north and the desert beyond the highway and railway in the west.

The closest residential area, Zeynaladbin Tagiyev settlement, is approximately 400m south of the project boundary Figure 2.1-2.

The site is planned to be in an elongated shape with the total area of 71.5 ha, and the power plant area (about 20ha) will be developed in the center, most wide part of the site.

The ocean side of the site is sand beach, with only little grass and shrub, no wood were observed. This is a desert area and not agricultural nor residential.

The planned project site has been governed by government, and all concerned governmental organizations have no claim on the usage of the site.



Figure 2.1-1 location of Yashma Project site (Google Earth)

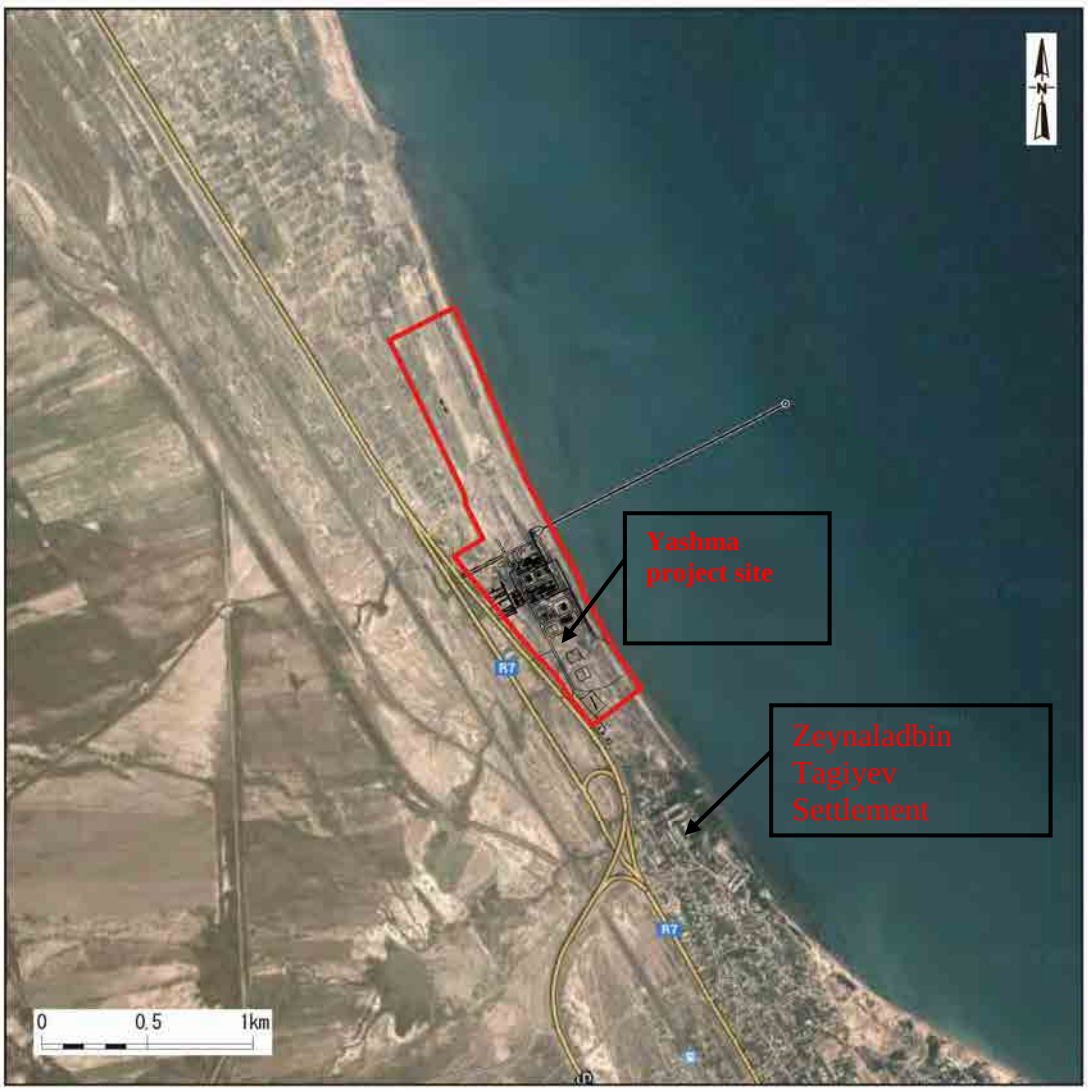


Figure 2.1-2 The Plan of Yashma Project Site and the Surrounding Area

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2.1.2 Transmission line and substation

As shown in Figure 2.1-3, the project proponent is planning a transmission system consisting of the existing substation and the newly-introduced substations (2 locations).

Sulu tepe substation are 40km south-southeast of the project site, Sumgayıt substation (in the industrial complex) are newly introduced. The existing substation is Yashma substation 2km northeast of the site.

New transmission line of 330kV or 220kV and new substations will be established. Places to be avoided are as follows:

Residential areas, private farm land, churchyards, national parks, heritage sites, protected areas, forests, cemeteries, rivers, lakes, railways, and highways, etc.

The sites of transmission lines and substations are a desert area and not agricultural. It is sure that the sites are the governmental land.

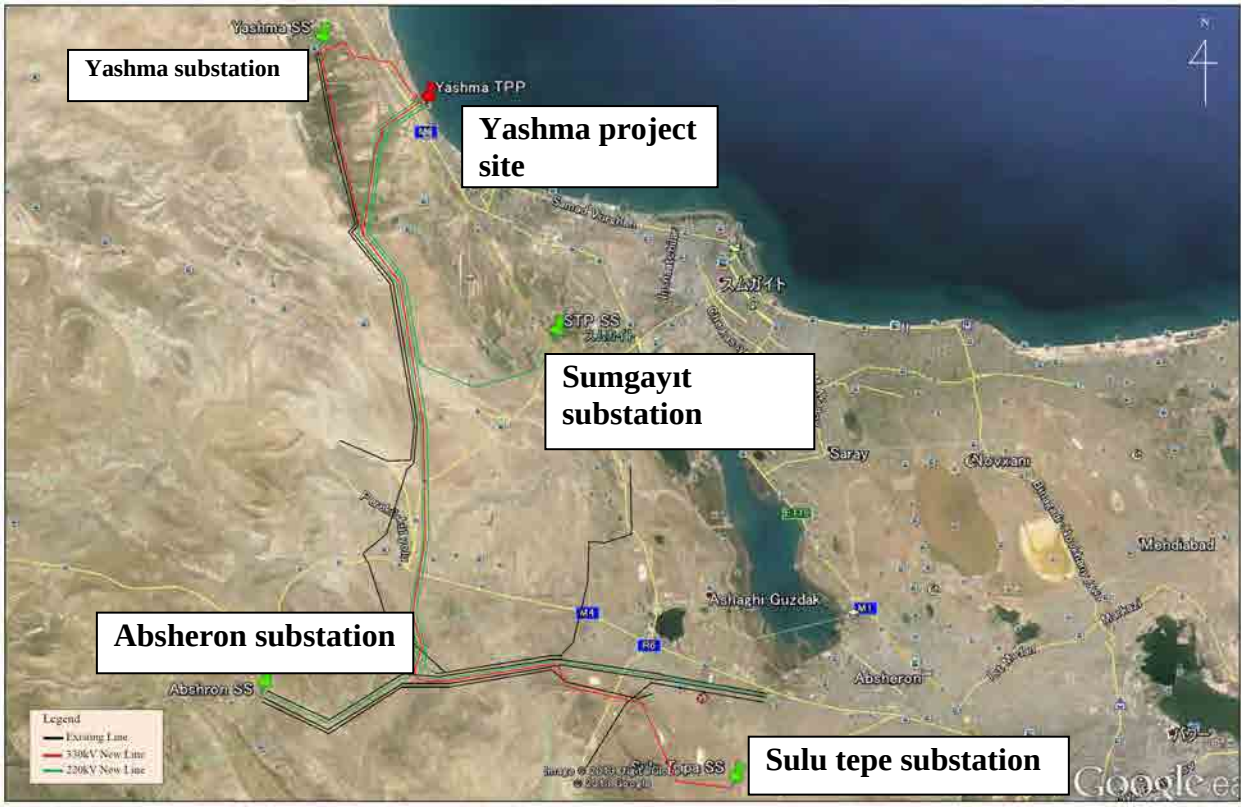


Figure 2.1-3 Total Plan of the Transmission Line and Substation

2.1.3 Gas pipeline

A branch line was to be installed from the existing gas pipeline along the national road on the west of the site, but the existing pipeline is for civil use and the capacity is not sufficient for use by the power plant.

First, the gas pipeline route was conducted by mapping the route on a map via the desktop study. Second, the gas pipeline route was confirmed in accordance with site investigation. Figure 2.1-4 shows finalized route map of gas pipeline. The gas pipeline will be installed from Aghdere village territory of Khizi region to the power plant.

The gas pipeline route length is 48 km and this structure is underground.

The gas pipeline route runs through mountainous terrain (70%) and flat terrain (30%).

The gas pipeline will pass through hill territory and the territory along the rivers. The route of gas pipeline is a semi-desert area and not private farm land nor residential area.It is sure that the site is the governmental land.

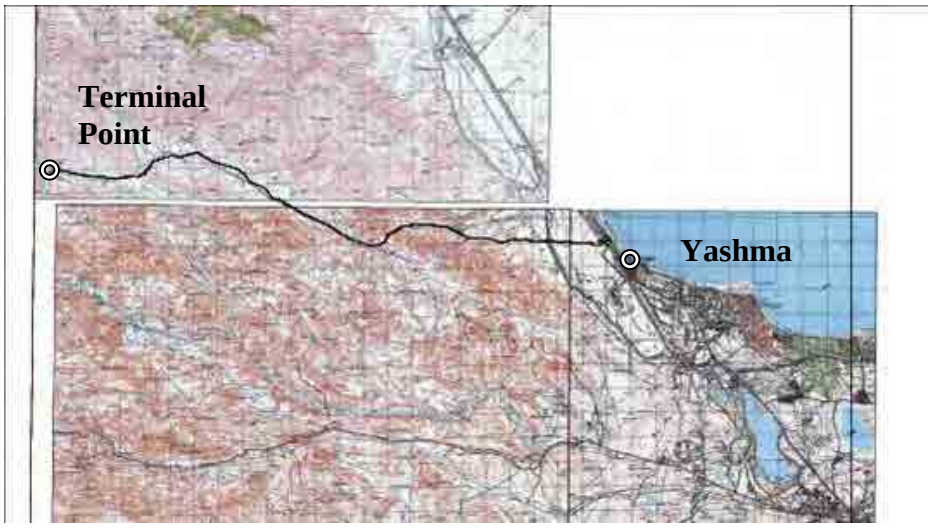


Figure 2.1-4 Route of the gas pipeline to power plant

2.2 Equipment and Processes of Power plant

2.2.1 Plant layout

The proposed power plant adopts combined cycle technology, generating power by gas turbine and steam turbine using natural gas as fuel. The outline of this technology is described below with Figure 2.2-1 describing schematic diagram of combined cycle technology.

-The compressed air is heated to a high temperature by combustion of fuel gas and expanded with exhaust gas.These expanded gas drive gas turbine and the electrical generator.

-The exhaust gases from the gas turbine are high temperature and this energy generate steam in a Heat Recovery Steam Generator.This steam drive steam turbine and the electrical generator.

-Power generation efficiency is higher than conventional power generation technology by boiler and steam turbine. CO_2 generation per unit of electricity will be small, and cooling water volume will be small.

The plant to be installed shall include two (2) blocks of CCPPs (namely Block 1 and Block 2), associated auxiliary equipment and necessary common facilities.

The CCPP shall consist of a highly efficient combined cycle block in a one on one single-shaft configuration comprising one (1) gas turbine, one (1) triple pressure reheat, outdoor type heat recovery steam generator (HRSG), one (1) reheat, condensing type steam turbine, one (1) electric generator, and miscellaneous auxiliary equipment.

The nominal net output per one (1) CCPP unit shall be 460MW. The circulating water system for cooling the condenser of the steam turbine and the closed circuit cooling water of plant auxiliary equipment shall be of a once-through cooling type with seawater. Figure 2.2-2 shows conceptual site layout for the plant.

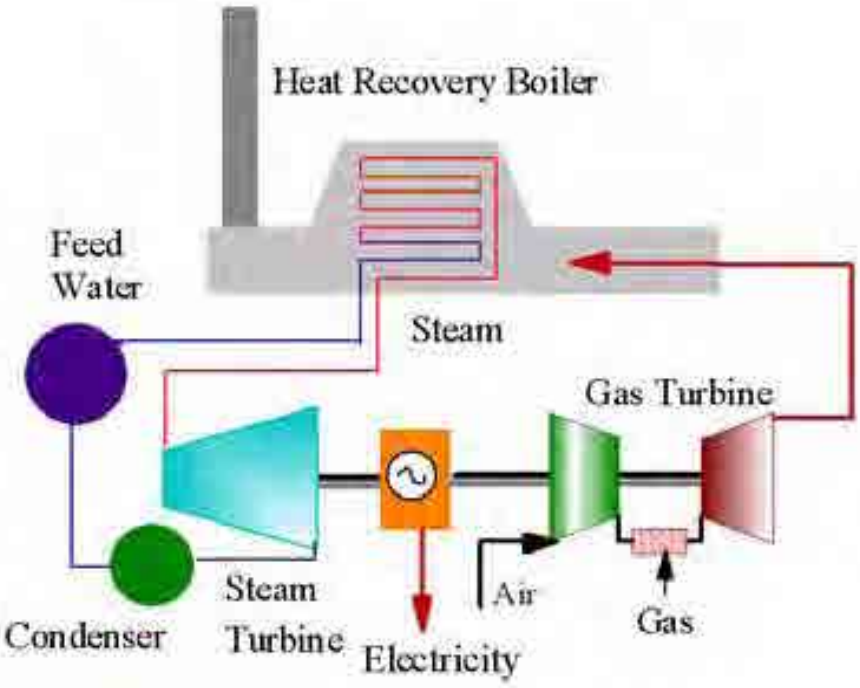


Figure 2.2-1 Schematic Diagram of Combined Cycle Technology

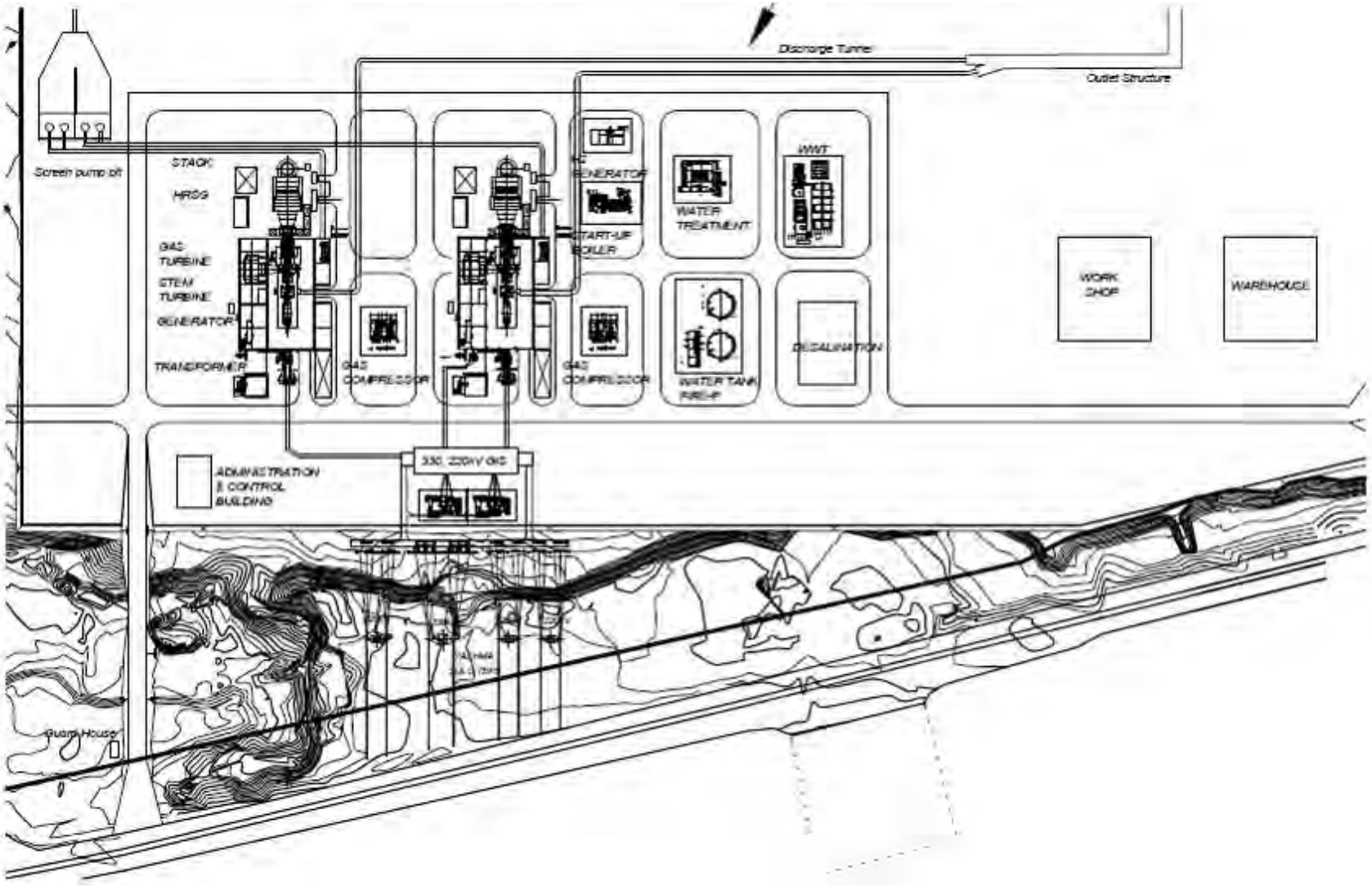


Figure 2.2-2 Conceptual site layout for the new plant

2.2.2 Outline of Power plant building and facilities

(1) Gas turbine and steam turbine

a. Gas turbine

The gas turbine shall be of single shaft configuration, open cycle type with low NOx design suitable for the specified natural gas(Figure2.2-3) .

The gas turbine design shall contain a minimum number of bearings, and shall be located on a steel frame or on adequate steel structures and concrete foundation.

The gas turbine shall be complete with all auxiliary systems such as a starting system, lube oil supply system, inlet air filtration system, fuel gas supply system, turning device, control and monitoring equipment necessary for safe, reliable and efficient operation with the fuel specified. The gas turbine for Block 1 and Block 2 shall be designed for indoor installation in an enclosure suitable for specified noise requirements. The size of the turbine building is width of 29.5m, length of 64.5m and height of 30m.

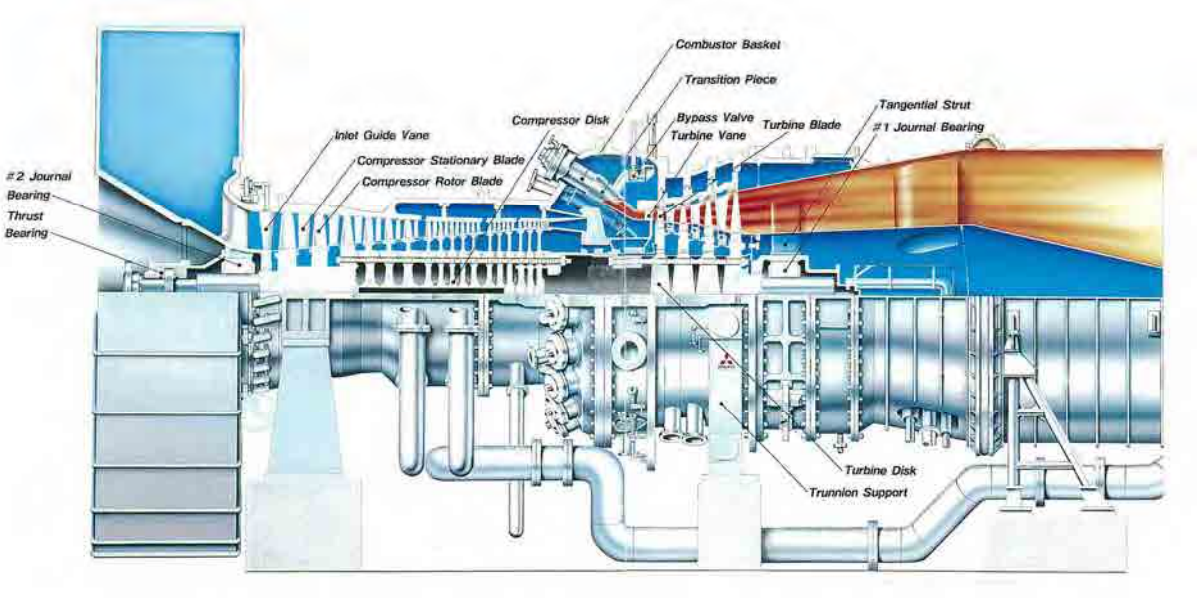


Figure 2.2-3 Longitudinal Cross Section Drawing of Typical F-class Gas Turbine

b. Steam turbine

The steam turbine shall be of a three (3) pressure-level turbine with HP, IP and LP sections. The steam shall be downward exhausted to a surface condenser which is cooled by circulating seawater of a once through type cooling system.

The steam turbine and ancillary systems shall be designed to run continuously under all specified conditions over the specified lifetime of the plant.

The steam turbine shall be complete with all auxiliary systems such as a steam condenser, lube oil supply system, control oil supply system, admission steam stop and throttling valves, governing system, steam bypass system, turning device, and control and monitoring equipment necessary for safe, reliable and efficient operation. The steam turbine shall be designed for indoor installation in an enclosure suitable for specified noise level conditions.

One set of gas turbine, steam turbine and generator to be installed inside a common turbine building with a ventilation system, an overhead travelling crane and laydown bay for carrying bulky components in and out.

(2) HRSG

This part of the specification covers the one (1) Heat Recovery Steam Generator (HRSG) complete with ducting, mountings, integral valves and pipes, and other specified items associated with the one (1) gas turbine generator of the combined cycle block.

The gas turbine exhaust gas path through the HRSG shall be horizontal or vertical with water and steam tubing located horizontally/vertically across the gas stream to suit the plant layout and as per the manufacturer's standard design.

The HRSG shall be designed for outdoor installation and shall be entirely weatherproof. Canopies shall be provided to protect both personnel and equipment (drum fittings, valve and circulating pumps) from the external environment.

(3) Transformer

The voltage of the power output from the block-1 generator will be stepped up to 330 kV utilizing a generator step-up transformer, while the block-2 generator will be stepped up to 220 kV utilizing a generator step-up transformer. The output from these two transformers is transmitted to the 330kV and 220 kV switchyards (GIS). Both GIS bus arrangements will utilize a double main bus and one (1) bus tie circuit breaker scheme.

(4) Stack

Standalone type fabricated with steel plates supported by steel structures with a height of 80m in consideration of the impact on the environment , which is described in Annex 6-1.

Exhaust gas emitted from the stack is set as 95℃ of temperature and 25m/s of emission rate, in order to reduce its impact on the environment.

(5) Cooling system

In order to minimize the area of water temperature rise, cooling water shall be taken by using intake tower from lower layer where water temperature is low about 6m deep at 1.3 km offshore and be discharged at the high rate of 2.5m/s from the coast near the project site. (Figure 2.2- 4-6). Since the water depth is relatively shallow at front area of the discharge outlet, seabed is partially dredged toward offshore to secure the flow and diffusion of discharged water, which is described in F/S report .

In addition, this water intake method prevents the issues listed below.

-Normally, floating wood waste, vinyl, plastic and other waste will remain within a depth of two meters of the sea surface.

-Waves whirling sand up from the seabed are of some concern, but with the lower level for water intake being 1.5 meters above the seabed, hardly any sand should enter the intake tower.

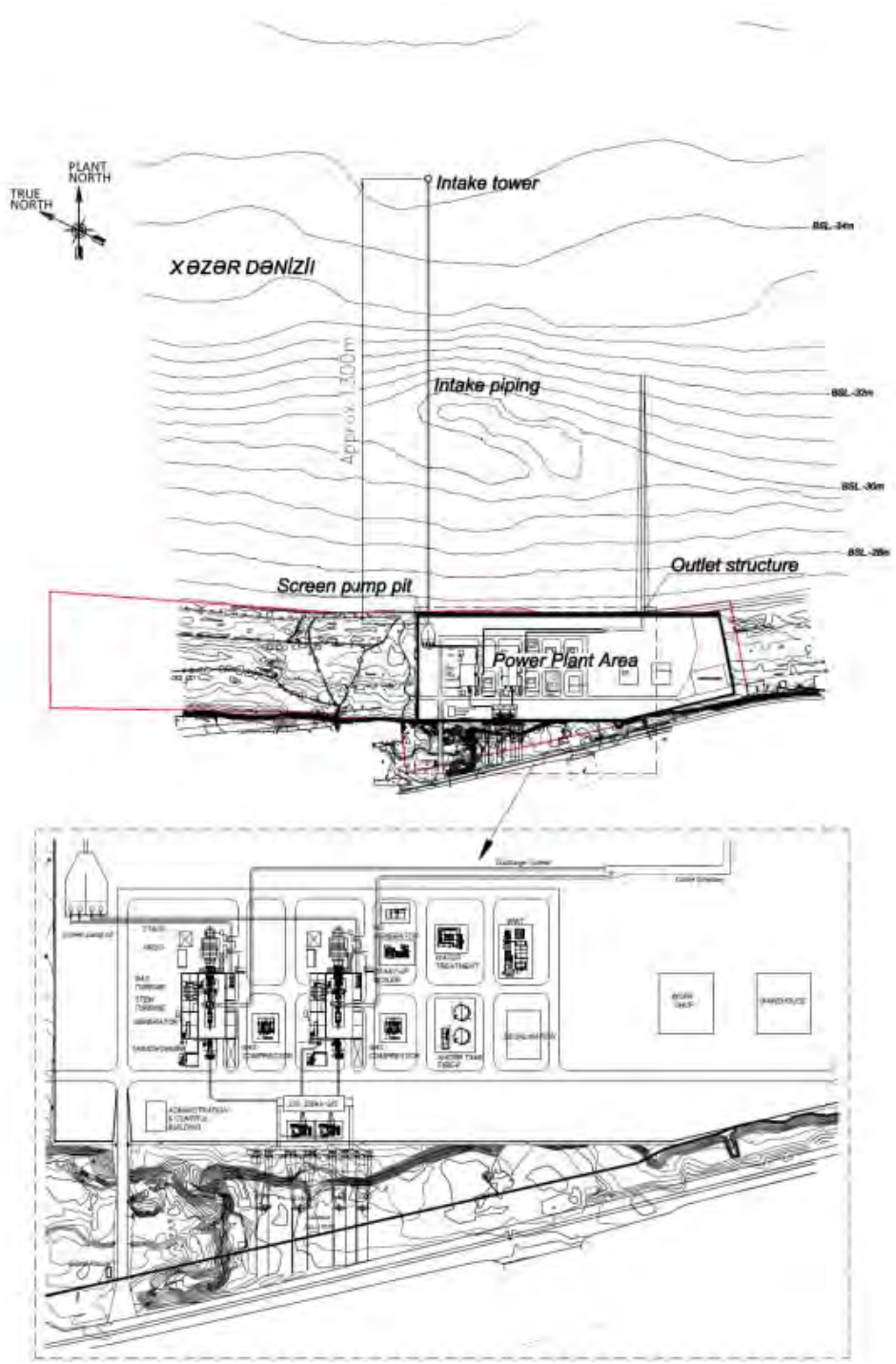


Figure 2.2-4 Intake tower and outlet of Cooling water

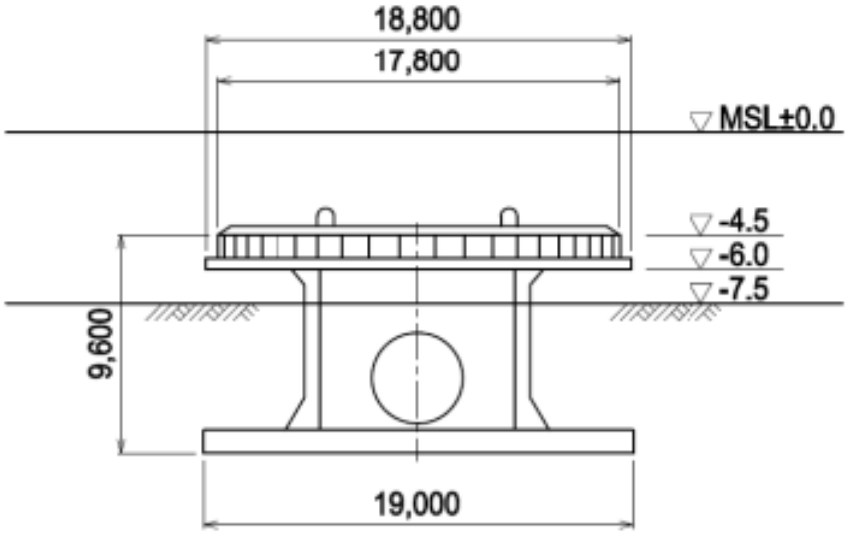


Figure 2.2-5 Water Intake Structures

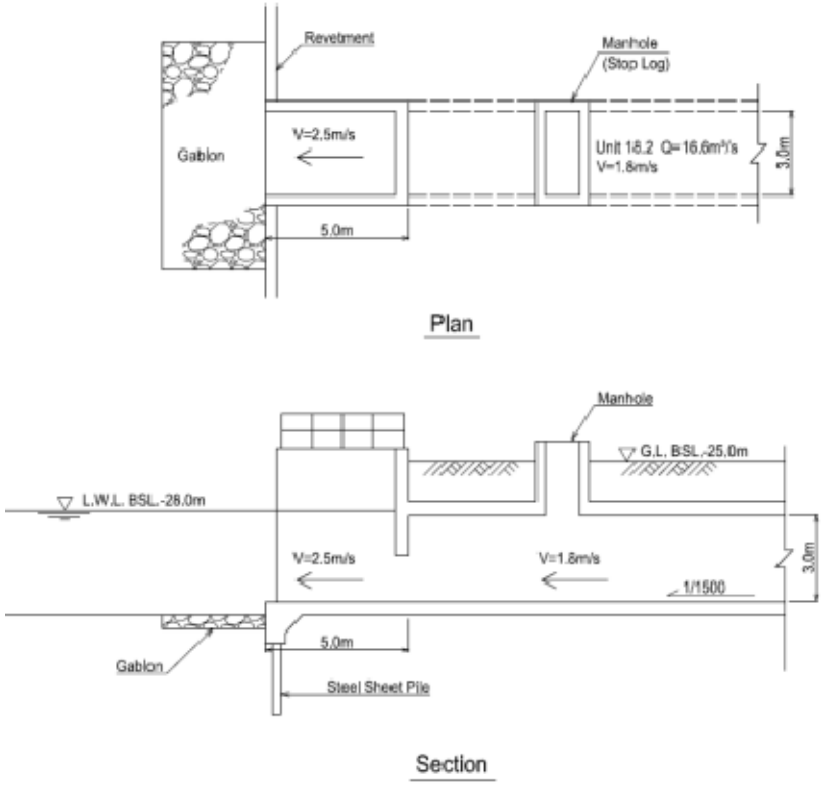


Figure 2.2-6 Water Intake Structures

(7)Water treatment system

The source for this project's service water and demineralized water shall be seawater.

A complete water treatment system comprising seawater supply facility, pretreatment facility, desalination plant, and demineralized water plant, shall supply service water and make-up water required for Yashma CCPP.

Potable water (drinking water) required for Yashma CCPP shall be drawn from a raw water storage tank. Water supply to the raw water tank is provided through the city water supply system in Yashma city.

2.2.3 Other facility

Central control room is to be installed at west of the facility center. Ware house for storing equipment and Work shop to be used for maintenance are to be installed at south of power generating facility.

The residential housing for power plant staff will be constructed in the project site (Figure 2.2.7).

An access road about 300m llong is to be constructed accessing from the highway and the national road running in the western side of the power plant.



Figure 2.2-7 Residential Housing for Plant Staff

2.2.4 Number of Worker

The number of the power plant staff during operation phase is estimated to be 170, and reaches about 200 if other staff like cleaning staff is included. It is considered that cleaning staff is employed from local area or out-sourced.

During maintenance period, at least 1,000 workers from outside will be needed.

2.2.5 Exhaust gas management

Pollutants in the exhaust gas emitted from the stack will be monitored at central control room by installing Continuous Emission Monitoring System (CEMS).

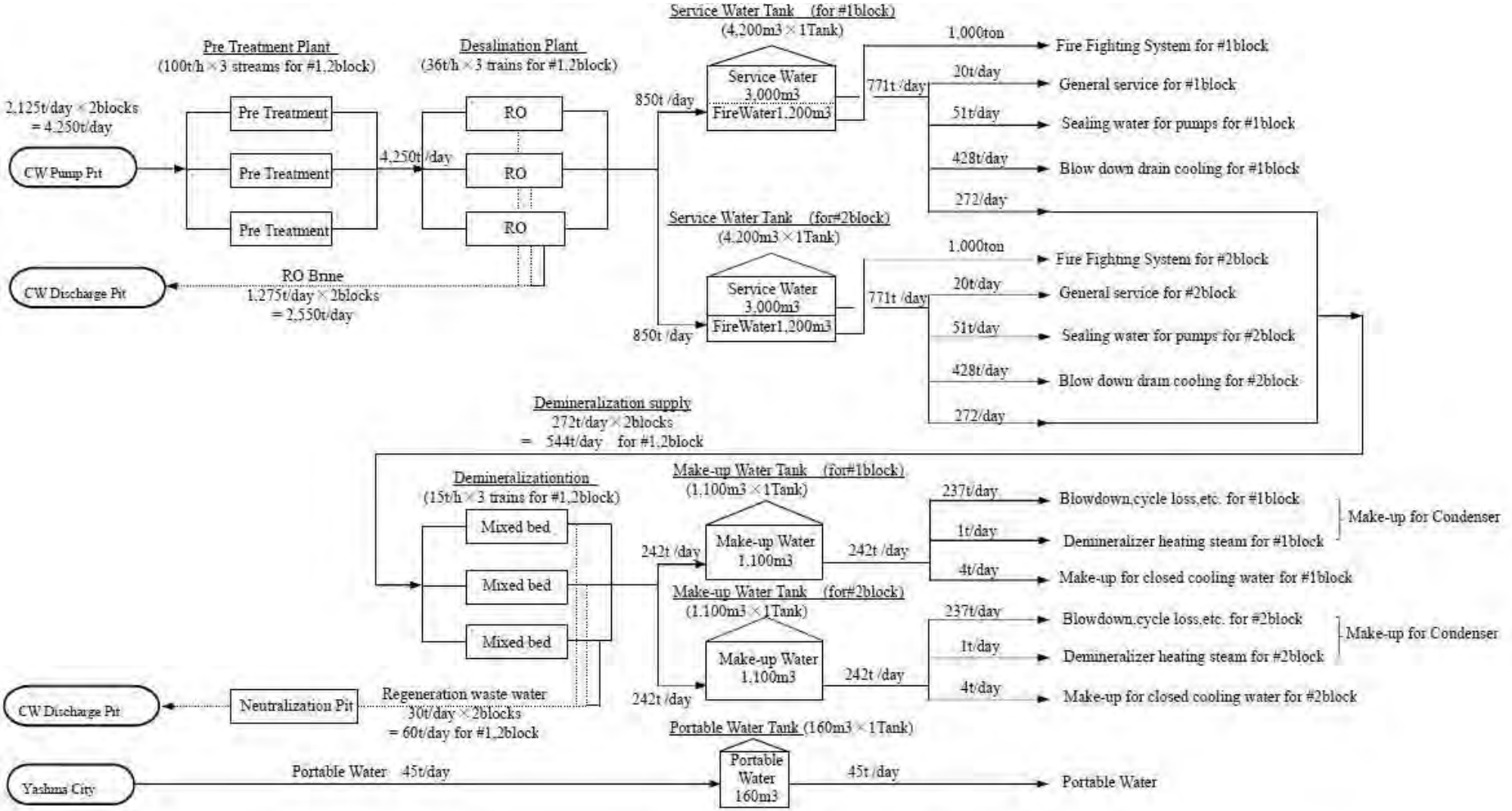


Figure 2.2-8 Water mass balance diagram

2.2.6 Waste water treat system

Wastewater will be mainly from raw water treatment plant and demineralization plant, oily wastewater, boiler blow water and domestic sewage. That wastewater will be treated by oil separation, neutralization, coagulation, sedimentation and aeration to meet with wastewater standard of IFC/WB guideline and Azerbaijan at the discharge outlet. Treated wastewater will be mixed and diluted with a large volume of thermal effluents and will be discharged into Caspian Sea..

The figure shows the treatment method and flow diagram of the wastewater.

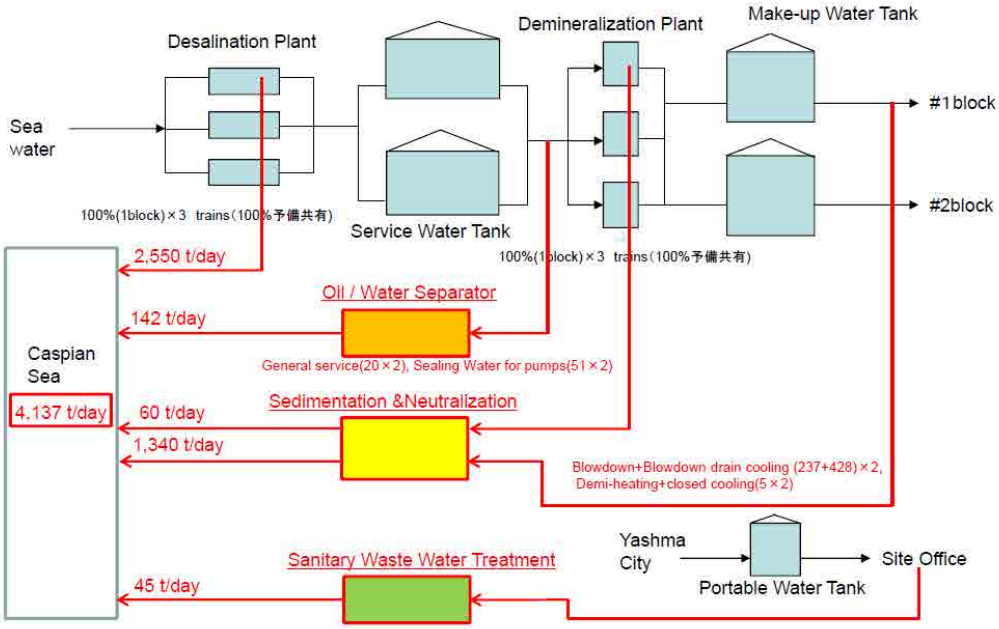


Figure 2.2-9 Waste water flow diagram

2.2.7 Waste disposal

Sludge from wastewater treatment plant and waste oil from lubricating oil exchanging work will be generated during the power plant operation phase. Scrap metal, scrap glass and waste plastic will also be generated from maintenance work. In addition, general waste such as food waste and paper will be generated from plant workers.

These waste will be reused as much as possible, outsourcing to outside vendors, and the rest will be disposed properly in accordance with relevant laws and regulations of Azerbaijan.

Specifically, paper wastes and iron scraps will be recycled. Other general wastes will be collected by Sumgayit city and carried to existing disposal fields.

All of the hazardous waste will be disposed by a waste management company approved by the government at disposal fields in Sumgayit which are permitted by the government in accordance with the Azerbaijan legislation.

2.2.8 Fire Fighting and Protection System

The Yashma CCPP will be designed and built with the provision of a safe operating environment and personnel. This will be achieved by separation and segregation of equipment with sufficient distances and by selection of suitable equipment and materials.

Hazardous areas are designated and suitable equipment is selected for use in these. Different firefighting systems will be installed depending on the operational characteristics of the

equipment, area and building to be protected (Table 2.2-1).

Table 2.2-1 List of protected areas and firefighting and detection systems types

Item	Building or Area	Fire Fighting System
1	Gas turbine	CO_2 extinguishing system
2	Steam turbine lube oil package, lube oil piping	Spray water dry type
3	Steam turbine bearings	Spray water dry type
4	Steam turbine building indoor	Wet stand pipe house system
5	Generator unit, auxiliary and start up transformer	Spray water dry type
6	Oil tanks	Form system, Dike protection
7	Control room	Cable basement: sprinkler system Control room: aragonite or similar
8	Electrical/Switchgear	Sprinkler system if required and portable fire extinguishers
9	Yard	Hydrants
10	Common	Protective signaling for fire and gas detection systems with main panel in the control room

2.2.9 Operation and Maintenance

The combustor and turbine blade as hot parts of the gas turbine are operated at a high temperature of more than 1,000°C. Thus, these hot parts require inspection, repair and replacement over shorter intervals of time due to more serious deterioration and damage, compared with the blade of the steam turbine. For each of these hot parts, the expected service life and inspection time intervals are determined by the Original Equipment Manufacturer (OEM).

Table 2.2-2 illustrates examples of time intervals for gas turbine inspections. The hot parts should be inspected and replaced under supervision of a technical advisor of the OEM.

Table 2.2-2 Examples of Time Intervals for Gas Turbine Inspections

Type of Inspection	Inspection Interval
Combustor Inspection	12,000 hours
Turbine Inspection	24,000 hours
Major Inspection	72,000 hours

Source: Study Team

2.3 Equipment of Transmission line and substation

2.3.1 Outline of transmission line facilities

Transmission lines and substation plans for the Yashma CCPP Project are shown in Tables 2.3-1. All projects for the Yashma CCPP are set to be completed by 2018.

Table 2.3-1 New Transmission Lines for Yashma CCPP

Voltage (kV)	Section of Transmission Line	No. of Circuit	Length (km)	Planned Completion Year
330	Yashma E/S - Yashma S/S	1	8.4	2018
	Yashma E/S - Sule TePe S/S	1	37.4	2018
220	Yashma E/S – YashmaS/S-Sanaya Qovsagi S/S	2	4.6	2018
	Yashma E/S - Absheron S/S-Boyuk Sor S/S	2	23.5	2018
	Yashma E/S - Sumgayit S/S	2	17.3	2018

S/S: Substation
E/S: Power Station

(Source: JSCA)

Design of the transmission tower for this project will be considered in details. Figure 2.3-1 shows general design of transmission tower. The height of the tower is about 20-40m, the width is about 7-8m, and the tower is installed every 350m in general.

Since the length of the transmission line for this project is about 90km, about 300 transmission towers will be installed for this project.

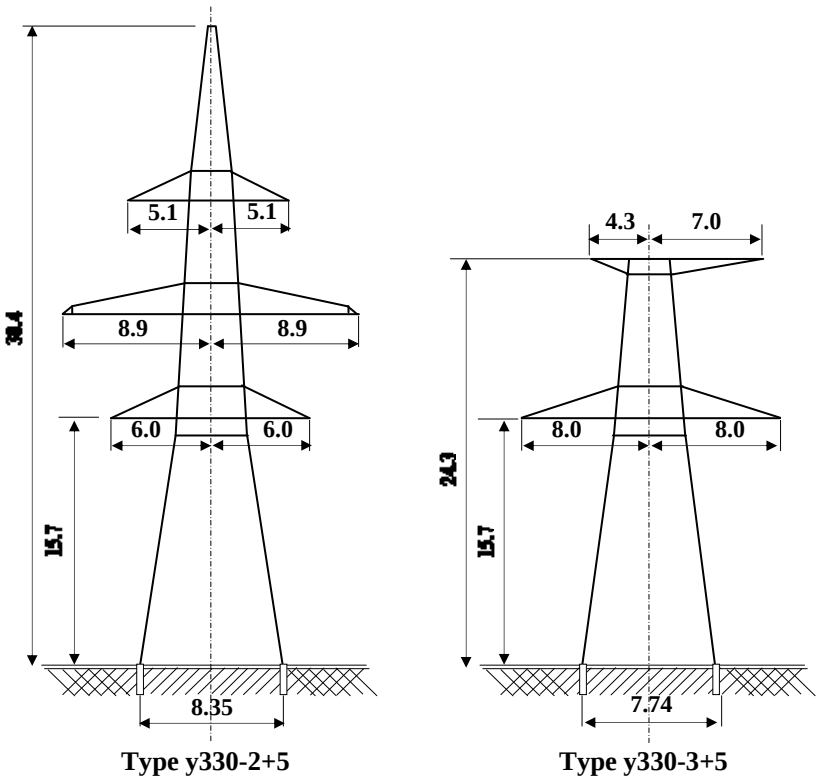


Figure 2.3-1 General Design of Transmission Tower (Sample)

2.3.2 Outline of substation

In order to properly transfer the power from Yashma CCPP, reinforcement and new constructions of several substations (hereafter S/S) will be necessary as below.

- Reinforcement of Yashma S/S
- New construction of SuleTepe S/S
- New construction of Sumgayit S/S

Table 2.3-2Substation for Yashma CCPP

Voltage (kV)	Name of Substation	Capacity (MVA)	Planned Completion Year
330	Yashma S/S Extension	1x200,2x240	2018
330	Sule TePe S/S	1x400, 2x250	2018
220	Sumgayit S/S	2x125	2018

S/S: Substation

(Source: JSCA)

(1) Yashma Substation

The layout of Yashma S/S is shown in Figure 2.3-2.

A 50m x 50m area for the new receiving unit is planned on the premises. If the area is insufficient, land procured for Yashma S/S will be expanded into the surrounding area. The surrounding area is public land, and non-residential. Hence, concerns over noise or other issues that could impact the environment are unlikely to occur.

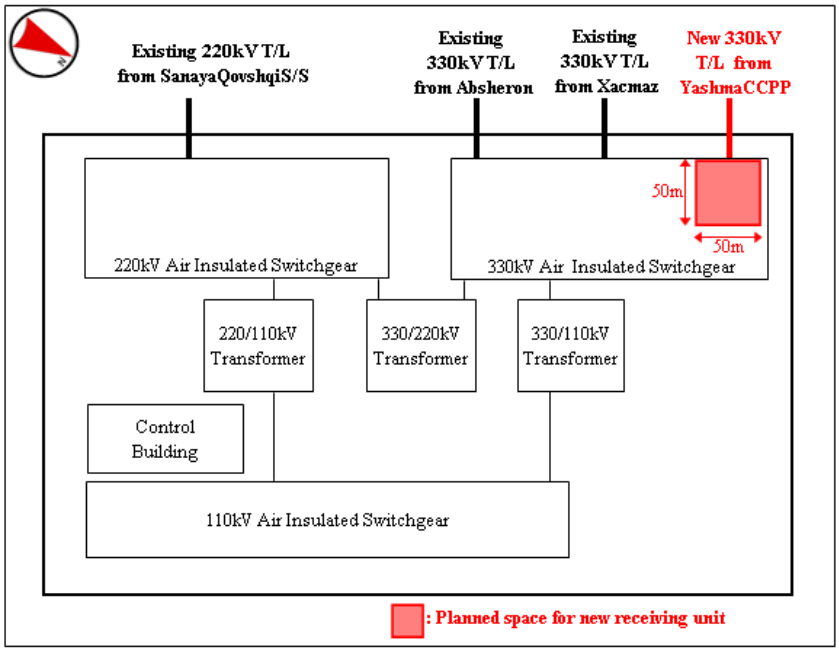


Figure 2.3-2 Layout of Yashma S/S

(2) Sulu Tepe Substation

The new 330kV transmission line (single circuit) will be connected from Yashma CCPP to SuluTepe S/S which is newly constructed. Additionally, other transmission lines will be

connected to SuluTepe S/S.

The dimensions for the new construction are 250m x 150m. The layout Plan of Sulu Tepe S/S is shown in Figure 2.3-3.

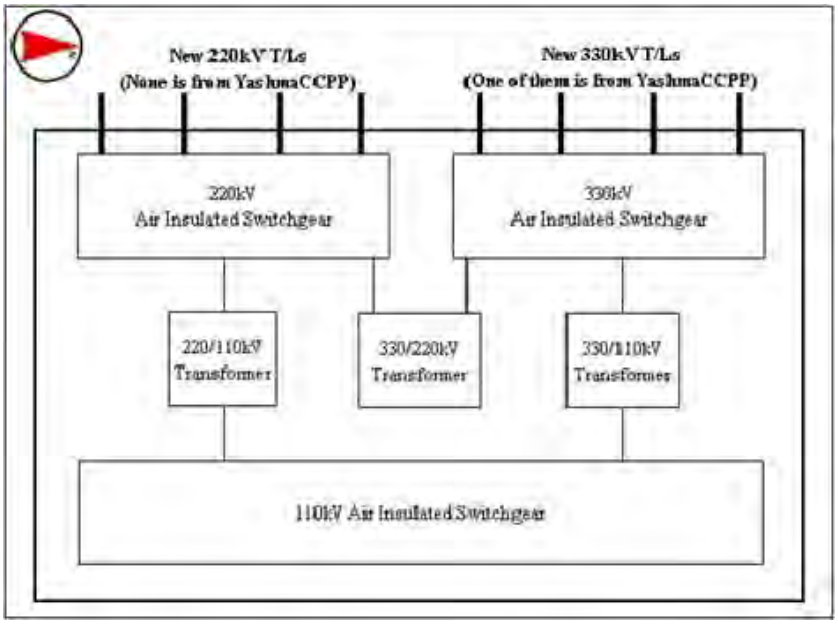


Figure 2.3-3 Layout Plan of Sulu Tepe S/S

(3) Sumgayit Substation

The new 220kV transmission lines (double circuits) will be connected from the Yashma CCPP to the Sumgayit S/S, which is newly constructed.
For reference, the dimensions for the new Sumgayit S/S are 250m x 150m.
The layout Plan of Sumgayit S/S is shown in Figure 2.3-4.

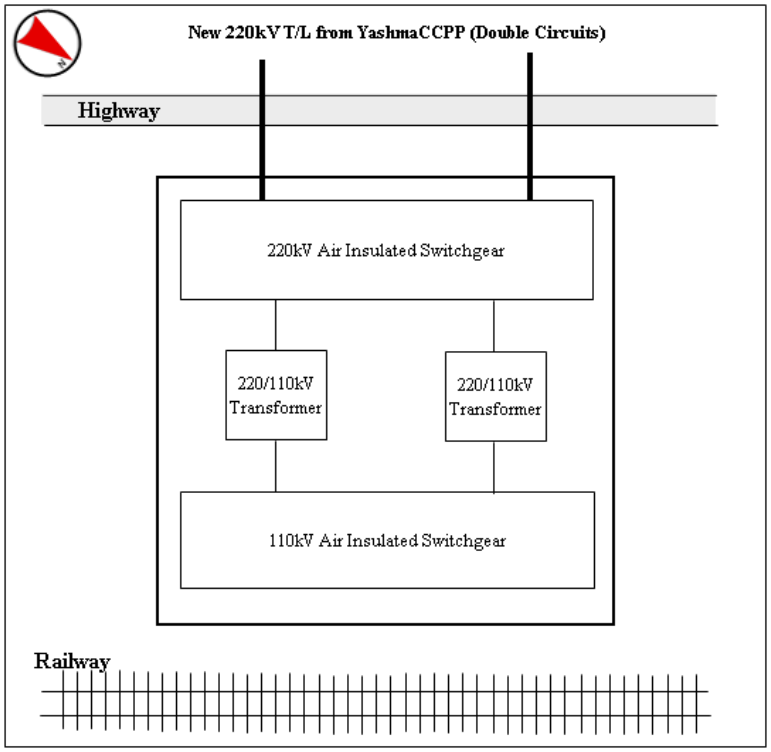


Figure 2.3-4 Layout Plan of Sumgayit S/S

2.4 Equipment of Gas Pipeline

2.4.1 Outline of gas pipeline facilities

Main specification for the gas pipeline is shown below. The gas pipeline will be buried about 1~2m underground.

- Yashma gas consumption: 200,000 m3/h
- Gas Pipeline Diameter: 720mm
- Working pressure of gas pipeline: 3.5MPa
- Design pressure of gas pipeline: 5.5MPa

The new preliminary pipeline route is fixed from the Khizi tie-in point to the Yashma Power Plant site. Gas supply volume and pressure are sufficient for Yashma CCPP, and gas compressor is not needed.
The next step is for Azerenerji JSC to carry out the financial arrangements and construction of gas pipeline. After completion of gas pipeline, SOCAR will carry out operation and maintenance of gas pipeline.

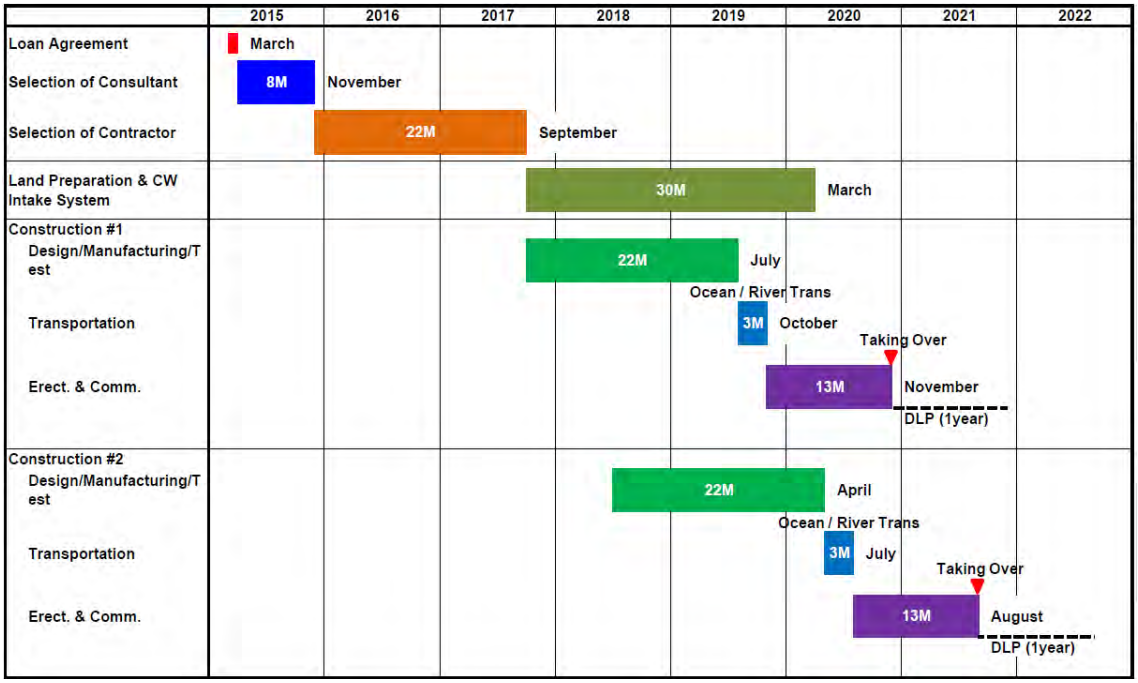
2.5 Site Development and Construction

2.5.1 Construction Schedule

If the project is implemented as a yen loan project, it will require 77 months to complete: 30 months from the agreement of the two governments (Azerbaijan and Japan) through to the selection of international consultants and preparation of EPC (engineering, procurement, and construction) contracts plus 47 months for the construction of two blocks of the combined cycle power plant.

Figure2.5-1 shows the overall project implementation schedule from the agreement of both governments to the completion of the project in the form of a bar chart. This implementation schedule will be revised as necessary due to changes in related conditions.

The work leading up to the loan agreement on the part of two countries is as shown below. It is difficult to say how much time will be required for this work to be completed, so we are not suggesting a timeframe here.



(Source: JICA Study Team)

Figure 2.5-1Expected Project Implementation Schedule for Yashma CCPP Project

2.5.2 Outline of Construction Activity for Power plant

(1) Land formation

The proposed power plant is facing the coast line and planned to raise the ground level about 1.5m higher than the high water level (HWL =BSL-26.5m) by embankment.

(2) Intake tower and water-intake pipe

An outline of the construction method for the intake tower and pipe are shown in Figure 2.5-2.

Dredging will be needed to install water intake tower and pipe. Dredged material will be temporarily stored at the site and all the material will be reused for backfilling the pipe.

Dredging will also be conducted around the discharge outlet, and the dredged material will be reused for banking the project site.

Silt fence will be installed to reduce turbidity when dredging and backfilling work.

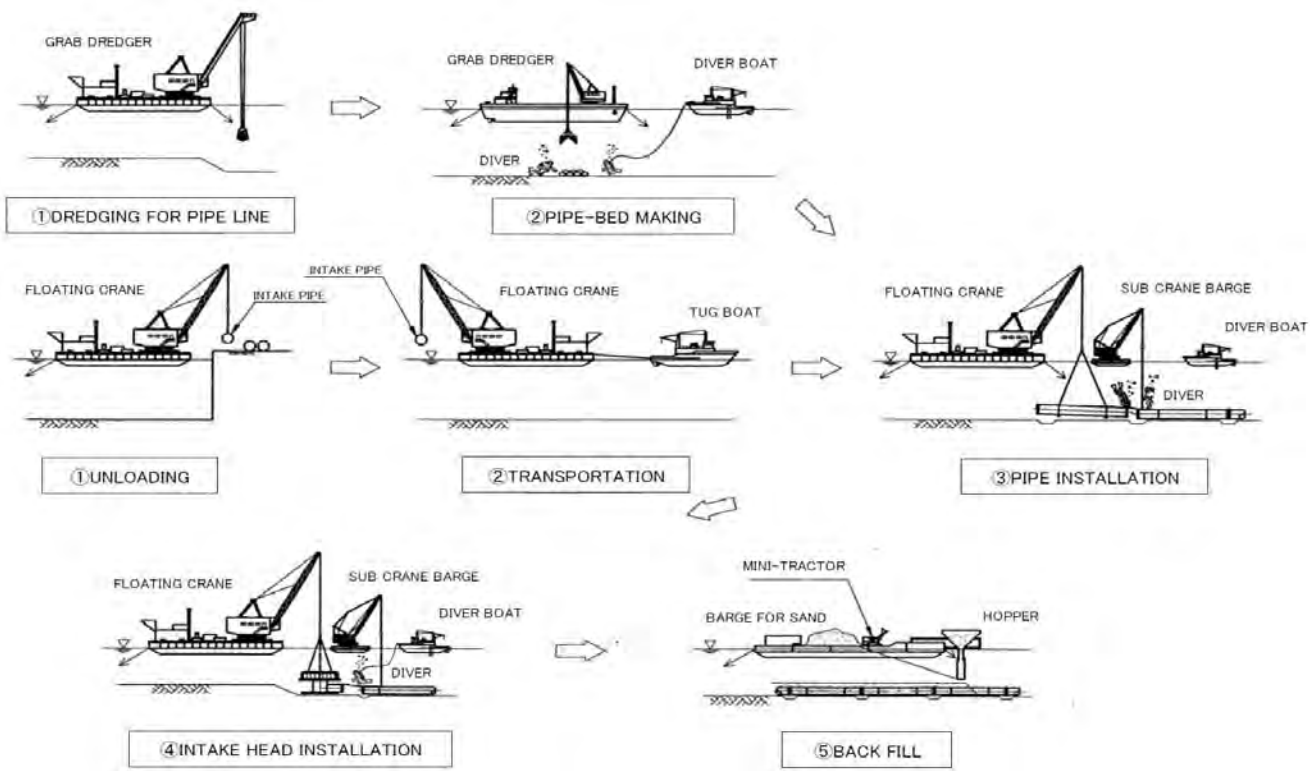


Figure 2.5-2 General Work Design for Offshore Intake Pipeline (example)

(3) Power plant

Civil works will involve the construction of the main power plant and auxiliary facilities and buildings. Mechanical and electrical works will include both on-site a fabrication, assembly, installation, and erection of power plant equipment and the stack structure, desalination plant demineralization plant, control system, power system, and various utility systems.

The major construction machinery used in the construction work will include bulldozer, trucks and back hoes for land formation and excavation, crawler crane, truck cranes, trailer and forklift for transportation of the equipment and material, mixers for producing concrete and other machine as air compressor and generator.

Wastes generated during the construction phase of the project include construction debris and wastes (e.g., scrap iron, steel, wooden frames, piping) and some other solid wastes (e.g., from labor sheds) and some waste water from construction processes. Waste will be reused by out-sourcing to the outside vendors, and the rest will be properly disposed in accordance with the relevant laws and regulations of Azerbaijan.
Wastewater generated from construction activities will be treated at temporary treatment system prior to discharge. Wastewater flow diagram is described in Figure 2.5-3.

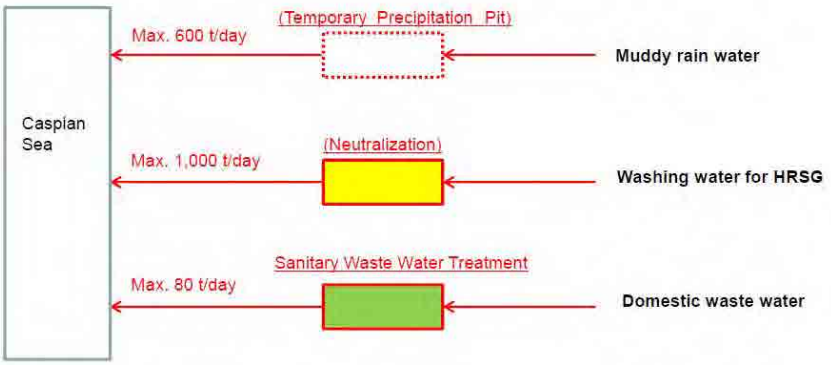


Figure 2.5-3 Waste water flow diagram

Construction will require between approximately 500 skilled and 2,000 unskilled workers. Construction workers will be engaged by contractors responsible for different construction packages. Construction water will be sourced from around the Existing water pipeline.

2.5.3 Outline of Construction Activity for Transmission line and substation

Main construction activities for transmission line are foundation work for transmission tower and installation of electric wire.

The foundation type whether the pad and column type or the pile foundation that would be applied to each tower shall be determined based on the results of the geological survey including the boring investigation at the detailed design stage.

Sample of Construction periods and number of large-sized vehicle, heavy equipment will be used as shown in Table 2.5-1. Equipment and materials will be transported by large-sized vehicles to each tower area, where towers will be assembled.

Table 2.5-1 Outline of construction equipment

Construction work	Equipment	Number (unit/tower)	period (day/tower)
Foundation work	Concrete mixer	4	7
	Backhoe	1	7
	Large-sized vehicle	4	3
Tower election work	Truck crane	1	7
	Large-sized vehicle	4	3

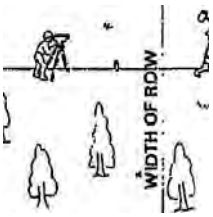
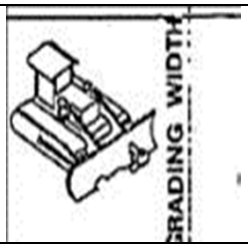
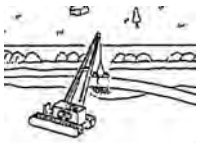
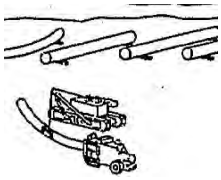
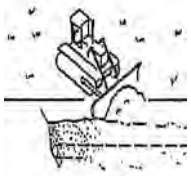
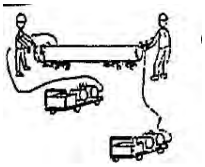
2.5.4 Outline of Construction Activity for Gas pipeline

Prior to pipeline installation, the ROW will be cleared of trees and bushes. The pipe will be transported to the ROW. The pipe will be strung and bent where necessary to allow for fitting the pipeline.

Individual lengths of the gas pipeline will be joined using welding machines. The project will excavate the pipe trench with specialized equipment according to site conditions. Gas pipeline will be lowered into a trench.

The trench is backfilled using excavated material to prevent damage to the pipe. A test will be conducted to evaluate the integrity of the completed pipe. The ROW will be restored.

Figure 2.5-4 presents an overview of gas pipeline construction procedure.

(1)	**Route selection & survey of ROW**		**(5)**	**Excavation of pipe trench**	
↓			↓		
(2)	**Preparation of ROW**		**(6)**	**Lowering of gas pipeline**	
↓			↓		
(3)	**Stringing & bending of gas pipeline**		**(7)**	**Backfilling & test of gas pipeline**	
↓			↓		
(4)	**Welding of gas pipeline**		**(8)**	**Clean-up of ROW**	

Source: Study team

Figure 2.5-4 Overview of Gas Pipeline Construction Procedure

EIA

Chapter 3

Chapter 3

EXISTING ENVIRONMENT: PHYSICAL AND CHEMICAL

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3. EXISTING ENVIRONMENT: PHYSICAL AND CHEMICAL

3.1 Meteorology

3.1.1 General condition

The Climate in Azerbaijan differs among the Northern Caspian, the Middle Caspian, and the Southern Caspian. While it is hot, dry and serene in summer regardless of regions, the climate in winter is cold and windy in the Northern Caspian, mild in the Middle Caspian and relatively hot in Southern Caspian.

In the Absheron sea region, where Sumgayit is located, strong winds called “Baku inlet” blow at 30-40 m/s in the direction of North-North-West. Average number of stormy days is 25-30 days during the year and these winds last for 10 hours at a time.

3.1.2 Temperature

The meteorological observation was made in Sumgayit meteorological station about 20 km southeast of the project site.

The outline of weather-monitoring results at the Sumgayit meteorological station from 2011 to 2013 is described below.
Average monthly air temperature in Sumgayit reaches 26 -27 in summer and below 5 in winter as shown in the figure below.

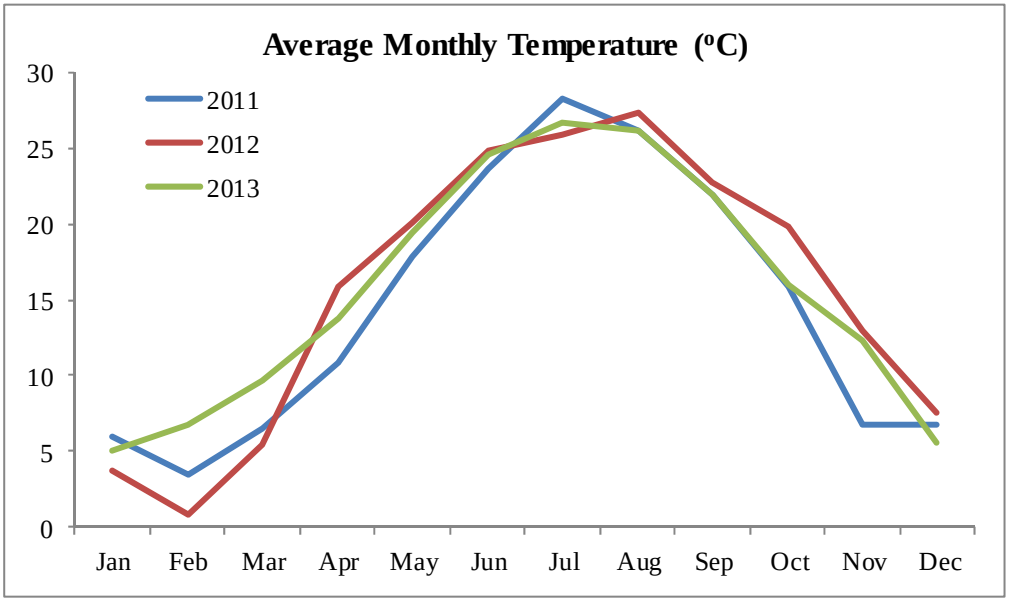


Figure 3.1-1 Average Monthly Temperature in Sumgayit from 2011 to 2013

3.1.3 Precipitation

The figure below shows average monthly precipitation in Sumgayit from 2011 to 2013. Summer tends to be dry with little rain, while 70% of precipitations are concentrated in autumn and winter.

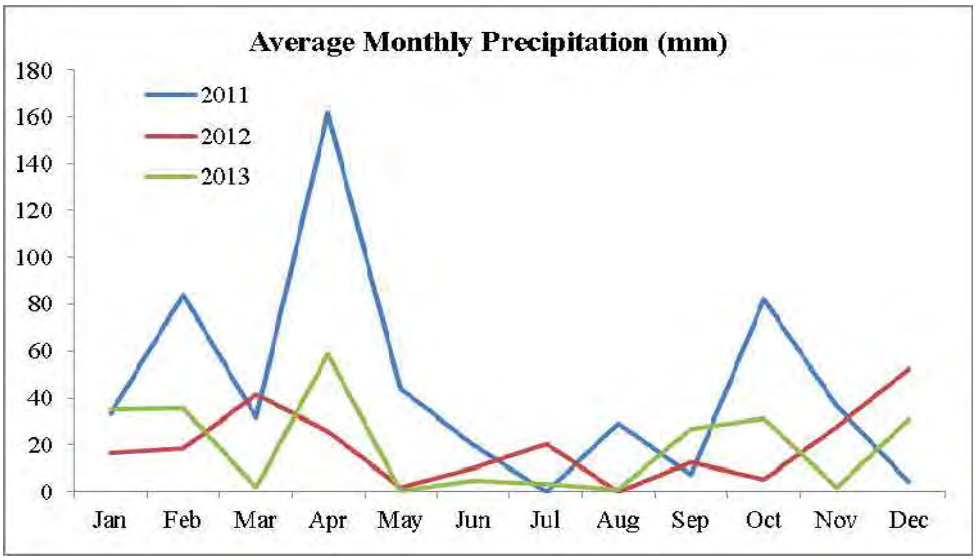
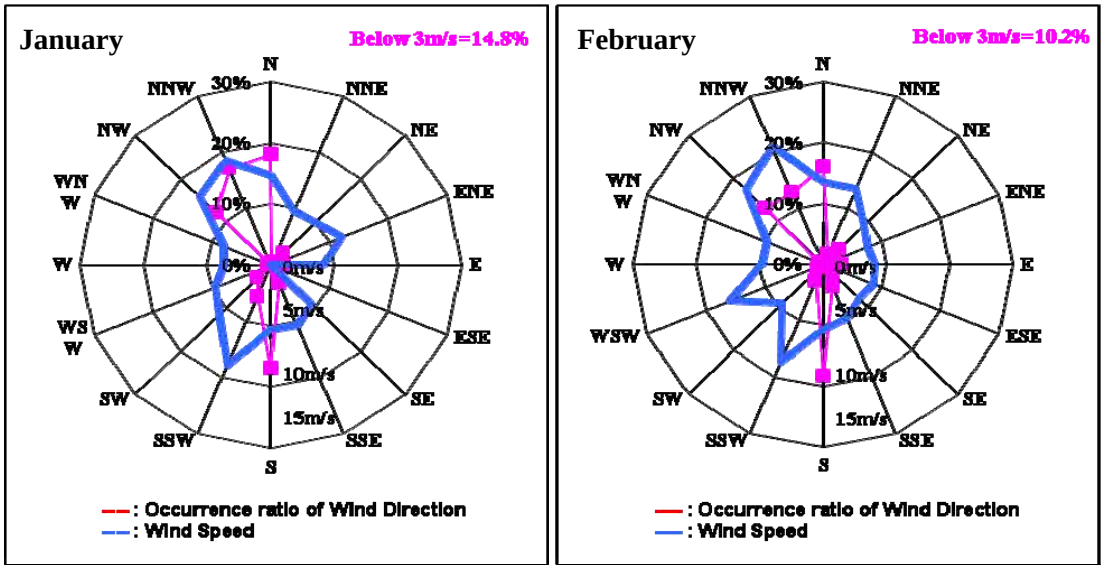
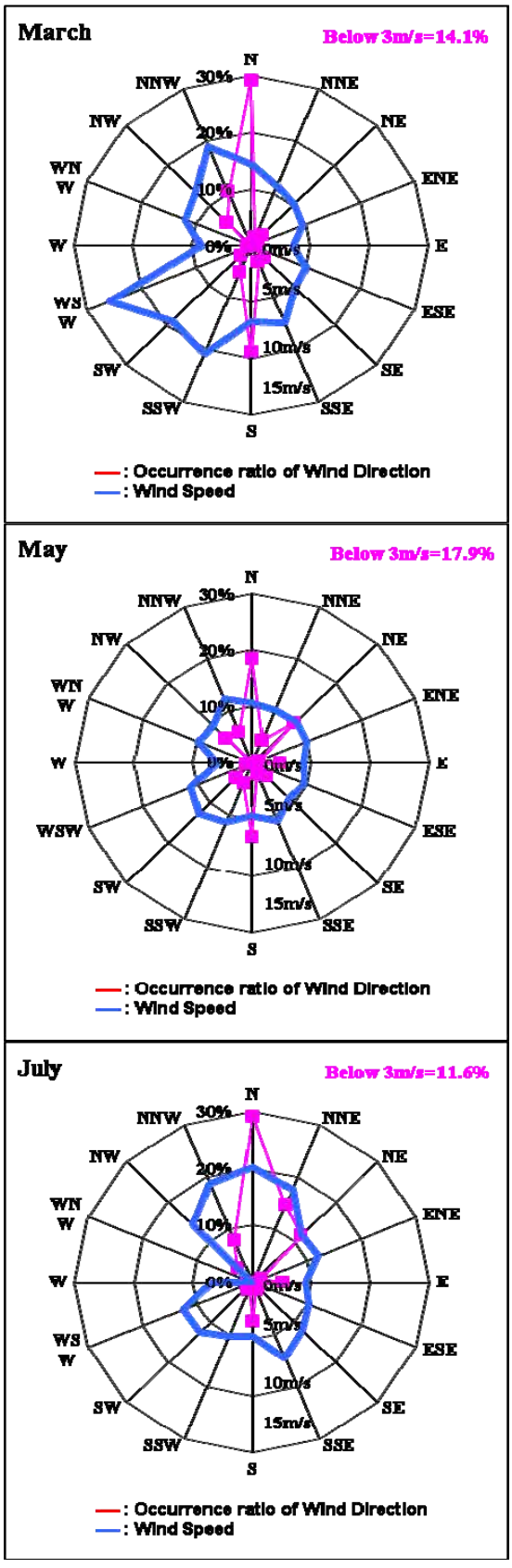


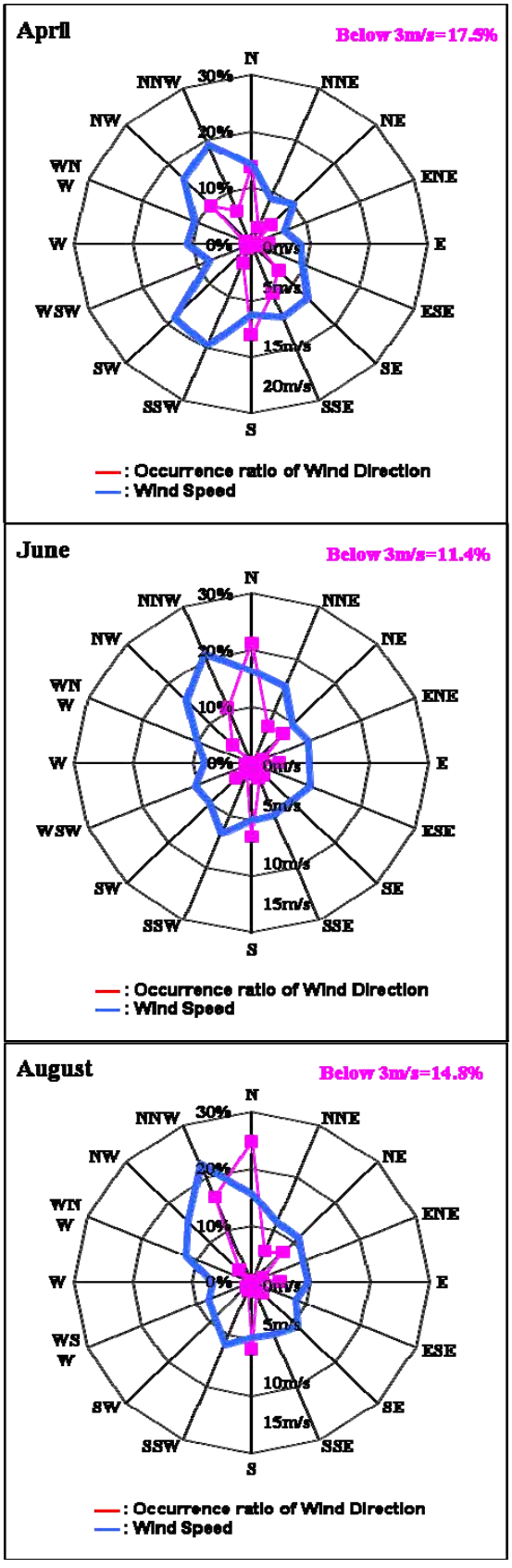
Figure 3.1-2 Average Monthly Precipitation in Sumgayit from 2011 to 2013

3.1.4 Wind

The figures below show wind direction and wind speed of the year 2011 to 2013 by month in Sumgayit. North, North-West and South winds are frequent throughout the year. With regard to wind velocity, strong wind is more frequent in winter, while weak wind is observed more often in summer relatively.




March
Below 3m/s=14.1%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
5m/s
10m/s
15m/s
—: Occurrence ratio of Wind Direction
—: Wind Speed


April
Below 3m/s=17.5%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
5m/s
15m/s
20m/s
—: Occurrence ratio of Wind Direction
—: Wind Speed

May
Below 3m/s=17.9%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
5m/s
10m/s
15m/s
—: Occurrence ratio of Wind Direction
—: Wind Speed

June
Below 3m/s=11.4%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
5m/s
10m/s
15m/s
—: Occurrence ratio of Wind Direction
—: Wind Speed

July
Below 3m/s=11.6%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
5m/s
10m/s
15m/s
—: Occurrence ratio of Wind Direction
—: Wind Speed

August
Below 3m/s=14.8%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
5m/s
10m/s
15m/s
—: Occurrence ratio of Wind Direction
—: Wind Speed

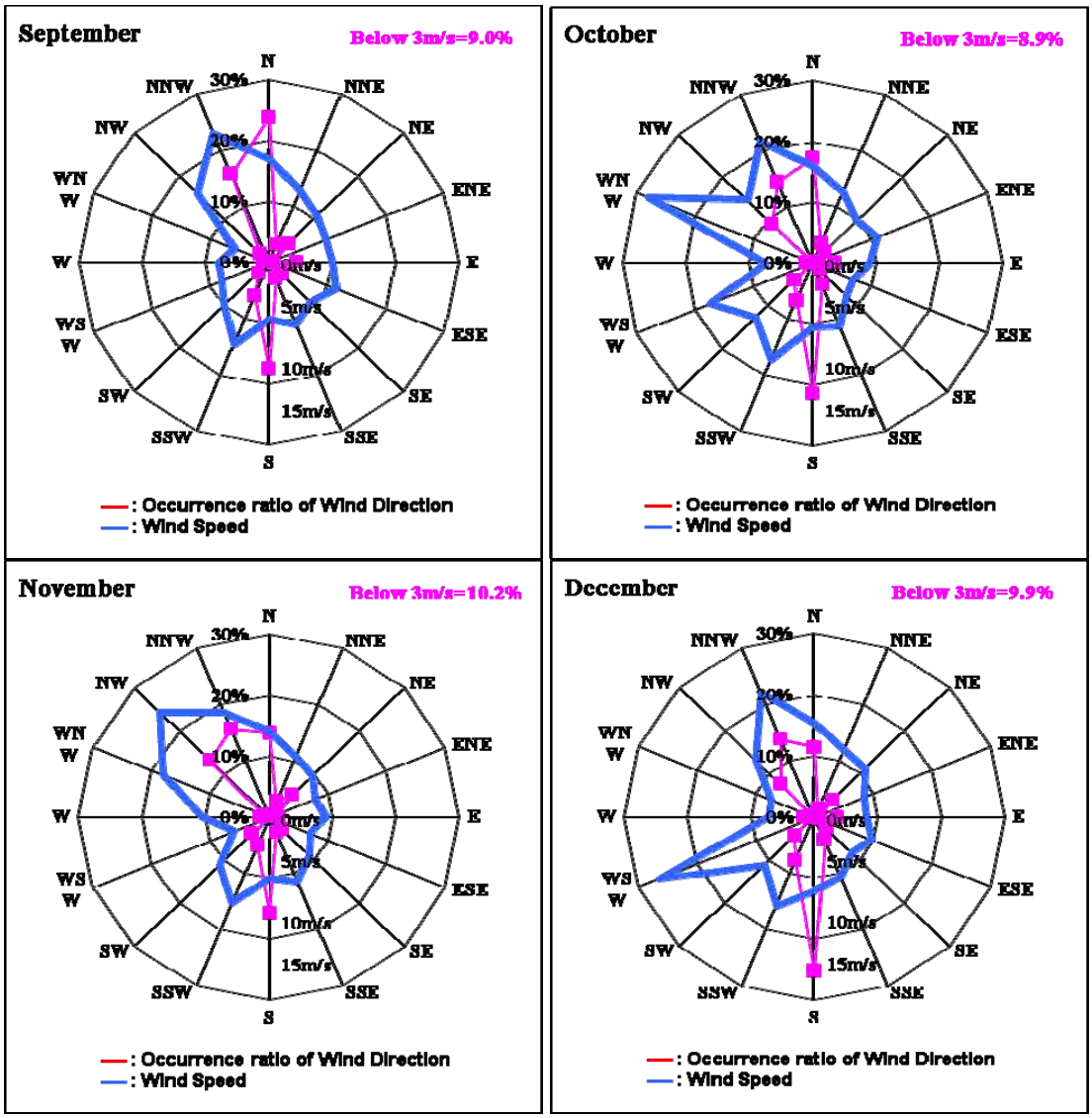


Figure 3.1-3 Monthly Wind Velocity and Wind Direction in Sumgayit from 2011 to 2013

3.2 Air Quality

3.2.1 Power plant

1) Document survey

There are two main sources of emission near the project site: transportation and oil-and-gas industry such as popping superfluous gas and oil refining plants. In 2000, industrial emissions declined while emissions from traffic doubled.

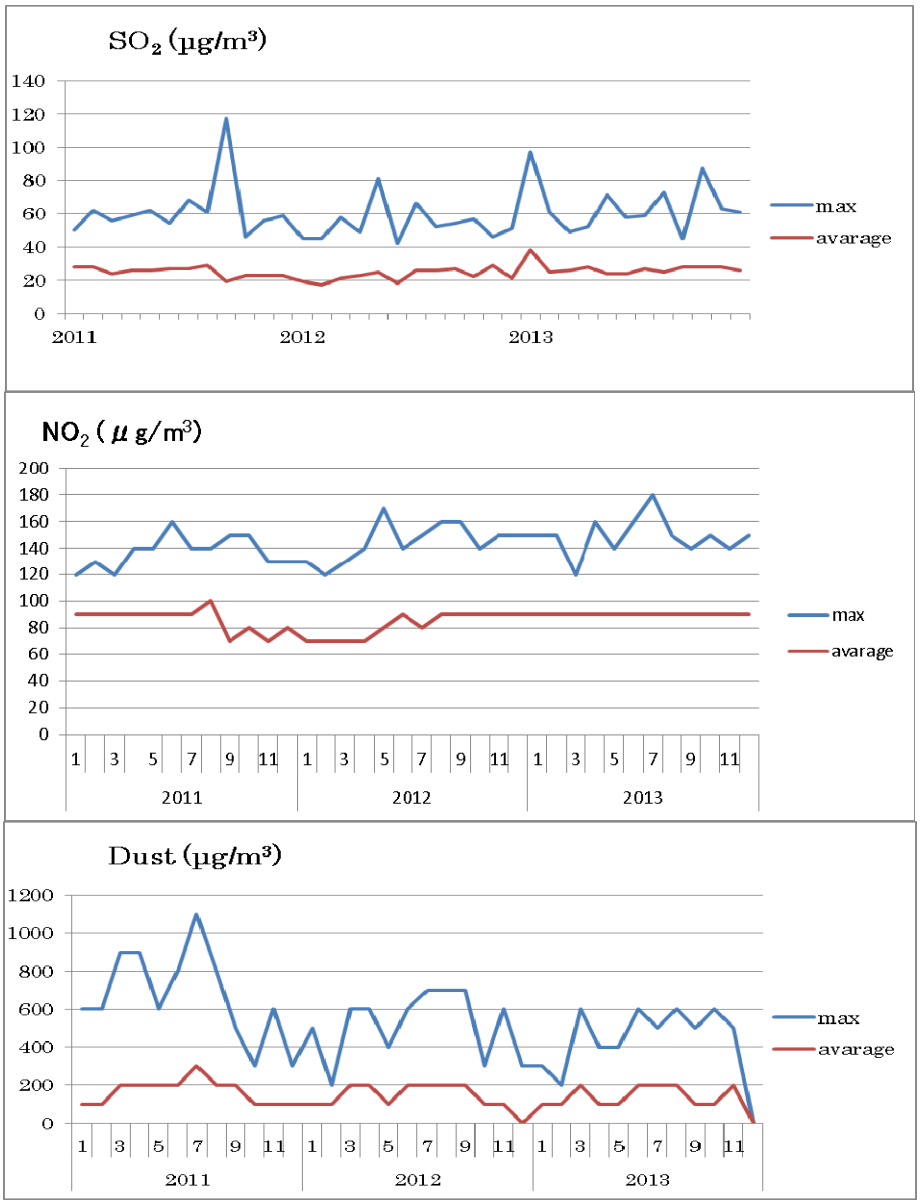
Figure3.2-1 shows the measured average and maximum value of three elements between 2011 and 2013: SO_2, NO_2 and dust, respectively.

As stated in 13.2.4, the results of the survey were compared with the environmental standard of EU and the IFC/WB Guidelines since the MAC standards in Azerbaijan does not fit in the criteria for judgment of the existing conditions survey.

The monthly average of SO_2 ranges from 20 to 40 μ g/m^3, which always exceeds annual average of the standard of EU (20 μ g/m^3).

The monthly average of NO_2 ranges from 70 to 100 μ g/m^3, which always exceeds annual average of the standards of IFC/WB Guidelines (40 μ g/m^3), as well.

The monthly average of dust is between 0 and 300 μ g/m^3, which is mostly above the annual average of the IFC/WB Guidelines and EU standards (70 μ g/m^3).



Substances	IFC/WB EHS guidelines (general)	EU Standards (Japanese Standards)
SO_2	500(10 min) 125(24hour) -	350(260)(1hr) 125(200)(24hr) 20(Yearly)
NO_2	200(1-hour) - 40(Yearly)	200(1hr) (75-110)(24hr) 40(Yearly)
Dust(PM_{10})	- 150(24hr) 70(Yearly)	(200)(1hr) 150(100)(24hr) 70(Yearly)

Figure 3.2-1 Air Quality Measured in Sumgayit from 2011 to 2013

Field survey

The field survey of air quality and noise, which should be conducted for 24 consecutive hours, was carried out in spring. Another field survey in winter was not undertaken due to its severe meteorological condition. Fluctuation of survey results on air quality can be considered to be limited because spreading area of air-pollution substance are dependent on the wind direction and both north and south winds are prevailing throughout a year in this region.

In the project site and around residential area were selected as the sampling points for air quality and noise measurement (Figure 3.2-2). The survey was conducted in 13th of May Jun 2014 with interval of 1hr for 1 day. These results are presented in Table 3.2-1 and Table 3.2-2.



(Source: JICA Study Team)

Figure 3.2-2 Sampling points of air quality survey

Background concentration of SO_2 is 22 - 27μg/m^3 at the site and 32 - 42μg/m^3 at the south side of residential area. This adequately meets the 10-minutes values （500μg/m^3） in IFC/WB EHS Guidelines and the values for an hour（500μg/m^3） in EU standards.

For 24 hours values, 24μg/m^3 at the site and 36μg/m^3at the south side of residential area respectively were measured, which fully satisfies EHS Guideline of IFC/WB and the environmental standard of EU.

Background concentration of NO_2 are 50 - 70 μ g/m^3 at the site and 60 – 100 μ g/m^3 at the south side of residential area, which fulfills an hour value of IFC/WB EHS Guidelines and standards of EU(200μg/m^3) .

For 24 hours values, 60μg/m^3 at the site and 83μg/m^3at the south side of residential area respectively were measure. This figures fit in the 24-hour values in Japanese environmental standards (70-110μg/m^3).

Background concentration of Dust are 100 μ g/m^3 at the site and 100 - 200 μ g/m^3 at the south side of residential area, which satisfies one-hour values in Japanese standards (200μg/m^3).

For 24 hours values, 100μg/m^3 at the site and 139μg/m^3at the south side of residential area respectively were measured, which meets 24-hour values of IFC/WB EHS Guidelines and standards of EU (200μg/m^3).

Table 3.2-1 Measure Results for Air Quality at the Site

Parameter	Unit	Project site			IFC/WB guideline (General: 2007)	EU Standards (Japanese Standards) (μg/m^3)
		Min	Max	Average (24hr)		
Sulfur dioxides (SO_2)	μg/m^3	22	27	24	500(10 min) 125(24hour) -	350(260)(1hr) 125(200)(24hr) 20(Yearly)
Nitrogen dioxides (NO_2)	μg/m^3	50	70	60	200(1-hour) - 40(Yearly)	200(1hr) (75-110)(24hr) 40(Yearly)
Dust	μg/m^3	100	100	100	- 150(24hr) 70(Yearly)	(200)(1hr) 150(100)(24hr) 70(Yearly)

Reference: Environmental performance reviews, United Nations 2010 and IFC/WB Environmental, Health, and Safety (EHS) Guidelines General, 2007

Table 3.2-2 Measure Results for Air Quality at the Residential Area

Parameter	Unit	Residential area			IFC guideline (General: 2007)	EU Standards (Japanese Standards) (μg/m^3)
		Min	Max	Average (24hr)		
Sulfur dioxides (SO_2)	μg/m^3	32	42	36	500(10 min) 125(24hour) -	350(260)(1hr) 125(200)(24hr) 20(Yearly)
Nitrogen dioxides (NO^2)	μg/m^3	60	100	83	200(1-hour) - 40(Yearly)	200(1hr) (75-110)(24hr) 40(Yearly)
Dust	μg/m^3	100	200	139	- 150(24hr) 70(Yearly)	(200)(1hr) 150(100)(24hr) 70(Yearly)

Reference: Environmental performance reviews, United Nations 2010 and IFC/WB Environmental, Health, and Safety (EHS) Guidelines General, 2007

3.3 Noise

3.3.1 Power plant site

The project site and around residential area were selected as the sampling points for Noise measurement (Figure 3.3-1). The survey was conducted in 13th of May 2014 with interval of 1hr for 1 day.

Noise levels during daytime at the site is 28 -38(dBA) and at the south of the residential area is 39 -54(dBA) respectively, which fully satisfies the environmental standard of Azerbaijan and EHS Guideline of IFC/WB.

Noise level during night time at the site is 25 - 29(dBA) and at the south side of the residential area is 37 - 44 (dBA), which fully satisfies the environmental standard of Azerbaijan and EHS Guideline of IFC/WB.



(Source: JICA Study Team)

Figure 3.3-1 Sampling Points of Noise Measurement Survey

Table 3.3-1 Noise Measure Result (Leq)

Survey date: 13th - May 2014

Sampling Point	time	Noise level (Leq:dBA)			noise standard of Azerbaijan (Leq:dBA)	IFC/WB EHS guidelines (General) (Leq:dBA)
		Min	Max	Average		
Project site	Daytime (7:00-23:00)	28	38	34	Industrial area: 65	Industrial area: 70
	Nighttime (23:00-7:00)	25	29	26	Industrial area: 55	Industrial area: 70
Residential Area	Daytime (7:00-23:00)	39	54	47	Residential Area: 60	Residential area: 55
	Nighttime (23:00-7:00)	37	44	40	Residential Area: 45	Residential area: 45

3.4 Current

3.4.1 Power plant site

General current system in Caspian Sea is described. Northern winds prevalent all the year on the sea create ground streams

According to Table 3.4-1, which shows frequency of streams direction near Sumgayit, streams to the east and south-east (around 40%) are frequently observed and those to the west and north west(around 30%)

In addition, the current speed, which is affected by wind velocity, is 10-20cm/s with moderate wind ands can reach 70cm/s with more than 10m/s winds.

Table 3.4-1 Frequency of Streams Direction Observed in Sumgayit (%)

Directions of streams	Observation point.1	Observation point.2	Observation point.3
N	10	10	11
NE	7	5	5
E	28	22	22
SE	12	20	20
S	5	4	4
SW	8	4	5
W	17	16	14
NW	13	19	19
Depth	5m	10 m	15m
Distance from shore	2 km	4 km	6 km

Current direction and velocity were observed in the locations in the intake point of cooling water and coastal facing area of site (Figure 3.4-1). The survey was conducted in 8th to 15th of May 201 with interval of 1hr.

Since existing literatures report the currents around the project site are influenced by the winds, wind direction and speed were also measured at the same time of the observation of current direction and speed.



(Source: JICA Study Team)

Figure 3.4-1 Survey Points of Current

The observed results of current direction and speed is shown in Figure 3.4-2.
During the observation period, southeast streams are prevailing along the coast due to the northwest winds. Current speed were mostly from 30 to 60cm/s.

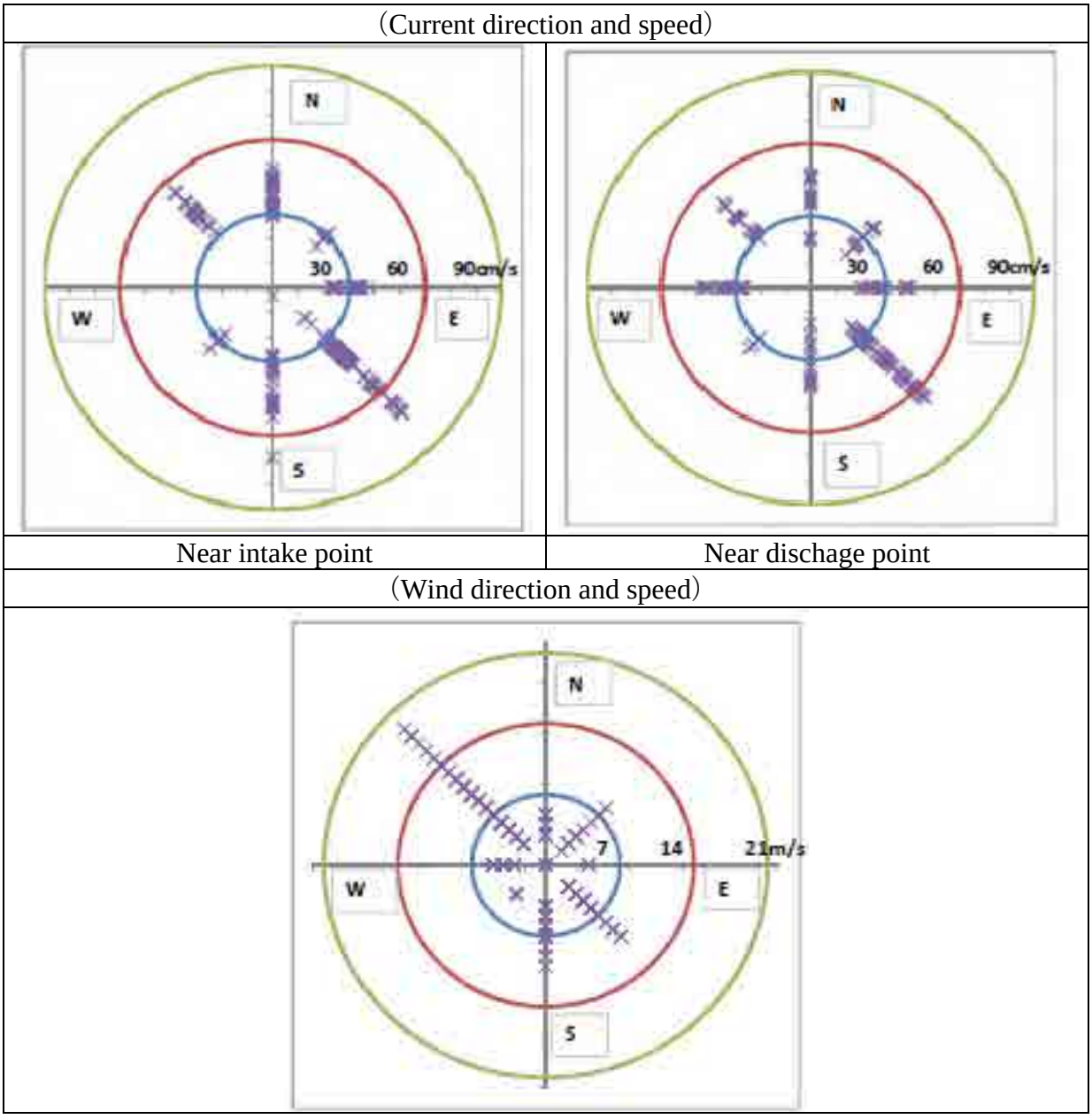


Figure 3.4-2 Current Rose

3.5 Water Quality

3.5.1 Power plant site

(1) Temperature and salinity

The Figure 3.5-1 shows the Monthly average of sea water temperature and salinity in Sumgayit, which were measured from 2011 to 2013.
Monthly average water temperature in Sumgayit reaches 25 -26℃ in summer and below 0-5℃in winter as shown in the figure below.

Monthly average salinity Sumgayit reaches 10-12‰in summer and below 6-8℃in winter as shown in the figure below.

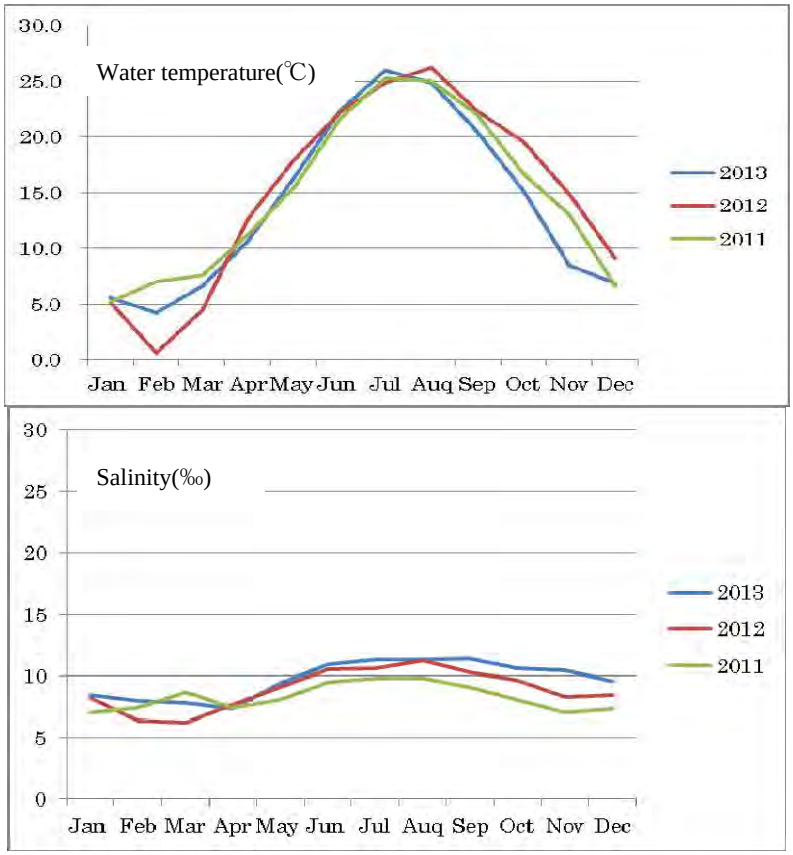


Figure 3.5-1 Monthly Average Water Temperature and Salinity in Sumgayit

According to the vertical water temperature distribution observed between 5 and 20m water depth near Sumgayit, water temperature of the low layer is lower than that of the surface. It is 2-5℃ at the 20m water depth and 1-2℃ at the 5-20m depth in spring and summer.

(2) Water quality

Table 3.5-1 reveals the recent situation of the sea water quality in Sumgayit. Compared with MAC of Azerbaijan, many elements had exceeded their MAC for three years. Above all, significantly high figures were measured in iron from 8.8 to 12.0mg/l in spite of 0.05mg/l in its MAC. The only substance which was below its MAC was cadmium.

Table 3.5-1 Sea Water Quality Measured in Sumgayit from 2011 to 2013

Element	Unit	2011		2012		2013		Azerbaijan Water quality standard(MAC)
		MAX	MIN	MAX	MIN	MAX	MIN	
pH	-	8.5	8.27	8.52	8.4	8.5	8.4	6.5~8.5
Dissolved oxygen (DO)	mg/l	10.53	9.43	10.45	9.46	10.45	9.46	>4.0-6.0
COD	mg/l	6.9	4.8	5.8	4.25	6.7	4.9	125
Oil and Grease	mg/l	0.18	0.01	0.17	0.08	0.13	0.015	0.05
Phenol	mg/l	0.14	0.06	0.13	0.07	0.12	0.06	0.001
Cd	mg/l	0.002	0.001	0.001	0.001	0.002	0.001	0.005
Cu	mg/l	0.039	0.020	0.024	0.015	0.028	0.017	0.01
Fe	mg/l	11.3	8.9	10.3	8.8	12.0	9.5	0.05

Element	Unit	2011		2012		2013		Azerbaijan Water quality standard(MAC)
		MAX	MIN	MAX	MIN	MAX	MIN	
Mn	mg/l	0.111	0.082	0.120	0.089	0.101	0.079	0.1
Ni	mg/l	0.022	0.012	0.024	0.012	0.022	0.015	0.01
Zn	mg/l	0.025	0.015	0.029	0.010	0.025	0.013	0.01
Co	mg/l	0.010	0.007	0.012	0.006	0.012	0.009	0.01

Field survey

Only small boats were available for the survey of water quality, marine water flow, and marine flora and fauna because no one is engaged in fishery near the project site. However, strong wind and turbulent waves around there in winter made it impossible to conduct survey by small boats.

Therefore, the field survey on water quality, marine water flow, and marine flora and fauna were carried out at the sea area facing the site in spring when the sea is calm.

The intake point of cooling water and coastal facing area of site were selected as the sampling points (Figure 3.5-2). The survey was conducted in 13th of May 2014.

Water quality data is shown in Table 3.5-2 added ambient sea water quality standards. According to the site results, most of values satisfy the environmental standard of Azerbaijan. However, values of Suspended Solids (SS) and Zink exceed the environmental standard.



(Source: JICA Study Team)

Figure 3.5-2 Sampling Points of Sea Water Quality Survey

Table 3.5-2 Water Quality Measure Result

Item	Unit	Environmental Standard of Azerbaijan (MAC)	Intake Point			Offshore Point from the Outlet Point		Nearby Outlet		
			Surface layer	Middle layer	Lower layer	Surface layer	Lower layer	50 meter left from center	Center of outlet	50 meter right from center
Temperature	℃	-	19.9-20.9	18.9-20.0	18.7-19.7	22.1-23.2	-	-	-	-
pH	-	6.5-8.5	8.19	8.18	8.18	8.19	8.18	8.19	8.22	8.24
DO	mg/L	>4.0-6.0	5.64	5.52	5.29	5.4	5.34	4.99	4,97	4.94
BOD	mg/L	25	7	7.3	8	10	11	8	9	12
COD	mg/L	125	16	15.4	15	24	20	13	17	26

Item	Unit	Environmental Standard of Azerbaijan (MAC)	Intake Point			Offshore Point from the Outlet Point		Nearby Outlet		
			Surface layer	Middle layer	Lower layer	Surface layer	Lower layer	50 meter left from center	Center of outlet	50 meter right from center
TSS	mg/L	30	6	5.4	5	11	10.1	**84**	**54**	**49**
Cadmium (Cd)	mg/L	0.005	0.00006	0.00006	<0.00002	0.00002	0.00003	0.00004	0.00004	0.00004
Chromium (Cr)	mg/L	0.005	0.0001	0.0001	0.0002	0.0002	0.0002	0.0003	0.0003	0.00003
Copper (Cu)	mg/L	0.01	0.006	0.007	0.002	0.005	0.005	0.002	0.002	0.002
Iron (Fe)	mg/L	0.05	0.002	0.002	0.003	0.002	0.002	0.003	0.004	0.004
Lead (Pb)	mg/L	0.1	0.001	0.001	0.00009	0.00003	0.0004	0.00004	0.00004	0.00004
Mercury (Hg)	mg/L	0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (Ni)	mg/L	0.01	0.001	0.001	0.001	0.001	0.001	0.003	0.003	0.003
Zinc (Zn)	mg/L	0.01	**0.02**	**0.02**	0.0001	0.004	0.004	0.001	0.009	0.001

3.6 Bottom sediment

The table 3.6-1 shows the maximum allowable concentration (MAC) of elements in Caspian Sea bottom and measured data of sea bottom sediment in Sumgayit between 2011 and 2013, respectively.

Most elements remain below their MAC, though the measurement found frequent excess of zinc, manganese and Iron over its MAC. These elements may be naturally sourced from soil and geology surrounding of the Caspian Sea.

Table 3.6-1 Sea Bottom Sediment Measured in Sumgayit from 2011 to 2013

Element	Unit	2011		2012		2013		MAC
		MAX	MIN	MAX	MIN	MAX	MIN	
Oil	mg/g	0.1	0.009	**0.8**	0.05	0.11	0.011	0.5
Phenols	mg/g	ND	ND	ND	ND	ND	ND	0.01
Zn	μg/g	**160.6**	97.4	**156.9**	107.4	**160.6**	97.4	100
Cu	μg/g	19.6	8.45	17.6	8.7	17.6	8.5	100
Ni	μg/g	24.95	16.1	21.9	15.5	22.9	15.5	100
Mn	μg/g	**283.3**	**176.85**	**272.9**	**172.7**	**283.3**	**176.85**	100
Co	μg/g	5.55	1.85	5.55	1.85	5.5	2.45	100
Fe	μg/g	**7115**	**3236.8**	**6431.9**	**2873.2**	**6369.9**	**2913.5**	500
Cd	μg/g	ND	ND	ND	ND	ND	ND	50

3.7 Topography and Geology

3.7.1 Power plant site

(1) Topography

a. Land

The terrain is mainly flat, in some places hilly or with small forms of topography. Also pits, earth banks and minor water streams exist. Contour lines on the maps were drawn through all topographical facilities, except for topographical forms of artificial origin.

The following survey results may be mentioned (Figure 3.7-1):

- The area consists of flat plains (95%) and hills (5%).
- Topsoil consists mainly of shrubs and marsh grass.

Figure 3.7-2 shows the cross section. The site will built on a plain extending 300m-400m from the coast. On the tip of the plain is a cliff, and there is an approximately 10m difference in elevation. A national road runs through the head of the cliff.

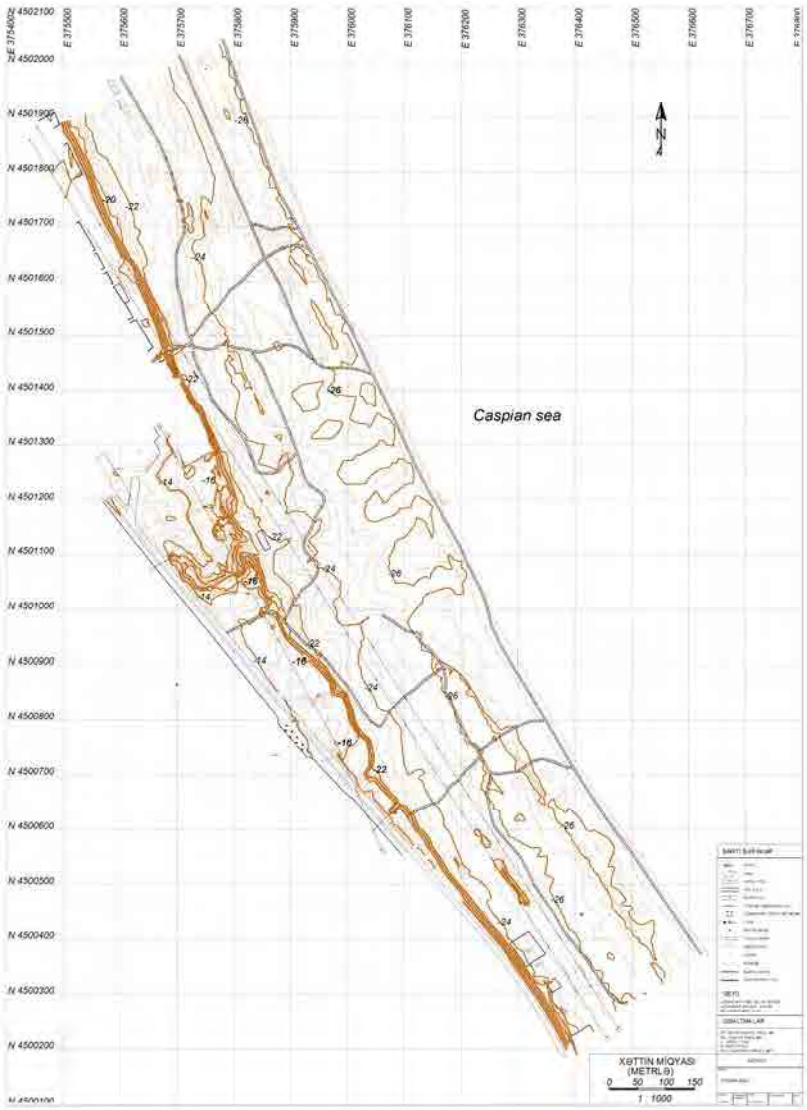
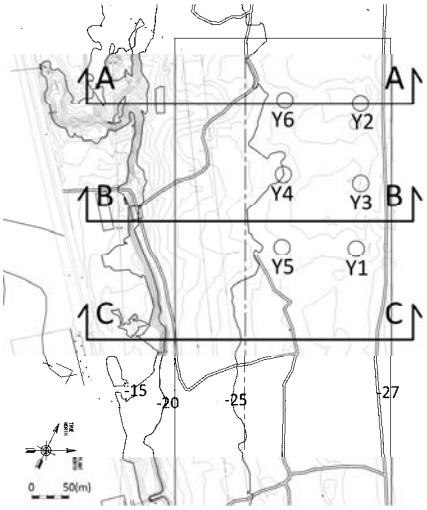


Figure 3.7-1 Map of topography



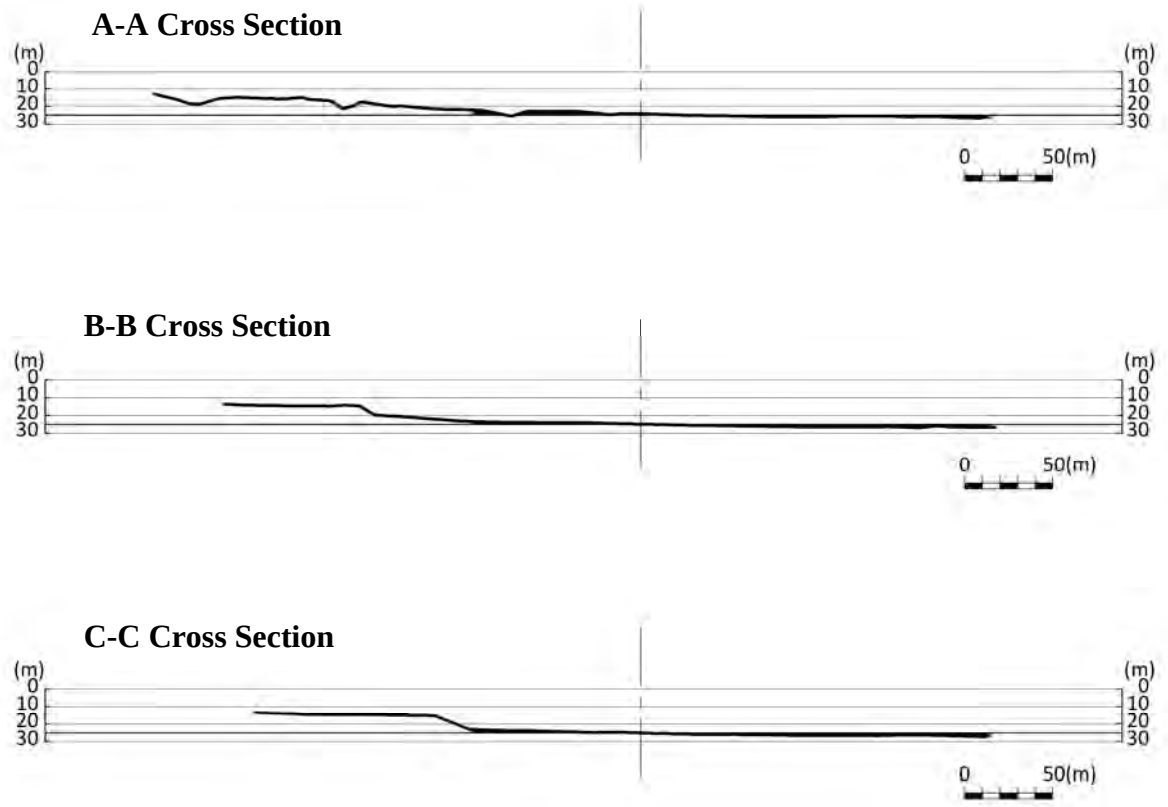


Figure 3.7-2 Cross section of topography

b. Sea bottom

When a basic examination was executed, the sounding was executed to understand the depth situation in a front sea area on the site. Bathymetric surveys were carried out from 4th January 2014 to 27th April 2014 during the calm weather conditions on the sea (Figure3.7-3).



Figure 3.7-3 Bathymetric surveys area

Water level on the Caspian Sea shore is 27.21 m. Depth increase dynamics moving away from the coast are shown in the Table 3.7-1 and Figure3.7-4.

3000 m away from the coast the depth is 8.80 m. 7 m of the sea depth is located at a distance of 1130 m from the coast.

Table 3.7-1 Depth Increase Dynamics Moving Away from the Coast

Coast distance, m	Height, m	Average depth, m
0	-27.21	0
10	-27.25	0.04
50	-27.48	0.27
100	-27.73	0.52
200	-28.26	1.05
400	-29.39	2.18
650	-31.51	4.30
1000	-33.65	6.44
1500	-34.68	7.47
2000	-35.17	7.96
2500	-35.54	8.33
3000	-36.01	8.80

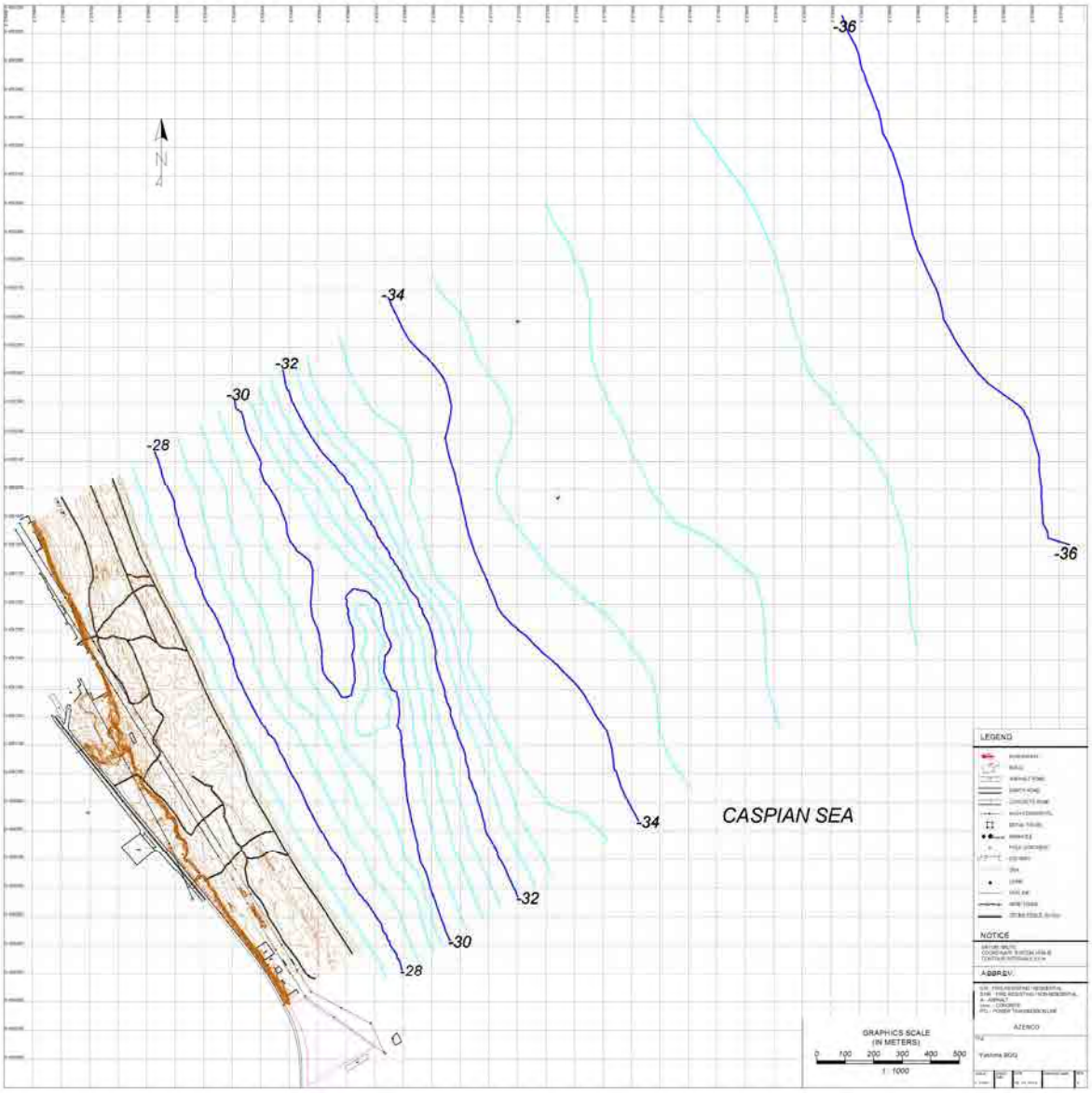


Figure 3.7-4 Bathymetric Map

(2) Geology

c. Land

Following geological surveys and analysis were carried out started on 22nd December 2013 to 30th March 2014.

-Engineering-geological investigation works consist of the followings:

-Visual check of the area and surroundings related to geological engineering, geological and hydrogeological conditions;

-Mechanical-core boring & sampling;

-Laboratory studies;

-Standard penetration test (SPT);

Figure 3.7-5 and Figure 3.7-6 shows geological section and geological profile.

Geological formation basis of the area is formed from Lower Pliocene Productive layer deposits and lithologically consists of thick clay soils.

From the ground surface it is covered with Contemporary Quaternary, New Khazar (mQıv) aged sands and has a very small thickness (0.5-1.5 m).

Geomorphologically, the area concerns to flat, seaside beach plain.

Ground water plane has been observed in all boreholes in the area and their average level is 0.6 m.

Water mineralization is high - 12 g/l. By salt content, they are chloride-natrium and chloride-natrium-sulphate. By sulphate quantity and mineralization degree, they are aggressive against Portland-cement and normal dense concretes.

According chemical analysis of aqueous extracts, quick and medium water-soluble salts amount is 6.7-19.6%. Salt content is mainly sulphate-natrium, and sometimes sulphate-chloride-natrium.

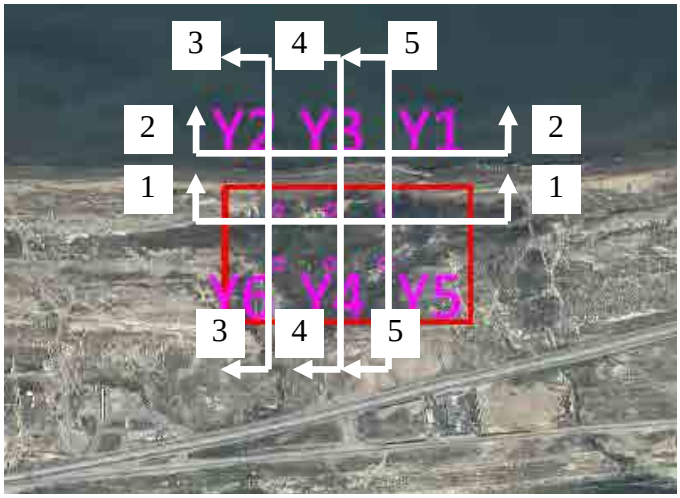


Figure 3.7-5 Geological section

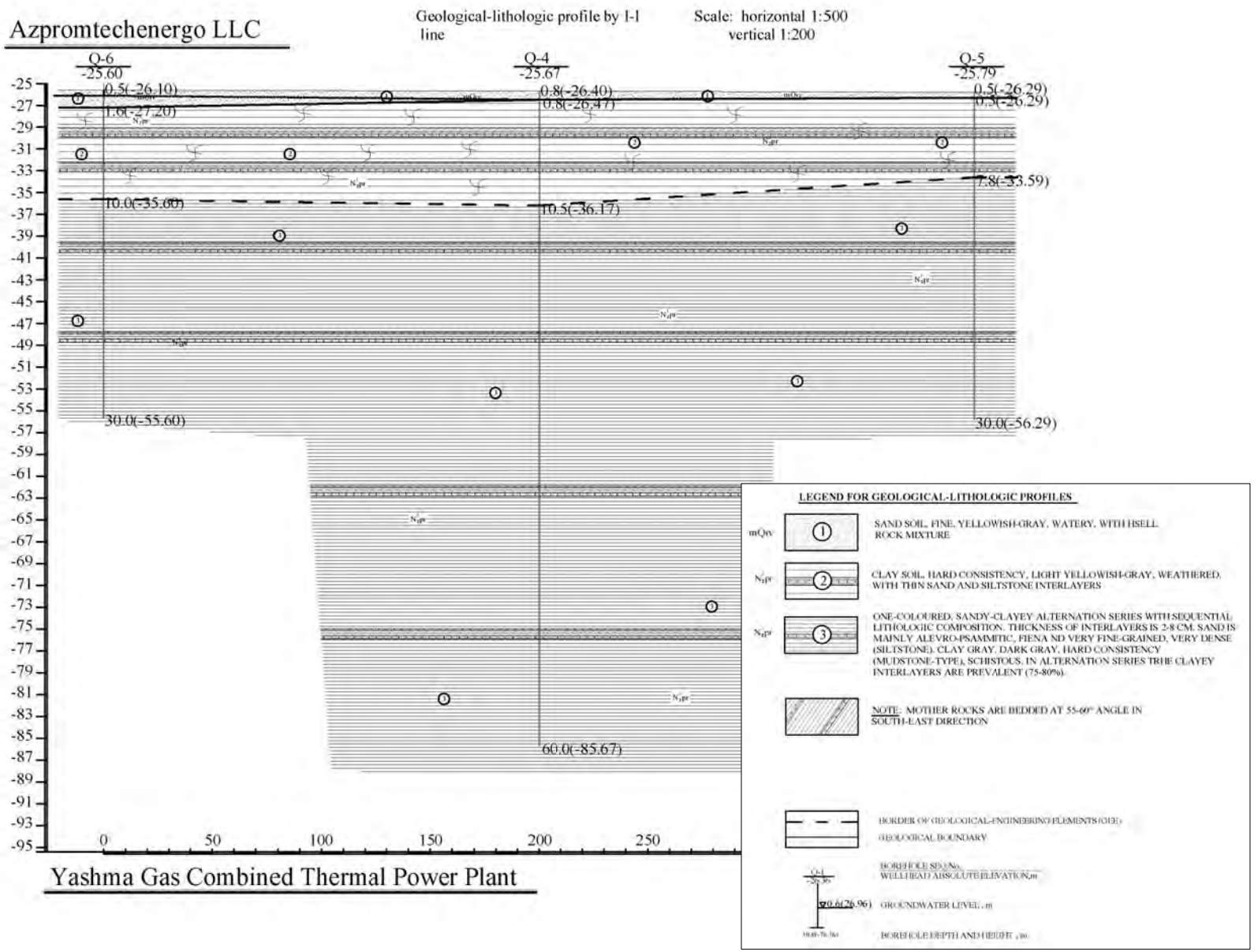


Figure 3.7-6(1) Geological profile (Line 1-1)

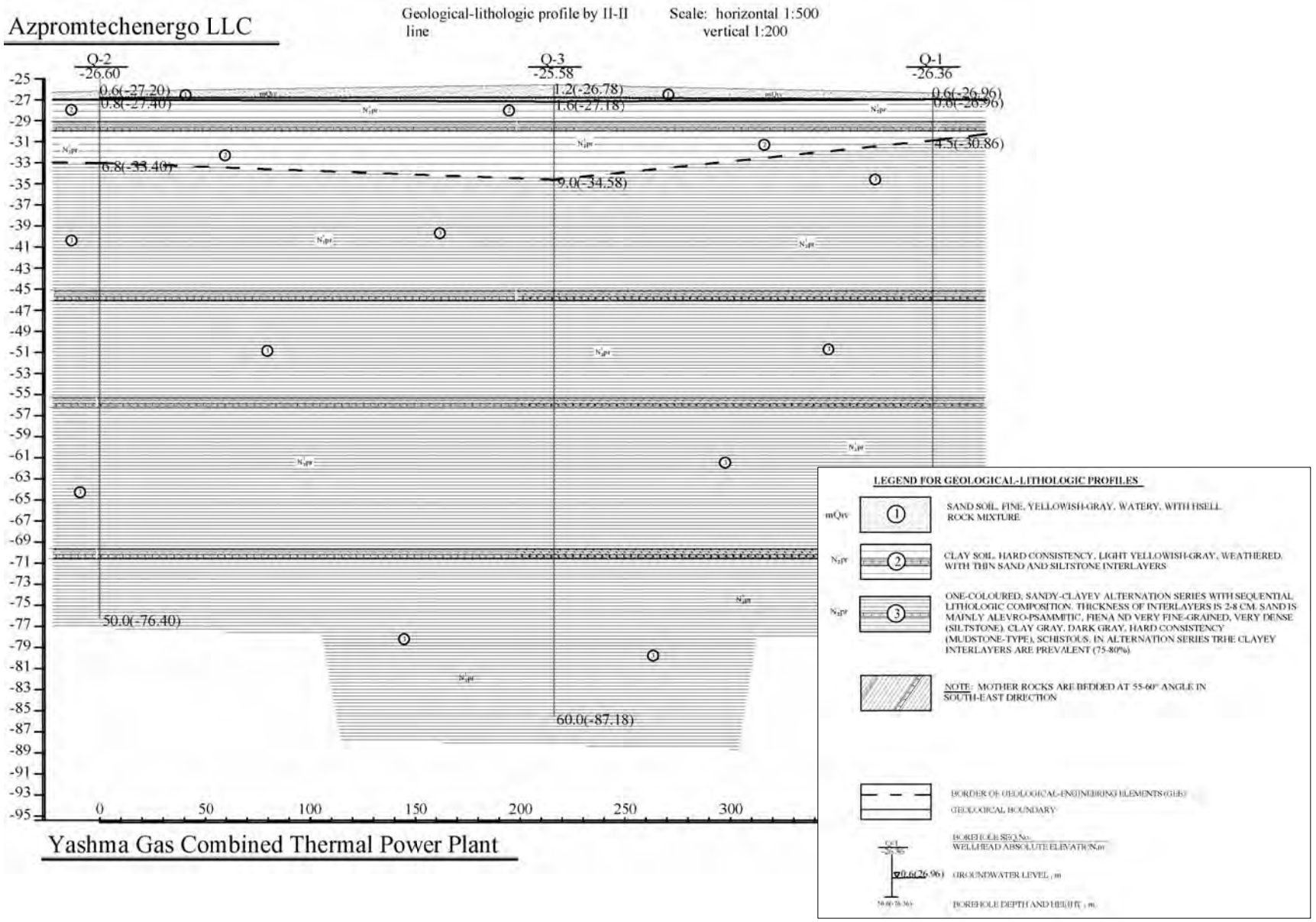


Figure 3.7-6(2) Geological profile (Line 2-2)

Figure 3.7-6(3) Geological profile (Line 3-3)

Figure 3.7-6(4) Geological profile (Line 4-4)

Figure 3.7-6(5) Geological profile (Line 5-5)

3.7.2 Transmission line and substation site

Topsoil on the area is mainly semidesert type and consists of wormwood and marsh grass. The area of transmission line routes relates to seismic zone 8. The transmission line routes start from Sumgait City and then run across Absheron Region. Relief in certain part of the area is hilly and generally it is plain.

According to visual observation results, soils on the route are mainly ore -yellowish-gray coloured, clayey -yellowish-black and bluish-red coloured, sedimentary gravel-pebble, with sand and loamy sand interbeds, weak-moist, of semihard and hard consistency.

Weather conditions on transmission line route:

3.7.3 Gas pipeline site

The gas pipeline route length is 48 km and runs through mountainous terrain (70%) and flat terrain (30%).

EIA

Chapter 4

Chapter 4

EXISTING ENVIRONMENT: ECOLOGICAL

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4. EXISTING ENVIRONMENT: ECOLOGICAL

4.1 Protected Area and Park

8 national parks and 35 protected areas (reserve and sanctuary) are designated by the Ministry of Environment and Natural Resource of Azerbaijan. Table 4.1-1 describes the list of the national parks, Table 4.1-2 describes the reserves, and Table 4.1-3 indicates sanctuaries. The location thereof is shown in Figure 4.1-1.

No national park or natural reserve is located near the project sites of power plant, transmission line, substation, and gas pipeline corridor.
The Altiaghaj national park is located about 40 km away from the power plant site to the north-west, about 40-50 km north-north-west from the transmission line corridor, and about 20km north from the gas pipeline corridor at closest point.

Table 4.1-1 National Parks in Azerbaijan

NO	Name of the SPNA	Administrative territory	Area(ha)	Date of establishment
1	Zangazur NP named after Academician H.Aliyev	Nakhichevan AR	42,797.4	2003
2	Shirvan NP	Garadagh district of Baku city, Salyan and Neftchala regions	54,373.5	2003
3	Aghgol NP	Aghjabadi and Beylagan regions	17,924	2003
4	Hirkan NP	Lankaran and Astara regions	40,358	2004
5	Altiaghaj NP	Khizi and Siyazan regions	11,035	2004
6	Absheron NP	Azizbayov district of Baku city	783	2005
7	Shahdagh NP	Guba, Gusar, Ismayilly, Gabala, Oghuz and Shamakhy regions	130,508.1	2006
8	Goygol NP	Goygol, Dashkasan and Goranboy regions	12,755	2008

(Source MENR website)

Table 4.1-2 Natural Reserves in Azerbaijan

NO	Name of the SPNA	Administrative territory	Area(ha)	Date of establishment
1	Gizilaghaj SNR	Lankaran region	88,360	1929
2	Zagatala SNR	Zagatala and Balakan regions	47,349	1929
3	Turyanchay SNR	Aghdash, Oghuz,Yevlakh and Gabala regions	22,488	1958
4	Shirvan SNR	Salyan and Neftchala regions	6,232	1969
5	Basitchay SNR	Zangilan region	107	1974
6	Garayazi SNR	Gazakh region	9,658	1978
7	Ilisu SNR	Gakh region	17,381.6	1987
8	Garagol SNR	Lachin region	240	1987
9	Eldar shami SNR	Samukh region	1,686	2004
10	Mud volcanoes SNR	Baku and Absheron peninsula	20,000	2007
11	Korchay SNR	Goranboy region	4,833.6	2008

(Source MENR website)

Table 4.1-3 Natural Sanctuaries in Azerbaijan

NO	Name of the SPNA	Administrative territory	Area(ha)	Date of establishment
1	Lachin SNS	Lachin region	20,000	1961
2	Korchay SNS	Goygol and Goranboy regions	15,000	1961
3	Bandovan SNS	Salyan region and Garadagh district	4,930	1961
4	Shaki SNS	Shaki region	10,350	1964
5	Gusar SNS	Gusar region	15,000	1964
6	Shamkir SNS	Shamkir region	10,000	1964
7	Gil island SNS	Gil island	400	1964

NO	Name of the SPNA	Administrative territory	Area(ha)	Date of establishment
8	Garayazy-Aghstafa SNS	Aghstafa region	10,000	1964
9	Barda SNS	Barda and Aghdam regions	7,500	1966
10	Zuvand SNS	Lerik,Yardimly regions	15,000	1969
11	Ordubad SNS	Ordubad region	27,869	1969
12	Ismayilli SNS	Ismayilly and Gabala region	23,438	1969
13	Qubadlı SNS	Qubadlı, Lachin region	20,000	1969
14	Lesser Gizilaghaj SNS	Lankaran region	10,700	1978
15	Dashaltı SNS	Shusha region	450	1981
16	Qızılja SNS	Gedebey region	5,135	1984
17	Arazboyu SNS	Zangilan region	2,200	1993
18	Gabala SNS	Gabala region	39,700	1993
19	Gakh SNS	Gakh region	36,836	2003
20	Hirkan SNS	Lankaran and Astara regions	1,553	2005
21	Arazboyu SNS	Nakhichevan AR	9,118	2005
22	Zagatala SNS	Zagatala and Balakan regions	6,557	2008
23	Arpachay SNS	Nakhichevan AR , Sharur region	68,911	2009
24	Rvarud SNS	Lerik region	510	2009

(Source:: MENR website)

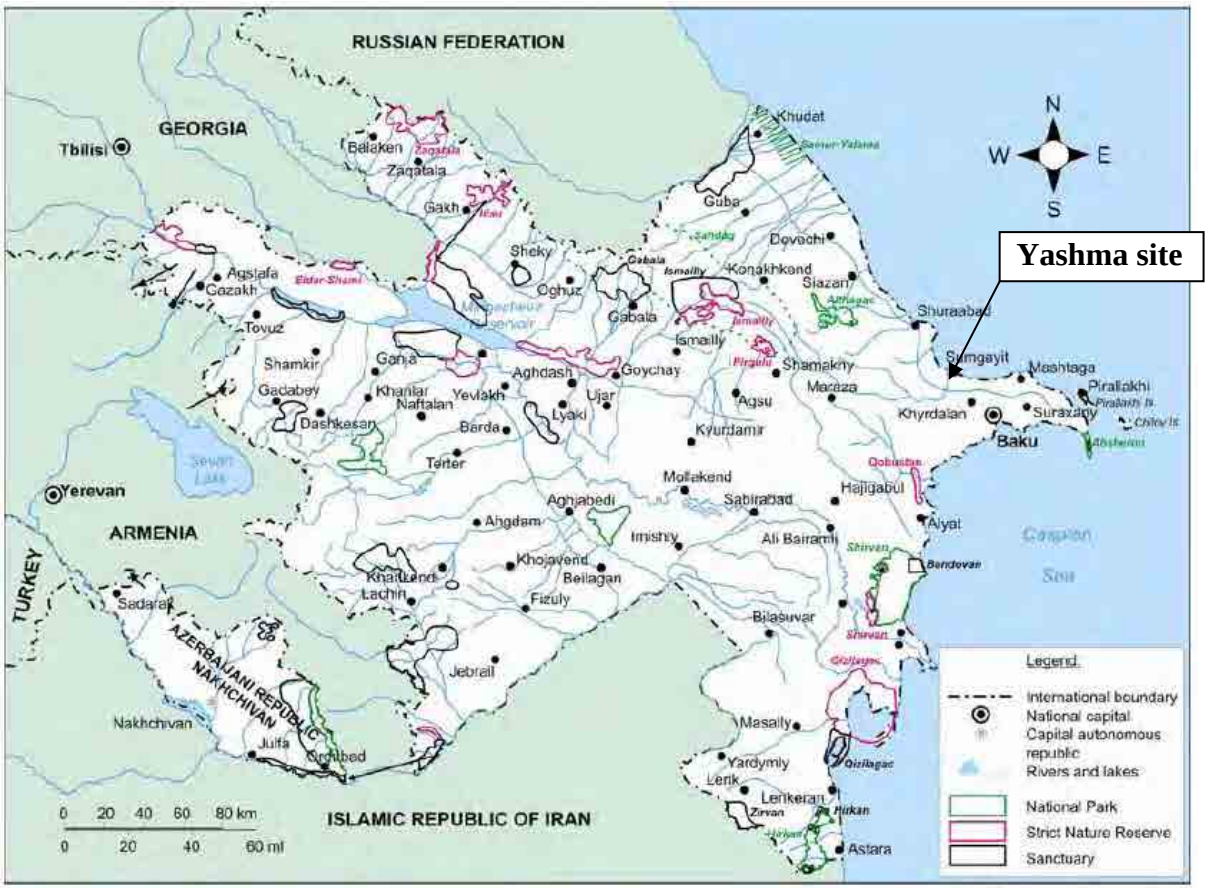


Figure 4.1-1Location of the Natural Parks and Reserves in Azerbaijan

(Source: Environmental Performance Reviews, United Nations, 2010)

4.2 Terrestrial Ecosystem

4.2.1 Terrestrial Flora

In order to obtain data on inhabiting condition of land flora and fauna as much as possible during the limited research period, the field survey was conducted in spring when plants are

luxuriant and the kinds of animals are abundant due to plenty precipitation and relatively high temperature.
Winter is severe condition for flora and fauna to live as temperature is low and wind is strong, in the project site which is no trees, no river and flat land.
Spring is also the season when migratory birds move to this area and start building their nests. Furthermore, the fact that it is semi-desert areas within and around the site is taken into account.
Existing literature was reviewed for the purpose of supplement because the field survey was conducted only during the limited period.

(1) Power plant

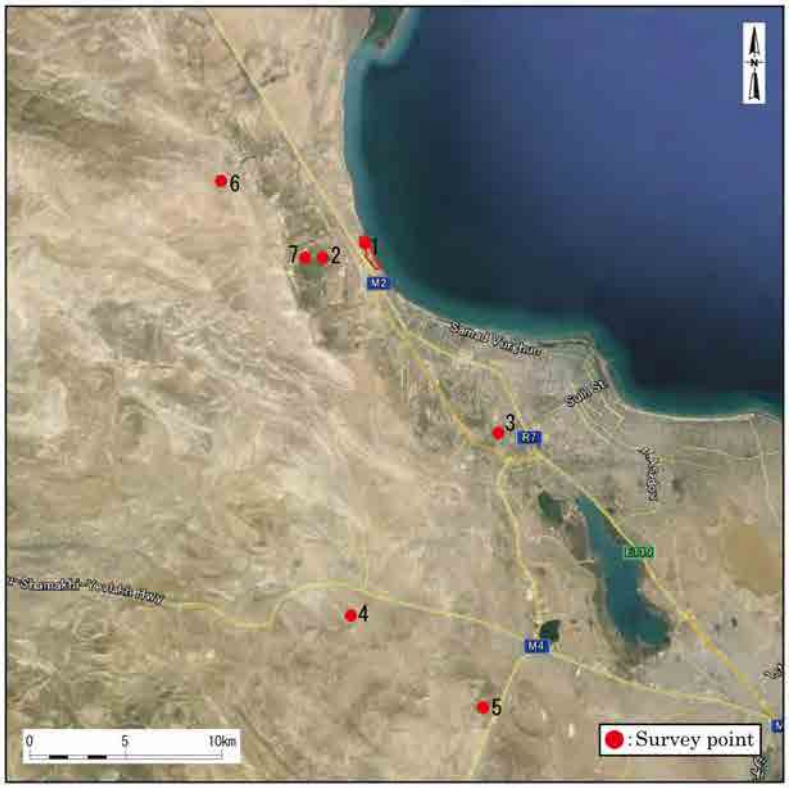
Most of the area around the thermal power plant is semi-desert area. The area is very dry, and most part of soil is salty and the flora is not rich.

According to the existing documents, as flora, inhabitants of *Convolvulus persicus, Atriplex fomini, Juncus littoralis, J.acutus Atropis gigantean, Calamagrostis gigantean, Agropyron elongatum, Acorellus pannonicus, Melilotus caspius* etc. are recorded in the sandy beach zone near the power plant project site.

Regarding flora in the land-side of the beach, *Agriophyllum arenartum, Artemisia arenaria, Elymus giganteus, Astragalus hyrcanus, Centaurea arenaria, Convolvulus erinaceus, Colligonum bakuense, C.petunnikowii, Artemisia scoparia and Scabiosa ucrainica* etc. are recorded.

According to the Red Book of Azerbaijan, three species are categorized as 'Vulnerable', and one species is categorized as 'Near Threatened'. One of these species are categorized as target species of CITES; however, there is no species designated under IUCN Red List.

Site survey of terrestrial flora was conducted from 19th to 22nd of May 2014 at 7 points around the site of the power plant, transmission line and gas pipeline. The figure below shows the locations of the 7 survey points; survey point No.1 and No.2 representing power plant site, No.3, No.4 and No.5 representing transmission line corridor, and No.6 and No.7 representing gas pipeline corridor.



(Source: JICA Study Team)

Figure 4.2-1 Survey Point of Terrestrial Flora

The table 4.2-1 shows the list of flora species observed around the project site (No.1 and No.2). 19 flora species were observed around the power plant project site during the site survey. No species is designated under Azerbaijan Red Book, IUCN Red List, nor CITES.

Table 4.2-1 List of flora species observed around the power plant site during site survey

Number	English name	Latin name	Project site	Project site	Azerbaijan Red Book	IUCN	CITES
			No.1	No.2			
1	Mediterranean hair grass	*Rostraria cristata*		●	-	-	-
2	Bulbous bluegrass	*Poa bulbosa*		●	-	-	-
3	Red anisantha	*Anisantha rubens*		●	-	-	-
4	Tufted grass	*Lolium rigidum*		●	-	-	-
5	Wheat eremopyrum	*Eremopyrum triticeum*		●	-	-	-
6	Wall barley	*Hordeum leporinum*		●	-	-	-
7	Coville's rush	*Juncus macrantherus*	●		-	-	-
8	Saltbush	*Atriplex fominii*	●		-	-	-
9	Tree glasswort	*Salsola dendroides*		●	-	-	-
10	Lucern	*Medicago minima*		●	-	-	-
11	Locoweed	*Astragalus igniarius*	●		-	-	-
12	Cut-leaved Cranesbill	*Geranium dissectum*		●	-	-	-
13	Bindweed	*Convolvulus persicus*	●		-	-	-
14	Siberian sea rosemary	*Argusia sibirica*	●		-	-	-
15	Fleawort	*Plantago notata*		●	-	-	-
16	Broad-leaved cudweed	*Filago pyramidata*		●	-	-	-
17	Ordered wormwood	*Artemisia marshalliana*	●		-	-	-

Number	English name	Latin name	Project site	Project site	Azerbaijan Red Book	IUCN	CITES
18	Clasping pepperweed	*Lepidium perfoliatum*		●	-	-	-
19	Neotorularia	*Neotorularia contortuplicata*		●	-	-	-

(2) Transmission line and substation

Corridor of transmission line takes its beginning from the "Yashma" power plant, crossing the Highway "Baku -Rostov (Russia) ", the rail-road "Baku-Makhachkala (Russia)", directing to the southwest, and crosses the Sumgait River and highway "Baku-Shemakha".

Most of transmission line corridor is located on a semi-desert area. Some places are however small meadow areas, which were formed by groundwater and rainwater.

According to the existing documents, as flora, inhabitants of 22 species are recorded along the transmission line corridor. Of those species, 3 species is categorized as ‘Vulnerable’ and one species is categorized as ‘Near Threatened’, according to Azerbaijan Red Book, and one species is targeted in CITES. There is no flora species designated under IUCN Red List.

The table 4.2-2 shows the list of flora species observed along the transmission line corridor (No.3, No.4 and No.5) during the site survey. 24 flora species were observed along the transmission line corridor, but no species is designated under Azerbaijan Red Book, IUCN Red List, nor CITES.

Table 4.2-2 List of flora species observed along transmission line corridor during site survey

No.	English name	Latin name	Transmission line	Transmission line	Transmission line	Azerbaijan Red Book	IUCN Red List	CITES
			No.3	No.4	No.5			
1	Mediterranean hair grass	*Rostraria cristata*		●	●	-	-	-
2	Bulbous bluegrass	*Poa bulbosa*			●	-	-	-
3	Red anisantha	*Anisantha rubens*		●	●	-	-	-
4	Tufted grass	*Lolium rigidum*		●	●	-	-	-
5	Wheat eremopyrum	*Eremopyrum triticeum*				-	-	-
6	Wall barley	*Hordeum leporinum*		●	●	-	-	-
7	Disorderly seepweed	*Suaeda confusa*	●			-	-	-
8	Microphyll seepweed	*Suaeda microphylla*	●	●		-	-	-
9	Tree glasswort	*Salsola dendroides*	●			-	-	-
10	Tree glasswort	*Salsola nodulosa*	●	●	●			
11	Lucern	*Medicago minima*		●	●	-	-	-
12	Cut-leaved Cranesbill	*Geranium dissectum*		●	●	-	-	-
13	Fleawort	*Plantago notata*		●	●	-	-	-
14	Broad-leaved cudweed	*Filago pyramidata*			●	-	-	-
15	Wormwood	*Arthemisia lerchiana*	●	●	●	-	-	-
16	Smallflower hawksbeard	*Crepis pulchra*		●		-	-	-
17	Persian marigold	*Calendula persica*			●	-	-	-
18	Linear koelpinia	*Koelpinia linearis*		●		-	-	-
19	Dwarf salsify	*Tragapagon pusillus*			●	-	-	-
20	Nettle-leaved goosefoot	*Chenopodium murale*		●		-	-	-
21	Caspian kalidium	*Kalidium caspicum*	●			-	-	-
22	Clasping pepperweed	*Lepidium perfoliatum*		●	●	-	-	-
23	Neotorularia	*Neotorularia contortuplicata*		●	●	-	-	-
24	Plantain	*Psylliostachys spicata*	●			-	-	-

(3) Gas pipeline

Corridor of gas pipeline takes its beginning from the point at the Agdere mountain village at an altitude of 734 m above sea level, and reaches "Yashma" power plant area on the Caspian Sea coast.

The corridor of the gas pipeline mainly goes through semi-desert and desert areas. In this respect and being located close to the gas pipeline corridor, the area of gas pipeline corridor is identical to the gas pipeline corridor. Therefore, same literature sources were used to identify flora and fauna species of these two areas.

According to the existing documents, as flora, inhabitants of 21 species are recorded along the gas pipeline corridor. Of those species, 3 species are categorized as 'Vulnerable', according to Azerbaijan Red Book, and one species is targeted in CITES. There is no flora species designated under IUCN Red List.

The table 4.2-3 shows the list of flora species observed along the gas pipeline corridor (No.6 and No.7) during the site survey. 30 flora species were observed along the gas

pipeline corridor, but no species is designated under Azerbaijan Red Book, IUCN Red List, nor CITES.

Table 4.2-3 List of flora species observed along the gas pipeline corridor during site survey

No.	English name	Latin name	Gas pipeline	Gas pipeline	Azerbaijan Red Book	IUCN	CITES
			No.6	No.7			
1	Mediterranean hair grass	*Rostraria cristata*		●	-	-	-
2	Aeluropus grass	*Aeluropus litoralis*	●		-	-	-
4	Red anisantha	*Anisantha rubens*		●	-	-	-
5	Tufted grass	*Lolium rigidum*		●	-	-	-
7	Wall barley	*Hordeum leporinum*		●	-	-	-
11	Disorderly seepweed	*Suaeda confusa*		●	-	-	-
12	Microphyll seepweed	*Suaeda microphylla*		●	-	-	-
13	Tree glasswort	*Salsola dendroides*	●	●	-	-	-
14	Tree glasswort	*Salsola nodulosa*		●			
15	Lucern	*Medicago minima*		●	-	-	-
17	Camel's thorns	*Alhagi pseudalhagi*	●		-	-	-
18	Cut-leaved Cranesbill	*Geranium dissectum*		●	-	-	-
19	Saltcedar	*Tamarix ramosissima*	●		-	-	-
22	Fleawort	*Plantago notata*		●	-	-	-
23	Broad-leaved cudweed	*Filago pyramidata*		●	-	-	-
24	Wormwood	*Arthemisia lerchiana*	●	●	-	-	-
25	Smallflower hawksbeard	*Crepis pulchra*		●	-	-	-
26	Linear koelpinia	*Koelpinia linearis*		●	-	-	-
27	Nettle-leaved goosefoot	*Chenopodium murale*		●	-	-	-
28	Caspian kalidium	*Kalidium caspicum*		●	-	-	-
29	Clasping pepperweed	*Lepidium perfoliatum*		●	-	-	-
30	Neotorularia	*Neotorularia contortuplicata*		●	-	-	-

4.2.2 Terrestrial Fauna

(1) Power plant

1) Amphibian and Reptile

According to the existing documents, as Amphibian, inhabitants of two species are recorded and 21 Reptile species are recorded around the power plant project site.
Of these species, one species is categorized as ‘Vulnerable’, according to the Red Book of Azerbaijan. According to IUCN Red List, one species is categorized as ‘Vulnerable’, one species as ‘Near Threatened’ and five species as ‘Least Concern’. In addition, two species are targeted in CITES.

Site survey of terrestrial fauna including amphibian, reptile, birds, and mammals was conducted from 19th to 22th of May 2014 at 7 points around the site of the power plant, transmission line and gas pipeline, which is at the same survey points as the terrestrial flora survey points. The figure 4.2-1 shows the locations of the 7 survey points; survey point No.1 and No.2 representing power plant site, No.3, No.4 and No.5 representing transmission line corridor, and No.6 and No.7 representing gas pipeline corridor.

According to the site survey result, fauna covered by the Azerbaijan Red List are not observed.

Additionally, this survey does not find precious species which are targeted by CITES and which are categorized into 'Endangered', 'Vulnerable', 'Near Threatened' of IUCN.
One species of Amphibian (*Pelophylax ridibundus*), which is categorized as 'Least Concern' of IUCN Red List, was observed at survey point No.1.
With regards to Reptile, Lacerta strigata, which is 'Least Concern' under IUCN Red List, was observed at the survey point No.1 and No.2

2) Bird

According to the existing documents, as birds, inhabitants of no less than 159 species are recorded around the power plant project site. Among the birds 39 species nest, 27 species appear in the winter, 81 are over-migrate, and 8 can be seen occasionally in the area.
According to the Red Book of Azerbaijan, one species is recorded as 'Endangered', one species as 'Near Threatened' and 11 species as 'Least Concern'. Of these species, 15 species are targeted in CITES and one species is categorized as 'Critically Endangered', two species as 'Endangered' two species as 'Vulnerable', five species as 'Near Threatened' and 115 species as 'Least Concern', according to the Red List of IUCN respectively.

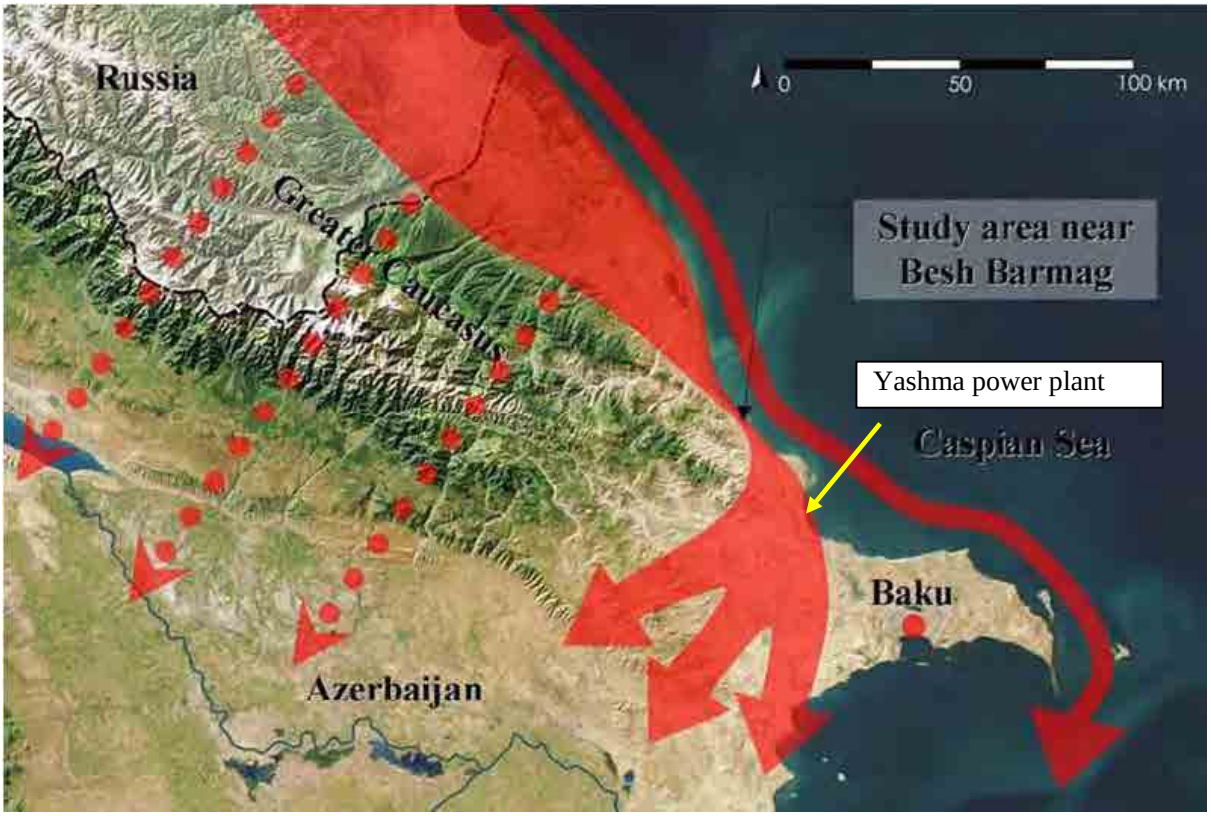
18 species were observed around the power plant site at either No.1 or No.2 survey point. However, they are not covered by Azerbaijan Red List.
Additionally, this site survey does not find any precious species which are targeted by CITES and which are categorized into 'Endangered', 'Vulnerable' and 'Near Threatened' of IUCN.
All of the species are categorized as 'Least Concern', according to the IUCN Red List.

Table 4.2-4 List of Bird species observed around the power plant site during site survey

No.	English name	Latin name	Project site	Project site	Azerbaijan Red Book	IUCN	CITES
			No.1	No.2			
1	House sparrow	*Passer domesticus*	●		-	Least Concern	-
2	Carrion crow	*Corvus corone*		●	-	Least Concern	-
3	Rock dove or feral pigeon	*Columba livia*	●		-	Least Concern	-
4	Blackbird	*Turdus merula*		●	-	Least Concern	-
5	Sky lark	*Alauda arvensis*		●	-	Least Concern	-
6	Crested lark	*Galerida cristata*	●	●	-	Least Concern	-
7	Desert wheater	*Oenanthe deserti*	●	●	-	Least Concern	-
8	Isabelline wheater	*Oenanthe isabellina*	●	●	-	Least Concern	-
9	Marsh warbler	*Acrocephalus palustris*	●		-	Least Concern	-
10	Little tern	*Sterna albifrons*	●		-	Least Concern	-
11	Sandwich tern	*Sterna sandvicensis*	●		-	Least Concern	-
12	Swallow	*Hirundo rustica*	●		-	Least Concern	-
13	Kestrel	*Falco tinnunculus*	●		-	Least	-

No.	English name	Latin name	Project site	Project site	Azerbaijan Red Book	IUCN	CITES
						Concern	
14	Magpie	*Pica pica*		●	-	Least Concern	-
15	Little swift	*Apus affinis*		●	-	Least Concern	-
16	Swift	*Apus apus*	●	●	-	Least Concern	-
17	Herring gull	*Larus argentatus*	●		-	Least Concern	-
18	Bee eater	*Merops apiaster*		●	-	Least Concern	-

Among 18 species observed, 3 species *Alauda arvensis, Sterna albifrons* and *Hirundo rustica* are migratory birds. According to the literature survey, migratory birds migrate from north, Russia or Eurasia to the south during autumn-winter period. Many of the migratory birds stay or stop over at wet lands or deltas of large rivers along the coast of Caspian Sea. The figure below shows migration routes (red-color) around the project site for the migratory birds to take from Russia to the wetlands and deltas of Caspian Sea located south of Azerbaijan.



*Broad red line: main migration route
*Narrow red line: coastal water bird migration route
*Dotted red line: minor migration route

Figure 4.2-2 Routes of Migration Birds (Heiss & Gauger, 2007)

3) Mammal

According to the existing documents, as Mammal, inhabitants of 20 species are recorded around the power plant project site. They can be classified into five groups; one species of Insectivora, six of Chiroptera, one of Logomorpha, eight of Rodentia, and four of Carnivora.

According to the red list of Azerbaijan, one species is categorized as 'Endangered', one species as 'Vulnerable' and one species as 'Least Concern'. Of these species, one species is categorized as 'Endangered', two species as 'Vulnerable' and 17 species as 'Least Concern', according to Red List of IUCN respectively. In addition, three species are targeted in CITES.

According to the site survey result, no mammal species were observed around the power plant site survey point (No.1 or No.2).

(2) Transmission line and substation

1) Amphibian and Reptile

According to the existing documents, as Amphibian, inhabitants of two species are recorded and 13 Reptile species are recorded along the transmission line corridor.
Of those species, one Reptile species is categorized as 'Vulnerable', according to the Red Book of Azerbaijan, According to IUCN Red List, one Reptile species is categorized as 'Vulnerable', one Reptile species as 'Near Threatened', and 2 Amphibian species and 4 Reptile species as 'Least Concern'. In addition 2 Reptile species is targeted in CITES.

According to the site survey result, one species of Amphibian (*Pelophylax ridibundus*), which is categorized as 'Least Concern' of IUCN Red List, was observed at survey point No.3. With regards to Reptile, 3 species were observed at the survey point No.3 and No.5 as shown in the table below. One species is categorized as 'Vulnerable' according to the Red Book of Azerbaijan ,IUCN Red List and targeted in CITES., one Reptile species 'Least Concern' of IUCN Red List

Table 4.2-5 List of Reptile species observed along transmission line corridor during site survey

No.	English name	Latin name	Transmission line	Transmission line	Transmission line	Azerbaijan Red Book	IUCN	CITES
			No.3	No.4	No.5			
1	Spur-thighed tortoise	*Testudo graeca*			●	Vulnerable	Vulnerable	+
2	Gecko	*Gymnodactylus caspius*	●			-	Not Applicable	-
3	Lizard	*Lacerta strigata*	●		●	-	Least Concern	-

2) Bird

According to the existing documents, as birds, inhabitants of 58 species are recorded along the transmission line corridor.
Of those species, one species is categorized in 'Endangered', one species as 'Near Threatened' and 6 species as 'Least Concern', according to Azerbaijan Red Book.
According to IUCN Red List, one species is categorized as 'Endangered', 3 species as 'Near Threatened' and 54 species as 'Least Concern'. In addition, 12 species are targeted in CITES.

According to the site survey result, 19 species were observed along the transmission line corridor at No.3, No.4 or No.5 survey point.
6 species *Corvus frugilegus*、*Melanocorypha calandra, Sterna hirundo, Delichon urbicum, Hirundo rustica, Motacilla alba* are migratory birds.

One species, *Buteo rufinus*, is categorized as 'Endangered', according to Azerbaijan Red Book, and all the 19 observed species are categorized as 'Least Concern', according to IUCN Red List. In addition, 2 species are targeted in CITES.

Table 4.2-6 List of Bird species observed along transmission line corridor during site survey

No.	English name	Latin name	Transmission line	Transmission line	Transmission line	Azerbaijan Red Book	IUCN	CITES
			No.3	No.4	No.5			
1	Long-legged buzzard	*Buteo rufinus*	●			Endangered	Least Concern	+
2	House sparrow	*Passer domesticus*		●	●	-	Least Concern	-
3	Raven	*Corvus corax*		●	●	-	Least Concern	-
4	Rock dove or feral pigeon	*Columba livia*		●	●	-	Least Concern	-
5	Turtle dove	*Streptopelia turtur*		●		-	Least Concern	-
6	Rook	*Corvus frugilegus*		●		-	Least Concern	-
7	Blackbird	*Turdus merula*	●			-	Least Concern	-
8	Calandra lark	*Melanocorypha calandra*	●			-	Least Concern	-
9	Crested lark	*Galerida cristata*	●	●	●	-	Least Concern	-
10	Isabelline wheater	*Oenanthe isabellina*			●	-	Least Concern	-
11	Sandwich tern	*Sterna sandvicensis*		●		-	Least Concern	-
12	Common tern	*Sterna hirundo*		●		-	Least Concern	-
13	House martin	*Delichon urbicum*	●			-	Least Concern	-
14	Swallow	*Hirundo rustica*		●	●	-	Least Concern	-
15	Kestrel	*Falco tinnunculus*	●		●	-	Least Concern	-
16	Magpie	*Pica pica*	●			-	Least Concern	-
17	Swift	*Apus apus*	●	●	●	-	Least Concern	-
18	Pied wagtail, white wagtail	*Motacilla alba*		●	●	-	Least Concern	-
19	Hoopo ovok	*Upupa epops*			●	-	Least Concern	+

3) Mammal

According to the existing documents, as birds, inhabitants of 18 species are recorded along the transmission line corridor.

Of those species, no species is designated under Azerbaijan Red Book. According to IUCN Red List, one species is categorized as 'Vulnerable' and 16 species as 'Least Concern'. In addition, 2 species are targeted in CITES.

According to the site survey result, one species (*Microtus socialis*) were observed along the transmission line corridor at survey point No.3 and No.4 and which is

categorized as ‘Least Concern’ of IUCN Red List but not designated under Azerbaijan Red Book nor CITES, was observed.

(3) Gas pipeline

1) Amphibian and Reptile

According to the existing documents, as Amphibian, inhabitants of two species are recorded and 13 Reptile species are recorded along the gas pipeline corridor.
Of those species, one Reptile species is categorized as ‘Vulnerable’, according to the Red Book of Azerbaijan, According to IUCN Red List, one Reptile species is categorized as ‘Vulnerable’, one Reptile species as ‘Near Threatened’, and 2 Amphibian species and 4 Reptile species as ‘Least Concern’. In addition 2 Reptile species is targeted in CITES.

According to the site survey result, no species of Amphibian was observed at survey point No.6 or No.7. With regards to Reptile, 6 species were observed at the survey point No.6 and No.7 as shown in the table below. One species is categorized as ‘Vulnerable’ according to the Red Book of Azerbaijan , IUCN Red List and targeted in CITES., two species ‘Near Threatened) and one species ‘Least Concern’ of IUCN Red List

Table 4.2-7 List of Amphibian/Reptile species observed along gas pipeline corridor during site survey

No.	English name	Latin name	Gas pipeline	Gas pipeline	Azerbaijan Red Book	IUCN	CITES
			No.6	No.7			
1	Spur-thighed tortoise	*Testudo graeca*		●	Vulnerable	Vulnerable	+
2	Lizard	*Lacerta strigata*	●	●	-	Least Concern	-
3	European glass lizard	*Ophisaurus apodus*	●		-	-	-
4	Snake-eyed lizard	*Ophisops elegans*		●	-	-	-
5	Four-lined snake	*Elaphe quatuorlineata*		●	-	Near Threatened	-
6	Blunt-nosed viper	*Vipera lebetina obtusa*		●	-	Near Threatened	+

2) Bird

According to the existing documents, as birds, inhabitants of 58 species are recorded along the gas pipeline corridor.
Of those species, one species is categorized in ‘Endangered’, one species as ‘Near Threatened’ and 6 species as ‘Least Concern’, according to Azerbaijan Red Book. According to IUCN Red List, one species is categorized as ‘Endangered’, 3 species as ‘Near Threatened’ and 54 species as ‘Least Concern’. In addition, 12 species are targeted in CITES.

According to the site survey result, 8 species were observed along the gas pipeline corridor at No.6 or No.7 survey point. One species, *Buteo rufinus*, is categorized as ‘Endangered’ and one species, *Haliaeetus albicilla*, is categorized as ‘Least Concern’, according to Azerbaijan Red Book, and all the 18 observed species are categorized as ‘Least Concern’, according to IUCN Red List. With regards to CITES, no species are targeted.

Table 4.2-8 List of Bird species observed along gas pipeline corridor during site survey

No.	English name	Latin name	Gas pipeline	Gas pipeline	Azerbaijan Red Book	IUCN	CITES
			No.6	No.7			
1	Long-legged buzzard	*Buteo rufinus*	●	●	Endangered	Least Concern	+
2	White-tailed eagle	*Haliaeetus albicilla*		●	Least Concern	Least Concern	+
3	Tree sparrow	*Passer montanus*	●	●	-	Least Concern	-
4	Calandra lark	*Melanocorypha calandra*	●		-	Least Concern	-
5	Crested lark	*Galerida cristata*		●	-	Least Concern	-
6	Isabelline wheater	*Oenanthe isabellina*		●	-	Least Concern	-
7	Swallow	*Hirundo rustica*	●		-	Least Concern	-
8	Kestrel	*Falco tinnunculus*	●	●	-	Least Concern	-

3) Mammal

According to the existing documents, as birds, inhabitants of 18 species are recorded along the gas pipeline corridor.

Of those species, no species is designated under Azerbaijan Red Book. According to IUCN Red List, one species is categorized as 'Vulnerable' and 16 species as 'Least Concern'. In addition, 2 species are targeted in CITES.

According to the site survey result, 3 species were observed along gas pipeline corridor. Of them, no species were designated under Azerbaijan Red Book. According to IUCN Red List, all the 3 species are categorized as 'Least Concern'. In addition, 2 species are targeted in CITES.

4.3 Marine Ecosystem

4.3.1 Marine Flora

As mention in the survey of water quality, strong wind and turbulent waves around there in winter made it impossible to conduct survey by small boat.

In order to obtain data on inhabiting condition of marine flora and fauna as much as possible during the limited research period, the field survey was conducted in spring when the number of phytoplankton, marine plants, and benthos begin increasing due to relatively high water temperature.

Existing literature was reviewed for the purpose of supplement because the field survey was conducted only during the limited period..

(1) Power plant

a. Phyto-plankton

According to the existing documents, as Phyto-plankton, inhabitants of 225 species and subspecies are recorded at Caspian Sea in front of the power plant. They include 60 species of Cyanophyta , 90 of Bacillariophyta, 34 of Pyrrophyta , 4 of Euglenophyta , 37 of Chlorophyta. Only 18% of the phytoplankton has a marine origin, while the rest are freshwater water species. Therefore, the coastal area of the Middle Caspian, which consists of saline water, has a poor phytoplankton composition.

Phyto-plankton was observed in the intake area for cooling water and outlet for thermal discharge of the project shown in Figure 4.3-1. The survey was conducted in 15th to 16 th of May 2014.



Figure 4.3-1 Survey location (Phytoplankton)

The table 4.3-1 shows the species of Phyto-plankton observed in these points.

Around the marine area in the front of the power plant project site, 14 species were found at the intake point and 11 species were found at the coastal facing area (around water outlet area).

Table 4.3-1 Species of Phytoplankton in the Survey Points

Latin name	Intake point	coastal facing area
	No1	No.2
Cyanophyta		
Aphanizomen flos-aquae	+	+
Nodularia harveyana	+	
Bacillariophyta		
Actinocyclus ehrenbergii	+	
Rhizosolenia calcar-avis	+	+
Rhizosolenia fragissima	+	+
Thalassiosira variabilis	+	+
Chaetoceros subtilis	+	+
Chaetoceros wighamii	+	+
Thalassionema nitzshioides	+	+
Coscinodiscus radiatus	+	+
Sceletonema costatum	+	
Dinophyta		
Prorocentrum cordata	+	+
Goniaulax digitale	+	+
Goniaulax polyedra	+	

b. Sea grass

According to the existing documents, as Sea grass, inhabitants of 33 species of Chorophycophyta, 24 of Rhodophycophyta, and 13 of Phaeophycophytaare recorded at Caspian Sea in front of the power plant.

As Sea grass, *Zostera noltii* inhabits the coastal area of the Middle Caspian, which in places forms extensive areas. It usually grows at a depth of 1.5-5 m, mainly in the sand, sand-shell, and rarely in silt sediments

During marine biological research, on the coastal line, there are significant accumulations of *Zostera noltii* (Figure.4.3-2).

Zostera noltii is removed by grazing or wave action during the winter and overwinters as a rhizome and shoot fragments, which enables recruitment and re-growth in the spring.

Zostera noltii is categorized as 'Least Concern' in red list of IUCN , but is not designated under Azerbaijan Red Book.



Figure 4.3-2 Sea Grass on the Coastal Line

4.3.2 Marine Fauna

a. Zoo-plankton

According to the existing documents, as Zoo-plankton, inhabitants of 189 species are recorded at Caspian Sea in front of the power plant. Among them, the most diverse are Infusoria (104 species) followed by Cladocera (36), Copepoda (23), Rotatoria (9), Mysidacea (6), Amphipoda (6), Cumacea (5). Other taxonomic groups are represented with 1-2 species.

Polyphemus exiguus, Podonevadne trigona pusilla, P.trigona typica, P.camptonyx angusta, Evadne anonyx, Synchaeta vorax, S.neapolitana are dominant species in zooplankton of the Middle Caspian, where they occur mostly in the coastal shallow water areas.

Zoo-plankton was observed in the intake area for cooling water and outlet for thermal discharge of the project shown in Figure 4.3-3. The survey was conducted in 15th to 16 th of May 2014.



Figure 4.3-3 Survey Location (Zoo-plankton)

The table 4.3-2 shows the species of Zoo-plankton observed in these points.

Around the marine area in the front of the power plant project site, 17 species were found at the intake point and 14 species were found at the coastal facing area (around water outlet area).

Moreover, near the intake point fish eggs in the composition of the zooplankton presumably belong to the Caspian kilka (*Clupeonella caspia*), which in the end of spring and early summer spawns in shallow waters at the western part of the Middle Caspian Sea.

Table 4.3-2 Species of Phytoplankton in Survey Points

Latin name	Intake point	coastal facing area
	No1	No.2
Hydrozoa		
Moerisia pallasi	+	
Scyphozoa		
Aurelia aurita	+	
Ctenophora		
Mnemiopsis leidyi	+	+
Cumacea		
Pterocuma pectinata	+	+
Stenocuma diastyloides	+	+
S. gracilis	+	
Amphipoda		
Pseudalibrotus caspius		+
Cladocera		
Polyphemus exiguus	+	+
Cercopagus prolongata	+	+
C. socialis		+
Pleopis polyphemoides	+	
Evadne anonyx	+	+
Podonevadne trigona	+	
Copepoda		
Limnocalanus grimaldii	+	+

Latin name	Intake point	coastal facing area
	No1	No.2
Calanipeda aquae-dulcis	+	+
Eurytemora grimmi	+	+
E. minor	+	+
Halicyclops sarci	+	
Acartia clausi	+	+

b. Macro Benthos

According to the existing documents, as Macro Benthos, inhabitants of 112 species are recorded at Caspian Sea in front of the power plant. Mollusks constitute 95.3% of total zoobenthos biomass; among mollusks the most developed are *Mytilaster lineatus* and *Abra ovata*. Both these species have been introduced into the Caspian from the Black sea.

Macro Benthos was observed in the intake area for cooling water and outlet for thermal discharge of the project shown in Figure 4.3-4.



Figure 4.3-4 Survey Location (Macro Benthos)

The table 4.3-3 shows the species of Macro benthos observed in these points.

Around the marine area in the front of the power plant project site, 12 species were found at the intake point and 8 species were found at the coastal facing area (around water outlet area).

Table 4.3-3 Species of Macro Benthos in the Survey Points

Latin name	Intake point	coastal facing area
Cordylophora caspia	+	
Nereis diversicolor	+	+
Conopeum seurati	+	
Cerastoderma rhomboids	+	+
Abra ovate	+	
Didacna pyramidata	+	+
Mytilaster lineatus		+

Latin name	Intake point	coastal facing area
Balanus improvises	+	+
Schizhorynchus eudorelloides	+	+
Stenicuma diastiloides	+	
Pontoporeia affinis	+	+
Pontogammarus meoticus	+	
Niphargoides compressus		+
Rhithropanopeus harrisii	+	

c. Fish

According to the existing documents, as Fishes, inhabitants of 62 species which consist of 10 families described below are recorded at Caspian Sea in front of the power plant.
10 families are explained here. First of all, four species belong to family STURGEONS. One of them, *Acipenser nudiventris derjavini* is designated in Red Book of Azerbaijan (Fauna, 2013).

Secondly, nine species are in the family CLUPEIDS which is represented with two genus; Clupeonella (kilka) and Alosa (shad). Thirdly, three species are grouped into the family SALMONIDS. Caspian salmon (*Salmo trutta caspius*) is listed in the Red Book of Azerbaijan (Fauna, 2013).
Fourthly, 12 species are in the family CYPRINIDS, three of which are on the Red Book of Azerbaijan; Chanari barbel (*Barbus capito*), Caspian barbell (*B. brachycephalus caspius*), and White-eyed bream (*A.sapa bergi*). One species in the family EELS, one in the PIPEFISHES two in the MULLETS, one in the SILVERSIDES and 26 in the GOBIIDS are identified in the Caspian. Lastly, sea zander (Sander marina) in the PERCHES is included in the Red Book of Azerbaijan.

In addition to these, among invertebrates inhabiting in the Middle Caspian, three species are used as food.

The biology of Red Data Species stated above is outlined in a following table. These species, which range from river to the sea, move from the sea to rivers and estuaries to lay eggs and grow up around the area where a river meets the sea.
There is no river flowing throughout a year around 30km of the site. Therefore, the sea area in front of the site cannot be considered as important habitats of these species.

Table 4.3-4 Biology of Red Data Fish in Azerbaijan

Red Data fish	Outline of biology
Acipenser nudiventris derjavini	Lay eggs in rivers in spring. Juvenile fish grow up in rivers for 2-8 years and move to the sea. Basically, occur in blackish waters, where a river meets the sea, and the sea. Run to the river to lay eggs at 6-18 ages. This fish is observed largely in the middle Caspian and South Caspian sea and hardly observed in the North Caspian sea.
Salmo trutta caspius	Lay eggs in rivers in autumn. Some juvenile fish move to the sea in spring and others stay in rivers. This fish is prefers to live in the South, West and South West of the Caspian sea
Barbus capito	Feed themselves mainly around estuaries. Move to side streams in the end of summer or autumn and lay eggs.

Red Data fish	Outline of biology
	This fish distribute in river basin of the Southern and Western Caspian sea
Barbus. brachycephalus caspius	Lay eggs in rivers and around estuaries from the end of April to the end of August. Become adult fish at 6-8 ages. This fish distribute in river basin of the Southern and Western Caspian sea
Abramis.saa bergi	Occur in blackish waters in downriver and estuaries. Lay eggs on underside of locks and waterweed in rivers flowing fast. This fish distribute in the Southern and Western Caspian sea
Sander marina	Occur in rivers and the sea whose salinity is 1~2ppt and can be often observed near estuaries and in downstream. Lay eggs in estuaries in July and August. Eggs hatch 2 or 3 days later. This fish is founded in All Caspian sea

During marine biological research, six species were found, and hearing investigation was also conducted.

The table 4.3-4 shows the species of Fish and Megalo-benthos observed in the project site and recorded in the surrounding area.

Table 4.3-5 Species of Fish in the Power Plant Site

English name	Latin name	coastal facing area	IUCN	Azerbaijan Red Book	CITEC
Caspian shad	*Alosa caspia*	+	Least Concern		
Caspian roach	*Rutilus caspicus*	+	Least Concern		
Golden mullet	*Liza auratus*	+			
Leaping gray mullet	*L. saliens*.	+			
Caspian round goby	*Neogobius melanostomus affinis*	+			
Bighead goby	*N.kesslery gorlap*	+			
Black-back shad	*A.kessleri kessleri*				
Kutum	*R.frisii kutum*				
Eastern bream	*Abramis brama orientalis*				
Common carp	*Cyprinus carpio*				
Deep-water goby	*Neogobius bathybius*				

(Source: Study Team)

d. Marine mammal

According to the existing documents, Caspian Seal (*Phoca caspica*) concentrates in the North Caspian, where mating, breeding and molting take place in the autumn-winter period, and spreads over the feeding areas in the northern part of the Middle Caspian where includes the area near the power station.

Recent surveys revealed no haul-out sites located close to the project site, and feeding takes place in open waters.

The field survey found Caspian Seal at about 100m offshore from the intake point.

Caspian Seal is categorized as 'Endangered' in red list of Azerbaijan and IUCN.

EIA

Chapter 5

Chapter 5

EXISTING ENVIRONMENT: SOCIO-ECONOMIC

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5. EXISTING ENVIRONMENT: SOCIO-ECONOMIC

5.1 General

Power plant will be located at Sumgayit district in Absheron Economic and administration regions.

Transmission line and substation will be almost passed Absheron district.

Gas pipeline will be passed Khizi district in Guba-Khachmaz Economic and administration regions.

5.2 Land Use

5.2.1 Power plant

The site location is at the north side of the base of Absheron Peninsula, with Caspian Sea on the east, Sumgayıt city on the south

The project site is governmental land and not been personally used for farm land and residential area, etc. The ocean side of the site is sand beach, with only little grass and shrub, no wood were observed.

There are a highway and a railway in the west from the site and semi-desert area behind them. Several houses and commercial facilities such as a petrol station exist in the west and south. The nearest residential area of Zeynaladbin Tagiyev Settlement, is located about 400m to the south from the site boundary. Yashma settlement is about 2km away on the north side.

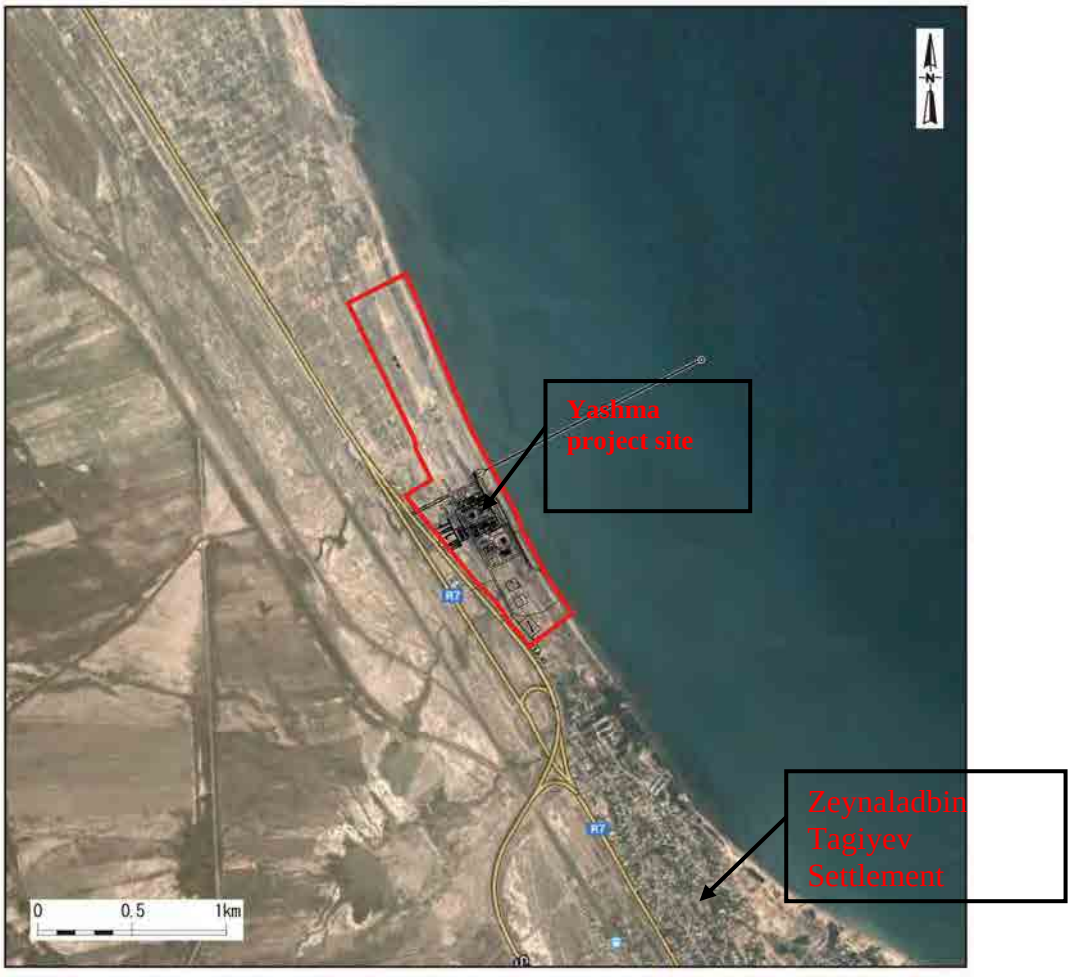


Figure 5.2-1The Plan of Yashma Project Site and the Surrounding Area

	
The Proposed Site Observed from the National Route on the West of the Site	The Proposed Site Observed from the National Route on the West of the Site
	
The Coastal Area of the Site	The Coastal Area of the Site

Figure 5.2-2 Land use of the project site

5.2.2 Transmission line and substation

As shown in Figure 5.2-3, the project proponent is planning a transmission system consisting of the existing substation and the newly-introduced substations (2 locations).

Sulu Tepe substation are 40km south-southeast of the project site, Sumgayıt substation (in the industrial complex) are newly introduced. The existing substation is Yashma substation 2km northeast of the site.

New transmission line of 330kV or 220kV will be established. Places to be avoided are as follows:

Residential areas, farm land, churchyards, national parks, heritage sites, protected areas, forests, cemeteries, rivers, lakes, railways, and highways, etc.

The nearest settlement of Sulu Tepe substation is Sulu Tepe Baladjar settlement. This settlement is over 2km away from Sulu Tepe substation.

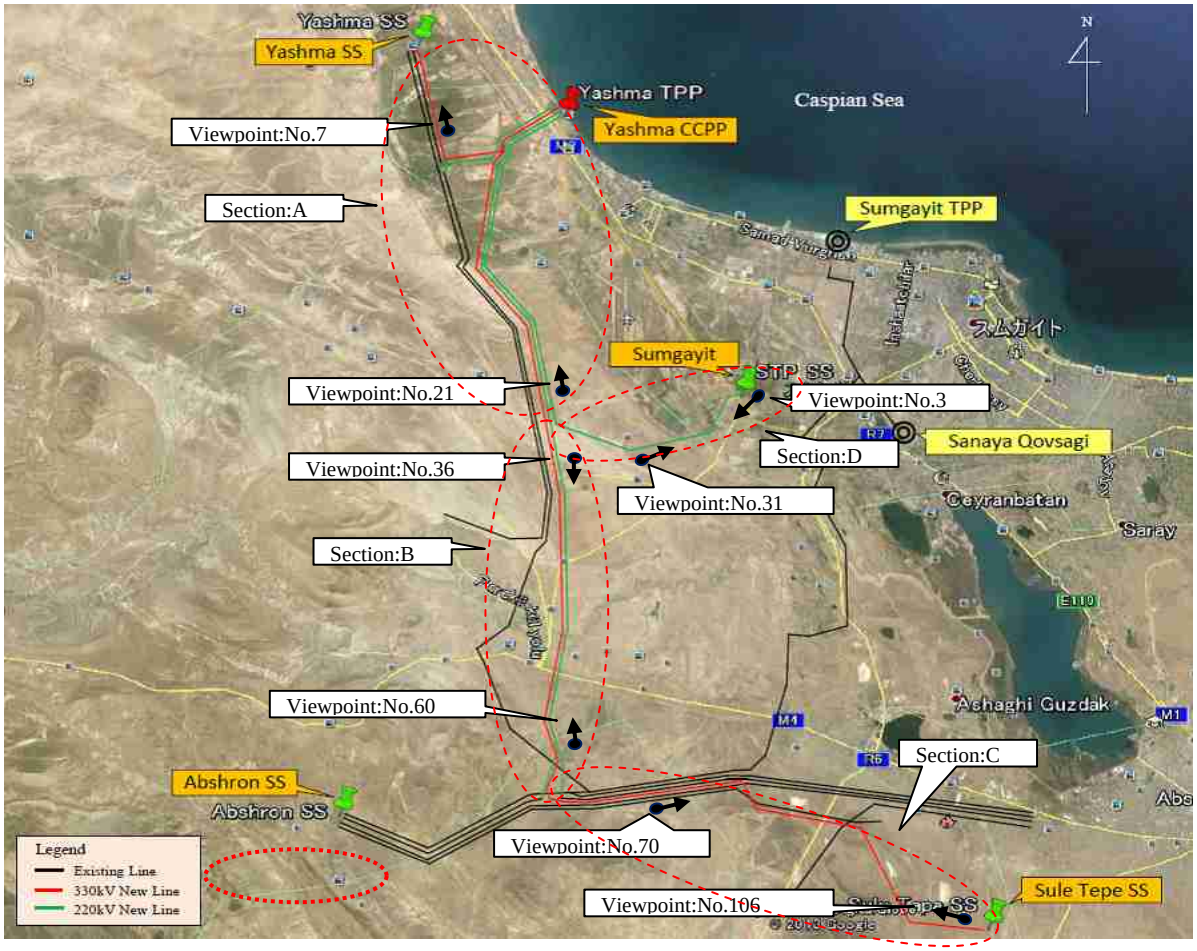


Figure 5.2-3 Total Plan of the Transmission Line and Substation

Pictures in Figure 5.2-4 show the existing condition of the main sections in Figure 5.2-3. Outlines of each section are described below:

- Section A

  There are no places that need to be avoided. Almost all the areas surrounding the transmission lines are wastelands.

- Section B

  There are no places that need to be avoided. Almost all the areas surrounding the transmission lines are wastelands.

- Section C

  There are no places that need to be avoided. Almost all the areas surrounding the transmission lines are wastelands.

- Section D

  There are no places that need to be avoided. Almost all the areas surrounding the transmission lines are wastelands.



(Fig.5.2-3,Viewpoint:No.7)



(Fig.5.2-3,Viewpoint:No.21)

Typical Situation of Section A



(Fig.5.2-3,Viewpoint:No.36)



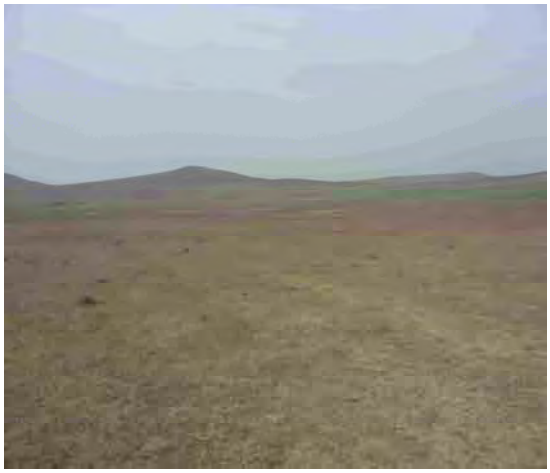
(Fig.5.2-3,Viewpoint:No.60)

Typical Situation of Section B

Figure 5.2-4(1) Pictures of Typical section of Transmission line



(Fig.5.2-3,Viewpoint:No.70)



(Fig5.2-3,Viewpoint:No.106)

Typical Situation of Section C



(Fig.5.2-3,Viewpoint:No.31)



(Fig.5.2-3,Viewpoint:No.3)

Typical Situation of Section D

Figure 5.2-4(2) Pictures of Typical section of Transmission line

・**Yashma Substation**

Pictures of equipment and planned space for the new receiving unit are shown in Figure5.2-5. The planned space is flat and there should be no obstacles in the construction of new unit.



(a) Planned space for new receiving unit



(b) Existing 330kV Air insulated switchgear



(c) Existing 330kV Transformer



(d) Existing 330kV Circuit Breaker

Figure 5.2-5 Pictures in Yashma S/S

・**Sulu Tepe Substation**

The construction site is shown in Figure 5.2-6. The site and surrounding area is the public land and non- residential. Hence, concerns over noise or other issues that could impact the environment are unlikely to occur.



Figure 5.2-6 Planned Construction Site for Sulu Tepe S/S

- **Sumgayit Substation**

  The planned construction site and surrounding area is public land, and non-residential, as shown in Figure5.2-7. Hence, concerns over noise or other issues that could impact the environment are unlikely to occur.

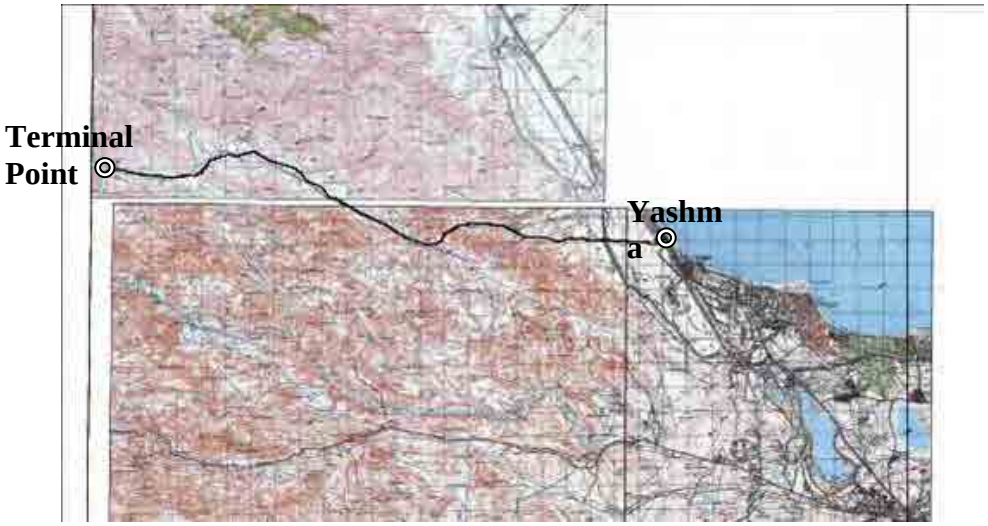


Figure 5.2-7 Planned Construction Site for Sumgayit S/S

5.2.3 Gas pipeline

The gas pipeline will pass through hill territory and the territory along the rivers. The route of gas pipeline is a semi-desert area and not personal farmland and nor residential area.

Figure 5.2-8 shows the proposed route of the gas pipeline and Figure 5.2- shows pictures of the route.



Source: Study team

Figure 5.2-8 Planned Construction Route for Gas Pipeline



Figure 5.2-9 Planned Construction Route for Gas Pipeline

5.3 Population and demography

The total population of Azerbaijan has risen to more than 9.3 million people as at 2013, as shown in the figure below. The population growth rate stayed around 1.3%.

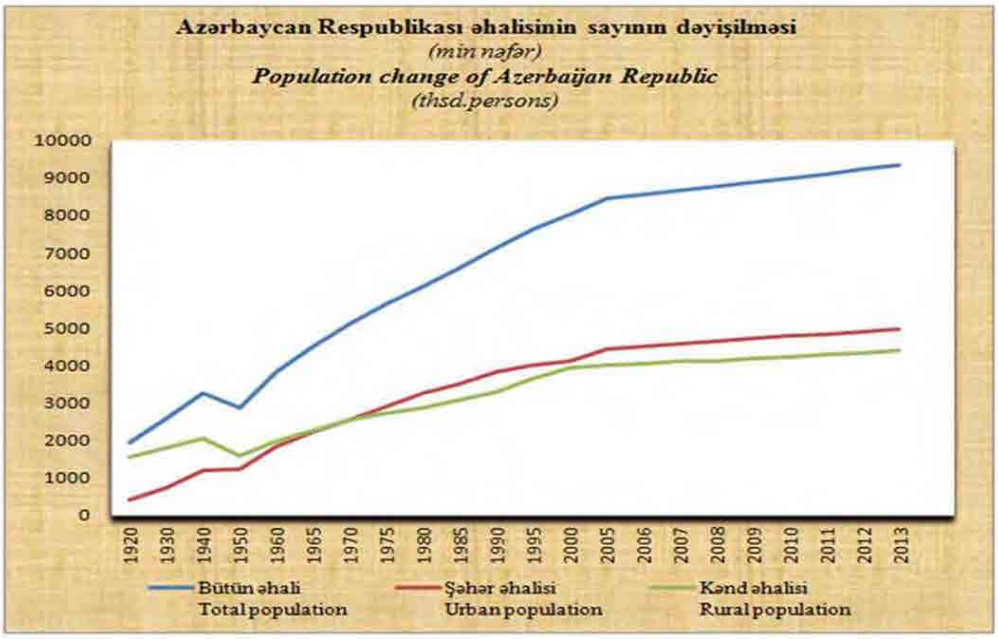
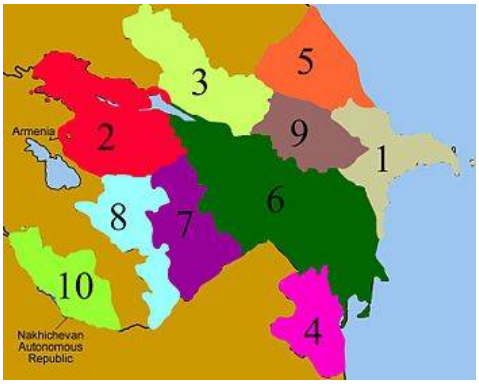


Figure 5.3-1 Population Change of Azerbaijan (thsd people)
Reference: The State Statistical Committee of the republic Azerbaijan

The population is significantly concentrated in Baku, the capital, with 2136.3 thousand people. Following Baku, Aran has the second largest population of 1875.5 people, which is the largest economic region in the country.

Table 5.3-1 Population of Economic Regions (thsd people)
Reference: The State Statistical Committee of the republic Azerbaijan

Economic and administration regions	Total(thsd person)
1)Baku city	2136.6
1)Absheron	533.7
2)Ganja-Gazakh	1210.6
3)Shaki-Zagatal	584.6
4)Lankaran	862.0
5)Guba-Khachmaz	508.5
6)Aran	1875.5
7)Yukharikarabakh	632.8
8)Kalbajar-Lachin	234.7
9Dakhlik-Shirvan	293.9
10)Nakhichivan	422.9



5.3.1 Power plant

According to the Table 5.3-2, Sumgayit has a population of 325,200 as of 2012. There is an increase in the population of 5,635, according to the 2012 census. The infant mortality under one year is 131.

Table 5.3-2 Demographic Indicators by Selected Economic and Administrative Regions and Towns of the Country in 2012

Economic and administrative regions and towns	Population size (at the end of year, thsd. person)	Person			
		births	deaths	increase	infant mortality under 1 year[1)]
Azerbaijan Republic	**9356.5**	**174469**	**55017**	**119452**	**1884**
Baku city	**2150.8**	**37459**	**12395**	**25064**	**784**
including:					
Binagadi region	251.5	4148	1261	2887	…
Garadagh region	114.4	2795	633	2162	…
Khazar region	158.2	2418	855	1563	…
Sabayel region	94.7	1488	622	866	…
Sabunchu region	231.3	4921	1615	3306	…
Surakhany region	207.0	4061	1247	2814	…
Narimanov region	169.6	2827	944	1883	…
Nasimi region	215.6	2636	1068	1568	…
Nizami region	188.3	3087	969	2118	…
Pirallahi region	18.2	296	137	159	…
Khatai region	261.9	4347	1441	2906	…
Yasamal region	240.1	4435	1603	2832	…
Absheron economic region-total	**538.4**	**10341**	**2635**	**7706**	**148**
including:					
Khizi region	15.5	332	90	242	2
Absheron region	197.7	2593	764	1829	15
Sumgait t.d.[2)]	325.2	7416	1781	5635	131

[1)]based on data of the Ministry Healthcare

[2)] İn this and following tables - t.d. is a territory division, t.u. is a territory unit. (t.d. of Sumgait includes - Sumgait city, 'Haji Zeynalabdin Tagiyev and Jorat settlements; t.d. of Ganja-Ganja city, Goygol and Hajikend settlements; Naftalan city t.u. - Naftalan town and one rural administrative division; t.d. of Shirvan: Shirvan town, Bayramli and Hajigahramanly settlements; t.d. of Khankendi - Khankendi town and Karkijahan settlement; t.d. of Nakhchivan - Nakhchivan city, Aliabad settlement and 3 rural administrative division).

Population of Zeynaladbin Tagiyev Settlement, which is the closest residential area to the proposed project site, has 20,674 with 10,337 male and 10,297 female.

5.3.2 Transmission line and substation

60,000 people live near the Sulu Tepe Baladjar settlement. In Binagadi region, the population was 238,500 in 2009 and reached 251,100 in 2013. Population density is 1,479 people/km in 2013.

5.3.3 Gas pipeline

As shown in Table 5.3-3, Khizi region has 14,731 people with 7,210 male and with 7,521 people female. Half of them live in urban area and the other half live in rural area.

In Aghdere village administrative territory, there are 256people, which account for 1.74% of total population of Khizi region. 137 of them are men and the others are women.

Table 5.3-3 Population of Khizi region and Aghdere village

Territory	Total		Male		Female	
	person	percent	person	percent	person	percent
Khizi region	14,731	100,0	7,210	100.0	7,521	100.0
urban population	7,471	50.72	3,681	51.05	7,521	50.39
rural population	7,260	49.28	3,529	48.95	3,731	49.61
Aghdere village administrative territory	256	1.74	137	1.90	119	1.58

5.4 Education

5.4.1 Power plant

There are four highly educational institutions in Sumgayit city: Sumgayit State University, Branch of the Azerbaijan College, Sumgayit State Technical College and Sumgayit Musical College.

In 2013, 3,603 school children finished 9th grade in Sumgayit and 2,887 finished 11th grade.

Siyazan vocational school is located in Zeynaladbin Tagiyev Settlement, Siyazan.

It is important to note that many children living in the Yashma go to school by buses or cars to the settlement of Z.Tagiyev 5-7km away from the Yashma. Therefore, many parents cannot afford to send their children to school.

5.4.2 Transmission line and substation

There are three schools and one kindergarten in Sulu Tepe. Residents complain about the lack of kindergartens.

5.4.3 Gas pipeline

2,888 children get their education in Khizi region in 2009 as shown in Table 5.4-1. Most of them go to general educational institutions (secondary schools) whereas some of them go to higher education institutions, secondary specialized education institutions and others.

Table 5.4-1 Education Statistics in Khizi region in 2009

Item	Total		Male		Female	
	person	as per total, percent	person	as per total, percent	person	as per total, percent
Total number	2,888	100.0	1,573	100.0	1,315	100.0
higher education institutions	129	4.5	81	5.2	48	3.6
secondary specialized education institutions	59	2.0	32	2.0	27	2.1
primary specialized-vocational education institutions	25	0.9	16	1.0	9	0.7
general educational institutions (secondary school)	2,672	92.5	1,444	91.8	1228	93.4
other education institutions	3	0.1	-	-	3	0.2

5.5 Sanitation and health

5.5.1 Power plant

Interviews with local people in Yashma settlement reveal problems with drinking water supply, effective waste management, standards of hygiene and sanitation and prevention of infectious diseases. Another issue is that there are no medical services near the settlement. The closest medical facilities are far from the settlement.

5.5.2 Transmission line and substation

There are some problems with water distribution, sanitation and wastes management in Sulu Tepe. Local municipality, officials, humanitarian organizations and Coca-cola try to help the communities in Sulu Tepe and Binagadi area have sustainable access to safe drinking water.

5.6 Public infrastructure

5.6.1 Power plant

There are two gas stations, a department of the Ministry of Transport and private café near the proposed project site with about 3 to 5 people working in each structure.
In terms of public utility, all flats of residential buildings in Sumgait are supplied with electric energy and natural gas meter.

Local people complain about a lack of basic infrastructure in Zeynaladbin Tagiyev Settlement, such as school, kinder garden, market, pharmacy and clinic. There are 18 hospitals in Sumgayit, which can accommodate 2,625 sick and wounded people (See Table 5.6-1), but such medical services are far from the settlement.
Educational and communicational facilities are distant, as well. Internal local transport system and access to the settlement from the coast also need improving.

Table 5.6-1 Main Indicators of Health by Economic and Administrative Regions and Towns of the Country

Economic and administrative regions and towns	Physicians person	Paramedical staff, person	Number of hospitals	Number of hospital beds	Number of ambulance-polyclinic service organizations	Power of the ambulatory policlinic institutions
Azerbaijan Republic	32,335	57,506	539	43,198	1,725	105,454
Baku city[1)]	19,044	21,173	130	16,887	293	32,468
including:						
Absheron economic region-total	1,815	3385	22	2,817	54	3,866
including:						
Khizi region	38	63	1	37	7	261
Absheron region	297	464	3	155	16	1,144
Sumgait city t.d. (Included .Tagiyev, Jorat settlements)	1,480	2,858	18	2,625	31	2,461

5.6.2 Transmission line and substation

Gas line and heating system are not supplied in 3km of the Yashma transmission line zone from the plant. That means that there are houses without gas near the planned plant. Municipality does not help the communities with gas and water distribution because Yashma lands do not belong to the municipality.

Additionally, the road condition is poor around Yashma, Yashma substation and in Sulu Tepe settlement.

There are many ongoing infrastructure activities in Sulu Tepe on improving road maintenance, asphalting of roads, sewer and water lines, planting trees and flowers, lines for pedestrians and lighting.

5.6.3 Gas pipeline

The main infrastructure in Khizi region is described below: roads, gas operation facility and water canal.

There are some parts of Azerbaijan main roads in Khizi region. For example, 52-79 km of highways connecting Azerbaijan with Russia passes through Khizi. The roads are under control of Road Exploitation Facility (REF) No.3 and it regularly cleans the roads in Khizi also in winter.

Khizi Gas Operation Facility (GOF) renders natural gas supply services to 3000 individual subscribers and 92 organizations. Gas meters have been provided to 2992 subscribers (99.7%). The total length of the pipeline is 139679 m.

Khizi Sukanal Department serves water to 2,735 people and 613 subscribers in Khizi town and 5 villages. In these areas, main water lines consist of D159-100 mm steel pipes. The

length of lines is 55000 p/m, while the length of the town and village water lines is 68000 p/m and consists of D100-D50-iron pipes.

5.7 Employment

The unemployment rate has decreased from 7.3% to 5.2% between 2005 and 2012 in Azerbaijan, as seen in Figure 5.7-1.

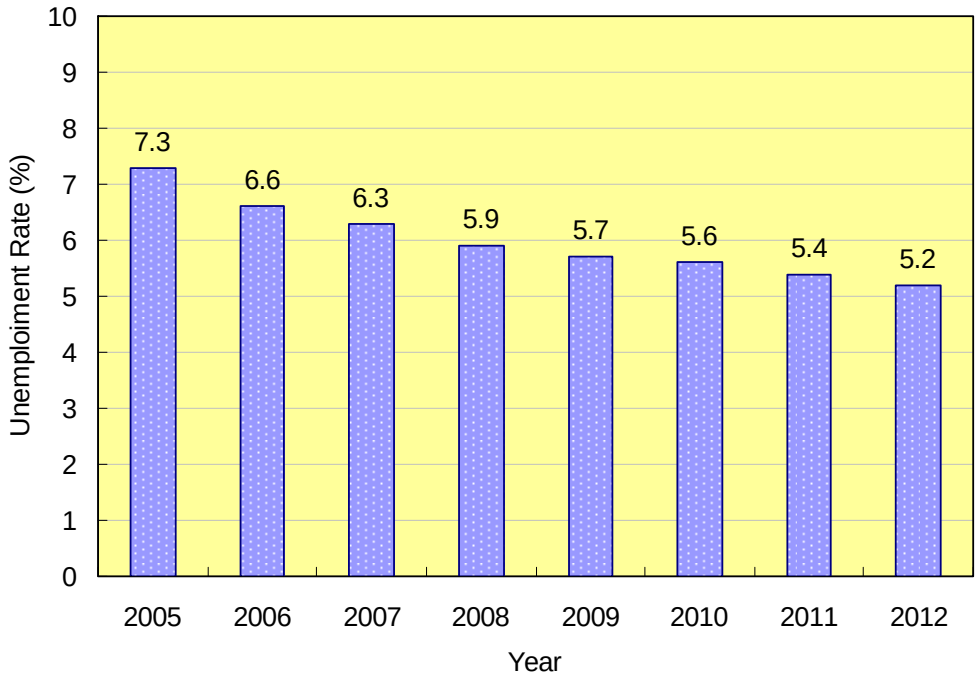


Figure 5.7-1 Unemployment Rate in Azerbaijan

Referring to the figure below, the GDP share by services, industry and agriculture has remained around 56%, 6%, and 38%, respectively during the period between 2005 and 2012 in Azerbaijan. Only the service industry has expanded slightly whereas the labour force engaged in industry and agriculture has been decreased.

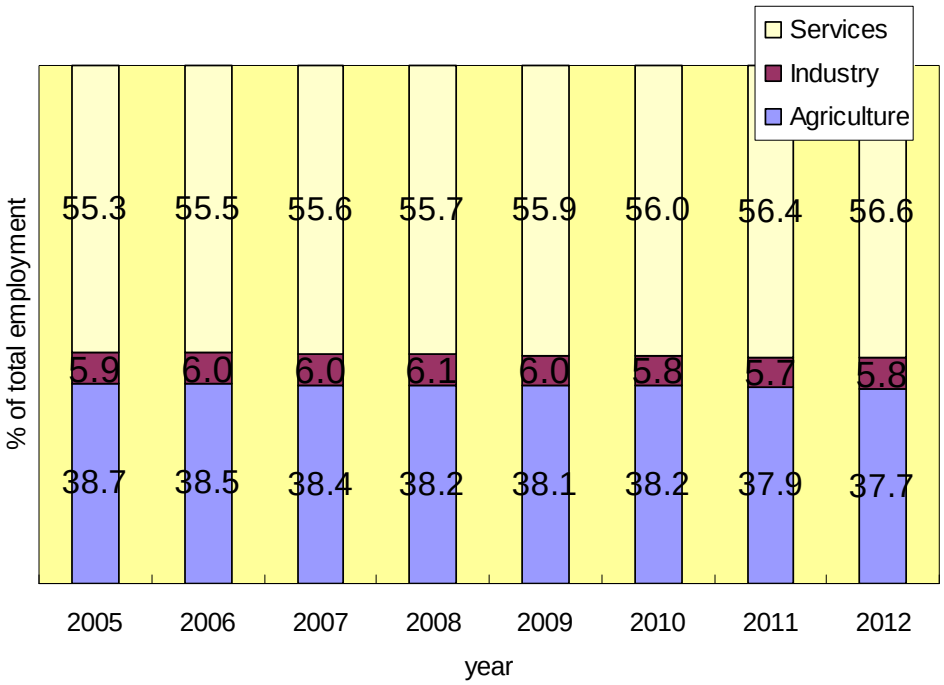


Figure 5.7-2 GDP Share by Sector from 2005 to 2012 in Azerbaijan

5.7.1 Power plant

In Sumgayit including Zeynaladbin Tagiyev Settlement, there are 50,427 pensioners, 32,840 ages, 13,793 disabled people and 3,794 families losing head.
Average amount of fixed monthly pensions is 147.43 manat. In comparison with the year 2011, number of people receiving grants is raised; whereas, average monthly amount per capita is reduced.

Yashma, Z.Tagiyev and other nearest villages of Sumgayit city have very high unemployment rate around 20-30% though the exact rate is not clear. One of the reasons of high unemployment rate is closing Polymer plant in the village.

Very low percentage of people works for schools, hospitals and kindergarten in the village center, the railway station in the village of Shirvan Z. Tagiyev and private shops or companies in Sumgayit, Khirdalan, Baku.

5.7.2 Transmission line and substation

There is no information about Sulu Tepe.

5.7.3 Gas pipeline

Table 5.7-1 shows positive trend that average monthly nominal salary in Khizi.
Average monthly nominal salary was boosted from 69.7 manat to 241.0 manat during the period between 2005 and 2012.
On the other hand, the number of unemployed people doubled from 44 in 2005 and 87 in 2012.
Additionally, a health-diagnostic center was opened in Khizi. 205 people will be employed.

Table 5.7-1 Labour Market in Khizi

Item	2005	2008	2009	2010	2011	2012
Average monthly nominal salary, manat	69,7	179,4	197,9	223,9	240,9	241,0
Number of unemployed people with status, person	44	75	78	81	99	87

5.8 Water use

5.8.1 Power plant

There are few large ships at the sea with more shoals in front of the plant, where water depth gets 7m around 1.3km off the coast.

The fishing in front of the project site is prohibited. In addition, though some people enjoy fishing with small boats for a recreational purpose, any other recreation activities are not conducted along the seashore.

5.9 Tourist site

5.9.1 Power plant

Khizi region, which is located right next to Sumgayit city, have some naturally and historically attractive places.

As for natural sites, Beshbarmak mountainous area and Altiagach national park in Khizi region are well known as one of the most beautiful natural places for their rich flora and fauna. Alti Agach in Khizi region is also famous as one of the most beautiful reserves. It was established for the purpose of preservation of rare animal and plant species of the Greater Caucasus. Those places are located about 40km away from the proposed project site.

5.9.2 Transmission line and substation

Tourist sites observed near the transmission line and substations are same as the ones near the power plant as stated above.

5.9.3 Gas pipeline

There is a national park including Alriagaj State Reserve with 110.35km^2 in Khizi region. The road connecting it with Aghdere village will be completed soon.

5.10 Cultural and Heritage properties

5.10.1 Power plant

There are several historically famous places around Alti Agach, which is located about 40km from the site. An ancient caravan route lies from there to Shamakhi located in the direction of southwest of Alti Agach. Even today tourists make tours along this route. Moreover, the Beshbarmak fortress built in the eighth century and the ruins of an antique city and of the Khizi fortress built in the fifth century are historically worth.

5.10.2 Transmission line and substation

There are no cultural places and heritages other than the places described in 5.9.1 Power Plant.

5.10.3 Gas pipeline

Khizi region has a lot of historical and architectural monuments.

There are 15-16th century monument Ag pir" in Halanj village and Caliph Suleiman pir in

Aghdere village**.** There are a 17-18th century church bell in Altiaghaj village, a 19th century mill on the banks of the river Atah in Halanj village and Pay dul-dul pir sacred place in Findigan village. There are bath in Khizi village built in 1923. In 2004, statue of the national leader Heydar Aliyev was erected in Altiagac "Jannat Bagi" recreation center and in 2006 in Khizi "Heydar Aliyev park".

5.11 Minorities

5.11.1 Power plant

There are many people from different ethnic groups such as akhiska turks, lezghins, tats, kurds, azeris, other refugees and internally displaced people from regions occupied by Armenia. The government of Azerbaijan and international and local NGOs support them to be integrated into local societies.

However, minorities do not live within and near the proposed project site.

5.11.2 Transmission line and substation

Referring to the previous section '5.10.1 Power plant', the same situation can be seen near the transmission line and substations.

5.11.3 Gas pipeline

In fourth to sixth centuries, Tats moved from Iran to Khizi. Today's population of Tats is only five as stated in Table 5.11-1. The other minority groups are Turks with 68, Russian with 27, Lezghis with 16, and Tatars with three people.

However, minorities do not live around the gas pipeline route.

Table 5.11-1 Share of Ethnic Groups in Khizi region

Item	Total Population	Percent	Male	Percent	Female	percent
Khizi region	14,731	100.0	7,210	100.0	7,521	100.0
Azerbaijanians	14,596	99.08	7,154	99.22	7,442	98.95
Turks	68	0.46	30	0.42	38	0.51
Russian	27	0.18	8	0.11	19	0.25
Lezghis	16	0.11	8	0.11	8	0.11
Tats	5	0.03	4	0.06	1	0.01
Tatars	3	0.02	0	0.00	3	0.04
Others	16	0.11	6	0.08	10	0.13

based on population registration data of 2009

In addition to these groups, attention should be paid 2,581 refugees and 468 internally displaced persons.

EIA

Chapter 6

Chapter 6

POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

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Annex 6-1 Air Quality simulation by model

Annex 6-2 Noise simulation by model

Annex 6-3 Thermal water simulation by model

6. POTENTIAL ENVIRONMENTAL IMPACTS ANDMITIGATION MEASURES

6.1 Selection of assessment items (Scoping)

The consideration matters of environmental impact, prediction, and evaluation are decided in accordance with activity plan, local characteristic, environmental components. The phase of processes is as below,

- Identification of potential impacts
- Prediction of impacts
- Evaluation of significant impacts
- Classification and priority of hypothetical significant impacts

The process for determination of the scope of the significant impacts will be conducted in the following steps:

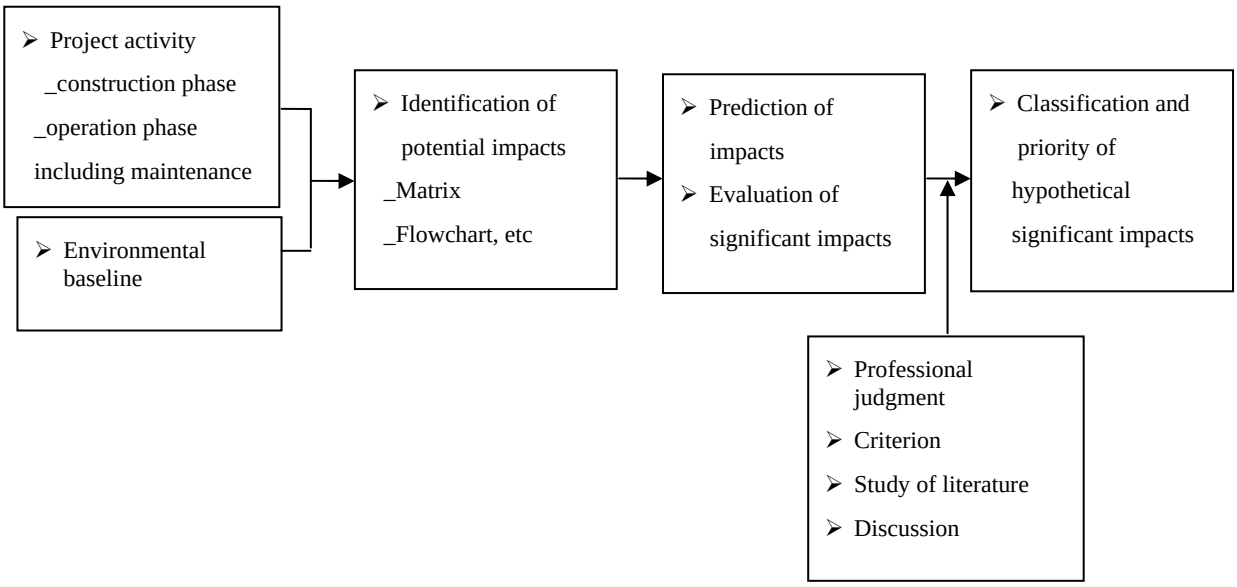


Figure 6.1-1 Flowchart of significant impacts study

On the basis of the first local survey results, Table 6.1-1 lists environmental impact assessment items and impacts that are likely to occur due to the constructions and operation of the Power plant (including of Access road),Transmission line (including of Substation) and Gas pipeline. The list has been prepared in accordance with items covered in The Azerbaijan Law and the JICA Guidelines (April 2010).

Table 6.1-1 (1) Scoping result for Power plant (including of Access road)

No	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negativ	Positive	Negativ	
【Pollution control measure】						
1	Air pollution	N	B	N	A	**During construction:** **-C**ivil engineering work, such as land formation, may cause dust, while heavy equipment and trucks are likely to discharge air pollutants (SOx, NOx, etc.). However, the scope of impacts from such pollutants will be limited to the vicinities of the construction areas. **During operation:** - Operation of the power plant will emit NOx.
2	Water pollution	N	B	N	A	**During construction:** -Muddy water will be generated during dredging work and land formation excavation. -During construction, domestic waste water and oil-containing waste water will be generated. However, the scope of impact will be limited to the vicinities of the work. **During operation:** - During operation, Thermal water, plant wastewater, domestic waste water and oil-containing waste water will be generated.
3	Waste	N	B	N	B	**During construction:** -The construction work will generate general waste and hazardous waste. **During operation:** - General waste and hazardous waste will be generated.
4	Soil contamination	N	B	N	B	**During construction:** - Lubrication oil and fuel, etc. spilled from construction vehicles and construction machinery, etc. are likely to cause contamination in the soil. **During operation:** - Lubrication oil and fuel spilled during operation of the power plant are likely to cause contamination in the soil.
5	Noise and vibration	N	B	N	A	**During construction:** -Operation of heavy equipment and trucks will cause impact from the temporary noise and vibration. In particular, pile driving will cause impact from the strong noise and vibration into surrounding broader areas. **During operation:** -Operation of the plant will cause impact from the noise and vibration. Generally impact of vibration from the plant of gas turbine is smaller than noise..

No	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negativ	Positive	Negativ	
6	Land subsidence	N	N	N	N	**During construction and operation:** - Water will not be drawn up from underground.
7	Odor	N	B	N	B	**During construction:** -If living waste at worker stations is handled improperly, the discarded waste may cause bad smell. **During operation:** -If living waste is handled improperly, the discarded waste may cause bad smell.
8	Substratum contamination	N	B	N	B	**During construction and operation:** - If untreated waste water is discharged, it will cause substratum contamination.
【Natural environment】						
1	Wild life preservation area	N	N	N	N	**During construction and operation:** -The site is located in no wild life preservation area and has no such nearby area.
2	Terrestrial ecosystems and rare species	N	C	N	C	**During construction:** -The site has a small sandy beach. Herbs and shrubs are scarce. Loss of habitat of animals and vegetation is expected. However similar environment extends into surrounding broad sandy beach areas. Limited impact on the ecosystems is expected. However, site survey will check the site for rare species, etc. -Construction work will generate air pollution, noise and vibration, etc. that will have impact on the terrestrial ecosystems. However, the range of such impact will be very limited. **During operation:** -The site has a small sandy beach. Herbs and shrubs are scarce. Loss of habitat of animals and vegetation is expected. However similar environment extends into surrounding broad sandy beach areas. Limited impact on the ecosystems is expected. However, site survey will check the site for rare species, etc. -Power plant will generate air pollution, noise and vibration, etc. that will have impact on the terrestrial ecosystems. However, the range of such impact will be very limited.
3	Marine ecosystems and rare species	N	C	N	C	**During construction:** -The dredging work for cooling water facilities and land reclamation are likely to generate muddy water. An official survey will check the site for impacts on rare species and other ecosystems. **During operation:** -Taking in organisms by cooling water intake, pollutants discharged from plant waste water and oil-containing waste water, and rises in the temperature of Thermal water are expected to have impact on marine organisms. An official survey will check for the ecosystems including

No	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negativ	Positive	Negativ	
						rare species.
4	River ecosystems	N	N	N	N	**During construction and operation:** - The site has no rivers inside.
5	River hydrology	N	N	N	N	**During construction and operation:** -The site has no nearby rivers. Water will not be drawn up from rivers.
6	Underground hydrology	N	N	N	N	**During construction and operation:** -Water from underground will not be drawn up during these operations.
7	Marine hydrology	N	N	N	B	**During construction:** - Since no port and harbor facilities will be constructed, there will be no change in flow conditions. **During operation:** -Because Cooling water will be intake and discharged, there will be changes in flow conditions in the vicinities of the discharged .
8	Topography and geology	N	N	N	N	**During construction and operation:** - Since the site will have no port and harbor facilities, no change will take place in the coast.
【Social environment】						
1	Resettlement and Land acquisition	N	N	N	N	**During construction and operation:** -Since the site is governmental land and not been used for farmland and residential area, .the construction and operation will have no impact.
2	Poor peoples	N	N	N	N	**During construction and operation:** -Since the site is governmental land and not been used for farmland and residential area, .the construction and operation will have no impact.
3	Ethnic minorities	N	N	N	N	**During construction and operation:** - There is no minority group living around the project site.
4	Local economy including employment and means of livelihood	B	N	B	N	**During construction and operation:** -Since the site is governmental land and not been used for farmland and residential area, .the construction and operation will have no impact. - Local people may be employed as workers by the power plant. It may purchase materials and equipment items in the local area.
5	Land use and utilization of local resources	N	N	N	N	**During construction and operation:** -Since the site is governmental land and not been used for farmland and residential area, .the construction and operation will have no impact.
6	Water use	N	B	N	B	**During construction:**

No	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negativ	Positive	Negativ	
						-There are few large ships at the sea with more shoals in front of the plant, where water depth gets 7m around 1.3km off the coast. -The fishing in front of the project site is prohibited. In addition, though some people enjoy fishing with small boats for a recreational purpose, any other recreation activities are not conducted along the seashore. - Muddy water may be generated from dredging work and land reclamation and excavation work, resulting in impact on the recreational fishing. **During operation：** -There are few large ships at the sea with more shoals in front of the plant, where water depth gets 7m around 1.3km off the coast. -The fishing in front of the project site is prohibited. In addition, though some people enjoy fishing with small boats for a recreational purpose, any other recreation activities are not conducted along the seashore. - Installation of water taking and discharging facilities and changes in flow conditions may have impact on navigation of small boats of recreational fishing.. - Taking organisms by cooling water intake, pollutants discharged from plant waste water and oil-containing waste water, and rises in the temperature of Thermal water may cause impact on the recreational fishing.
7	Existing social infrastructure and social service	N	B	N	B	**During construction**: - Inflows of workers may need to build lodging houses, medical treatment facilities, sewer systems and other infrastructure. - Traffic during construction is expected to increase. **During operation:** -Lodging houses, medical treatment facilities, sewer systems and other infrastructure may be needed for workers.
8	Social bodies including society-related capitals and social organizations that make local decisions	N	N	N	N	**During construction and operation:** - Since the site is governmental land and not been used for farmland and residential area. Thus, it will foresee no relations with social bodies, such as local bodies that make decisions on matters including relocation of local people.
9	Unfair distribution of damage and	N	B	N	B	**During construction and operation:** -If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.

No	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negativ	Positive	Negativ	
	benefit					
10	Conflict of interests within the local area	N	N	N	N	**During construction and operation:** - Since the site is governmental land and not been used for farmland and residential area, conflict of interests is not expected to take place within the local area.
11	Cultural heritage	N	N	N	N	**During construction and operation:** - Since the surroundings of the site have no historical, cultural and religious precious heritages, no impact is expected..
12	Scenery	N	N	N	N	**During construction and operation:** - Since the surroundings of the site have no scenic spots, no impact is expected..
13	Gender	N	N	N	N	**During construction and operation:** -No particular impact is expected to take place on the gender.
14	Rights of children	N	N	N	N	**During construction and operation:** -No particular impact is expected to take place on rights of children.
15	HIV/AIDS and other infectious diseases	N	B	N	N	**During construction:** -Inflows of foreign workers may spread such infectious diseases. **During construction:** -Inflows of foreign workers may be few.
16	Work environment (including labor safety)	N	B	N	B	**During construction and operation:** - Workers may have accidents during service. - Security guards may infringe on the security of surrounding people.
【Other】						
1	Accident	N	B	N	B	**During construction:** - Traffic accidents may occur during operation of vehicles. **During operation:** -Fire and Traffic accident by operation of facilities and/or vehicles.
2	Impact across the borders and on	N	B	N	B	**During construction:** -Although CO_2 is generated during construction, the impact is limited to a temporal period and hardly expected to take place across the

No	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negativ	Positive	Negativ	
	climatic change					borders and on climatic change. **During operation:** -Although operation of the power plant will generate CO_2, the CCPP system is efficient and CO_2 generation per kWh is smaller than the existing power plant. Thus, impact is hardly expected to take place across the borders and on climatic change.

Note) Categories are classified as follows:

A: There will be a serious impact.

B: There will be a certain impact.

C: The extent of impact will be uncertain. (A further survey will be needed to make the expected impact clear.)

N: Impact will hardly be expected.

Table 6.1-1 (2) Scoping Result for Transmission line (including of Substation)

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
【Pollution control measures】						
1	Air pollution	N	B	N	N	**During construction:** -Although heavy equipment and trucks are likely to generate air pollutants, the quantity of the emission is small. Thus, impact from the emission will be limited to the vicinities of the construction areas. **During operation:** No air pollutants will be generated.
2	Water pollution	N	N	N	N	**During construction:** - Since the substation and the power transmission line will be built in avoidance of river , soil of some embankments and earth cuts may not overflow into the river. **During operation:** Since the number of workers of the substation is small, waste water will hardly be generated.
3	Waste	N	B	N	N	**During construction:** -Construction work will generate general waste and hazardous waste. **During operation:** -Waste will hardly be generated.
4	Soil contamination	N	B	N	N	**During construction:** - Lubrication oil and fuel oil spilled from construction vehicles and construction machinery, etc. are likely to cause contamination in the soil. **During operation:** -Lubrication oil and fuel oil spilled will hardly be generated at periodical inspections.
5	Noise and vibration	N	B	N	B	**During construction:** Operation of heavy equipment and trucks will cause impact from the noise and vibration. **During operation:** -The substation will generate noise.
6	Land subsidence	N	N	N	N	**During construction and operation:** -water will not be drawn up from underground.
7	Odor	N	B	N	N	**During construction:**

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
						-If living waste is not handled properly, the discarded waste will cause bad smell. **During operation:** Waste will hardly be generated.
8	Substratum contamination	N	N	N	N	**During construction and operation:** Waste water will hardly be generated.
【Natural environments】						
1	Wild life preservation area	N	N	N	N	**During construction and operation:** -The site and route for the substation and transmission line are located in no wild life preservation area and has no such nearby area.
2	Terrestrial ecosystems and rare species	N	B	N	B	**During construction:** -The site and route for the substation and transmission line have been designated in avoidance of forests. - Although Loss of habitat of animals and vegetation is expected, the area is only within the basement area of the tower. -Construction work will generate air pollution, noise and vibration, etc. that will have impact on the terrestrial ecosystems. However, the range of such impact will be very limited. **During operation:** -The power transmission line may cause bird strikes.
3	Marine ecosystem and rare species	N	N	N	N	**During construction and operation:** Since the substation and power transmission line business is operated inland, there will be no impact on the marine ecosystem.
4	River ecosystem and rare species	N	N	N	N	**During construction and operation:** Since the substation and the power transmission line will be built in avoidance of river**,** soil of some embankments and earth cuts may not overflow into the river.
5	River hydrology	N	N	N	N	**During construction and operation:** River water will not be taken in.
6	Underground hydrology	N	N	N	N	**During construction and operation:** Water will not be drawn up from underground.
7	Marine hydrology	N	N	N	N	**During construction and operation:** Since the substation and power transmission line business is operated inland, it will hardly have impact on the oceanographic phenomena.

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
8	Topography and geology	N	N	N	N	**During construction:** The site and the route are in a flat area and sediment runoff will not occur. **During operation:** Soil flowage will not occur.
【Social environment】						
1	Resettlement and Land acquisition	N	N	N	N	**During construction and operation:** Since the substation and the power transmission line are governmental land and not been used for farmland and residential area, .the construction and operation will have no impact.
2	Poor peoples	N	N	N	N	**During construction and operation:** Since the substation and the power transmission line are governmental land and not been used for farmland and residential area, .the construction and operation will have no impact.
3	Ethnic minorities	N	N	N	N	**During construction and operation:** There is no minority group living around the substation site and transmission line route.
4	Local economy including employment and means of livelihood	B	N	N	N	**During construction and operation:** - Since the substation and the power transmission line are governmental land and not been used for farmland and residential area, .the construction and operation will have no impact. **During construction:** - The construction will lead to purchasing material and equipment items in the local area and also offer employment opportunities to local people. **During operation:** - The operation will not lead to purchasing material and equipment items in the local area and also not offer employment to local people.
5	Land use and utilization of local resources	N	N	N	N	**During construction and operation:** - Since the substation and the power transmission line are governmental land and not been used for farmland and residential area, .the construction and operation will have no impact.
6	Water use	N	N	N	N	**During construction:** - Since the substation and the power transmission line will be built in avoidance of river，soil of some embankments and earth cuts may not overflow into the river. **During operation:** The substation will hardly generate waste water.

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
7	Existing social infra structure and social service	N	B	N	N	**During constructio**n: - Inflow of some numbers of workers is expected. - Traffic is expected to increase during construction. **During operation:** - Very few workers is expected at periodical inspections.
8	Social bodies including society-related capitals and social organizations that make local decisions	N	N	N	N	**During construction and operation:** - Since the substation and the power transmission line are governmental land and not been used for farmland and residential area, No impact is expected on society-related capitals and social bodies such as local bodies that make decisions on local affairs.
9	Unfair distribution of loss and benefit	N	B	N	N	**During construction:** -If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed. **During operation:** - The employment of local people for the operation of the substation and the transmission line will not be generated.
10	Conflict of interests within the local area	N	N	N	N	**During construction and operation:** -Since the substation and the power transmission line are governmental land and not been used for farmland and residential area, compensation will have no conflict of interests..
11	Cultural heritage	N	N	N	N	**During construction and operation:** - Since the surroundings of the construction site and route for the substation and transmission line have no historical, cultural and religious precious heritages, no impact is expected.
12	Scenery	N	N	N	N	**During construction and operation:** -Since the surroundings of the construction site and route for the substation and transmission line have no scenic spots, no impact is expected.
13	Gender	N	N	N	N	**During construction and operation:** -No particular impact is expected to take place on the gender.

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
14	Rights of children	N	N	N	N	**During construction and operation:** -No particular impact is expected to take place on rights of children.
15	HIV/AIDS and other infectious diseases	N	B	N	N	**During construction**: - Inflow of small numbers of workers is expected. **During operation:** - Very few workers is expected at periodical inspections.
16	Work environment (including labor safety)	N	B	N	B	**During construction and operation:** -Workers may have accidents during construction and maintenance
【Other】						
1	Accident	N	B	N	B	**During construction :** -Traffic Accidents may occur during construction **During operation:** -Steel towers may fall down due to a storm, heavy rain, etc.
2	Impact across the borders and on climatic change	N	B	N	N	**During construction:** -Although CO_2 is generated during construction, the impact is limited to a temporal period and hardly expected to take place across the borders and on climatic change. **During operation:** -No particular impact is expected to take place across the borders and on climatic change.

Note) Categories are classified as follows:
A: There will be a serious impact.
B: There will be a certain impact.
C: The extent of impact will be uncertain. (A further survey will be needed to make the expected impact clear.)
N: Impact will hardly be expected.

Table 6.1-1 (3) Scoping Result for Gas pipeline

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
【Pollution control measures】						
1	Air pollution	N	B	N	N	**During construction:** -Although heavy equipment and trucks are likely to generate air pollutants, the quantity of the emission is small. Thus, impact from the emission will be limited to the vicinities of the construction areas. **During operation:** - No air pollutants will be generated.
2	Water pollution	N	B	N	N	**During construction:** - The part of gas pipeline will be built in river side , soil of some embankments and earth cuts may overflow into the river. **During operation:** - No waste water will be generated.
3	Waste	N	B	N	N	**During construction:** - Construction work will generate general waste and hazardous waste. **During operation:** - No waste will be generated.
4	Soil contamination	N	B	N	N	**During construction:** - Lubrication oil and fuel may be spilled from construction vehicles and construction machinery, etc. are likely to cause contamination in the soil. **During operation:** - Lubrication oil and fuel oil may be not occurred at periodical inspections.
5	Noise and vibration	N	B	N	N	**During construction:** -Operation of heavy equipment and trucks will cause impact from the noise and vibration. **During operation:** -Because gas compressor will not be installed, no noise will be generated.
6	Land subsidence	N	N	N	N	**During construction and operation:** Water will not be drawn up from underground.
7	Odor	N	B	N	N	**During construction:** If living waste is not handled properly, the discarded waste will cause bad smell.

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
						During operation: No waste will be generated.
8	Substratum contamination	N	N	N	N	**During construction and operation:** No waste water will be generated..
【Natural environments】						
1	Wild life preservation area	N	N	N	N	**During construction and operation:** The gas pipeline route is located in no wild life preservation area and has no such nearby area.
2	Terrestrial ecosystems and rare species	N	B	N	N	**During construction:** -The gas pipeline route have been designated in avoidance of forests. - Loss of habitat of animals and vegetation is expected -Construction work will generate air pollution, noise and vibration, etc. that will have impact on the terrestrial ecosystems. However, the range of such impact will be very limited. **During operation:** -The gas pipeline is introduced in the underground and will not influence the migration of the organisms. -Air pollution, noise and vibration will not generate.
3	Marine ecosystem and rare species	N	N	N	N	**During construction and operation:** - Since the gas pipeline is operated inland, there will be no impact on the marine ecosystem.
4	River ecosystem and rare species	N	B	N	N	**During construction:** - The part of gas pipeline will be built in river side , soil of some embankments and earth cuts may overflow into the river. **During operation:** -No waste water will be generated.
5	River hydrology	N	N	N	N	**During construction and operation:** - River water will not be taken in.
6	Underground hydrology	N	N	N	N	**During construction and operation:** - Water will not be drawn up from underground.
7	Marine hydrology	N	N	N	N	**During construction and operation:** -Since the gas pipeline is operated inland, there will be no impact on the marine ecosystem.

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
8	Topography and geology	N	B	N	N	**During construction:** -Soil flowage may occur. **During operation:** -Soil flowage will not occur.
【Social environment】						
1	Resettlement and Land acquisition	N	N	N	N	**During construction and operation:** - Gas pipeline route was selected avoiding personal farm land and residential area
2	Poor peoples	N	N	N	N	**During construction and operation:** - Gas pipeline route was selected avoiding personal farm land and residential area
3	Ethnic minorities	N	N	N	N	**During construction and operation:** - Ethnic groups don't lives in the village through which gas pipeline passes.
4	Local economy including employment and means of livelihood	B	N	B	N	**During construction and operation:** - Gas pipeline route was selected avoiding personal farm land and residential area **During construction:** - The construction will lead to purchasing material and equipment items in the local area and also offer employment opportunities to local people. **During operation:** - The operation will not lead to purchasing material and equipment items in the local area and also not offer employment to local people.
5	Land use and utilization of local resources	N	N	N	N	**During construction and operation:** - Gas pipeline route was selected avoiding personal farm land and residential area
6	Water use	N	B	N	N	**During construction:** - The part of gas pipeline will be built in river side , soil of some embankments and earth cuts may overflow into the river. **During operation:** No waste water will be generated.
7	Existing social	N	B	N	N	**During construction**:

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
	infrastructure and social service					- Inflow of some numbers of workers is expected. - Traffic is expected to increase during construction. **During operation:** - Very few workers is expected at periodical inspections.
8	Social bodies including society-related capitals and social organizations that make local decisions	N	N	N	N	**During construction and operation:** - Gas pipeline route was selected avoiding personal farm land and residential area
9	Unfair distribution of loss and benefit	N	B	N	N	**During construction:** - Gas pipeline route was selected avoiding personal farm land and residential area - If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed. **During operation:** - The employment of local people for the operation of the gas pipe line will not be generated.
10	Conflict of interests within the local area	N	N	N	N	**During construction and operation:** - Gas pipeline route was selected avoiding personal farm land and residential area
11	Cultural heritage	N	N	N	N	**During construction and operation:** - Since the surroundings of the gas pipeline have no historical, cultural and religious precious heritages, no impact is expected..
12	Scenery	N	N	N	N	**During construction and operation:** -Since the surroundings of the gas pipeline have no scenic spots, no impact is expected.
13	Gender	N	N	N	N	**During construction and operation:** - No particular impact is expected to take place on the gender.
14	Rights of children	N	N	N	N	**During construction and operation:** - No particular impact is expected to take place on rights of children.

No.	Item	Assessment				Reasons of assessment
		Construction period		Operation period		
		Positive	Negative	Positive	Negative	
15	HIV/AIDS and other infectious diseases	N	B	N	N	**During construction**: - Inflow of some numbers of workers is expected. **During operation:** - Very few workers is expected at periodical inspections.
16	Work environment (including labor safety)	N	B	N	B	**During construction and operation:** -Workers may have accidents during construction and maintenance
【Other】						
1	Accident	N	B	N	B	**During construction :** -Traffic Accidents may occur during construction **During operation:** - Gas leakage may occur from the pipeline.
2	Impact across the borders and on climatic change	N	B	N	N	**During construction:** Although CO_2 is generated during construction, the impact is limited to a temporal period and hardly expected to take place across the borders and on climatic change. **During operation:** No particular impact is expected to take place across the borders and on climatic change.

Note) Categories are classified as follows:

A: There will be a serious impact.

B: There will be a certain impact.

C: The extent of impact will be uncertain. (A further survey will be needed to make the expected impact clear.)

N: Impact will hardly be expected.

6.2 Impact assessment and measures for avoiding or mitigating the impact

Impact assessment has been made by studying the measures for avoiding or mitigating the impact with respect to various forms of environmental items. The measures for avoiding or mitigating the impact are shown in the environment management plan in Chapter8.

6.2.1 Power plant

(1) Construction phase

1) Pollution

a) Air quality

Generation of dust is expected by land preparation, and generation of air pollutants (SOx and NOx, etc.) is predicted from the operation of heavy machinery and trucks, but the impact will be limited only to the surrounding area.

According to the Beaufort scale, when wind speed exceeds about 6m/s, dust on the ground may be lifted up. The occurrence ratio of wind speed exceeding about 6m/s around the project site is very high, above 35%.

With the observation of dust caused by the strong winds, periodic watering of the site and road, covering of the soil-transport trucks and periodic car wash covering will be conducted to reduce dust generation.

Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce exhaust gas discharged from construction machinery and vehicles.

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b) Water quality

Muddy water will be generated during dredging work and land formation excavation. Domestic waste water and oil-containing waste water will be generated.

Temporary rainwater drainage, sedimentation pond will be installed around the construction area. Its surface water shall be discharged to the Caspian sea after the sedimentation.

In case dredging is conducted on installing intake equipment, the use of the silt fence or sheet and of pump dredgers with less turbidity generation will be considered in order to minimize turbidity.

A wastewater treatment facility for workers, such as a septic tank and and temporary toilet, an oil separator for oily run-off water, will be installed in the worker’s camp and construction area.

These measures will minimize the impact of contamination of sea water.

c) Waste

Waste generated from the construction work will include metal chips, waste plastic, wood shavings, waste glass and waste oil. Furthermore, household waste discarded from the camping site of the workers will include cans, bottles and garbage. If such waste is inadequately handled, sea water may be contaminated, and sanitation problems may arise.

Development of waste management program including education of workers to encourage reduction and reuse of waste will be promoted.

Non-recyclable and hazardous waste will be stored and disposed at appropriate sites according to related regulations. To reduce the amount of solid waste discharged from the workers in camping site, efforts will be taken to employ local workers as many as possible, so that the amount of household waste at the plant will be minimized.

Specifically, paper wastes and iron scraps will be recycled. Other general wastes will be collected by Sumgayit city and carried to existing disposal fields.
All of the hazardous waste will be disposed by a waste management company approved by the government at disposal fields in Sumgayit which are permitted by the government in accordance with the Azerbaijan legislation.

These measures will be taken to ensure that water pollution or sanitary problems resulting from waste will not arise.

d) Soil contamination

Soil pollution will possibly be caused by leakages of oil and chemical materials at the construction site. Oil and chemical materials will be stored at installed appropriate storage place in the project site to prevent any permeation into the ground. These measures will minimize the impact of any soil contamination.

e) Noise and Vibration

<Noise>

Operation of heavy equipment and trucks will cause impact from the temporary noise. In particular, pile driving will cause impact from the strong noise into surrounding broader areas.
There is some house of residence located near the project site, and sufficient consideration must be given to minimizing any noise impact.

The level of noise resulting from the operation of the construction machinery was simulated using the following estimation model.

Noise level estimation model

Noise predictions were carried out in accordance to International Standard ISO 9613, Acoustics-Attenuation of Sound during Propagation Outdoor.
The ISO Propagation model calculates the predicted sound pressure level by taking the source power level for equipment in separate octave bands and subtracting a number of attenuation factors

Noise level data of noise source

The major construction machinery used in the construction work will include trucks and back hoes for excavation, crawler crane, truck cranes, trailer and forklift for transportation of the equipment and material, mixers for producing concrete and other machine as air compressor and generator.
Piling work for the basis will not be conducted because the project site has an adequate foothold.

Results of simulation

Figure 6.2-1 shows the distribution of noise levels.
Noise level generated by construction activities is 37 to 57 dB(A) at the boundary of the power plant site and 44 to 51 dB(A) at the residence.

The noise levels at 2 points in resides exceed the night-time noise level standard of Azerbaijan and IFC/WB guideline.
Construction work is not implemented at night in principle. The noise levels at all points in resides not exceed the day-time noise level standard of Azerbaijan and IFC/WB guideline.

Noise impact caused by construction activities will be mitigated by managing the construction schedule in order to level out the construction amount and scale as well as introducing up-to-date low-noise equipment's.
Temporal noise insulation fences will be installed around the site as necessary.
Large equipment transportation will be mainly conducted by shipping, and schedule management will maintain level amounts of the vehicles.
Measures for reducing generation of noise, such as speed reduction of vehicles in residential areas, will be taken, whereby vehicle noise impact will be minimized. Thus, all efforts will be made to minimize the noise impact.
Monitoring on noise levels will also be necessary.



(Source: JICA Study Team)

Figure 6.2-1Results of Simulating Noise Level from Construction Work

<Vibration>
Operation of heavy equipment and trucks will cause impact from the temporary vibration. In particular, pile driving will cause impact from the strong vibration into surrounding broader areas.
There is some house of residence located near the project site, and sufficient consideration must be given to minimizing any vibration impact.

The level of vibration resulting from the operation of the construction machinery was simulated using the following estimation model.

Vibration level estimation model
Vibration predictions were carried out by model normally used in Japan, taking the source power level for equipment in separate octave bands and subtracting a number of attenuation factors:

Vibration level data of noise source
The major construction machinery used in the construction work will include trucks and back hoes for excavation, crawler crane, truck cranes, trailer and forklift for transportation

of the equipment and material, mixers for producing concrete and other machine as air compressor and generator.
Piling work for the basis will not be conducted because the project site has an adequate foothold.

Results of simulation
Vibration level generated by construction activities is 19 to 48 dB at the boundary of the power plant site and 25 to 40 dB at the residence.

The vibration levels at all points is low and satisfy with standard of Japan (Day: 55dB). Furthermore, all the predicted values are enough below the threshold level, around 50dB, at which human being can feel vibration.

The operation of heavy machinery and trucks is predicted to create vibration, but this will be limited to the surrounding area. In the actual construction work, schedule management will be performed to maintain constant amounts of construction work and to ensure that low vibration equipment will be used as much as possible.

Piling work for the basis will not be conducted because the project site has an adequate foothold. Construction work is not implemented at night in principle.

Large equipment transportation will be mainly conducted by shipping, and schedule management will maintain level amounts of the vehicles.

Measures for reducing generation of vibration, such as speed reduction of vehicles in residential areas, will be taken, whereby vehicle vibration impact will be minimized.

f) Odor
In case domestic waste from the workers' camp is not appropriately treated, the rotting waste may produce a foul odor. Before starting the construction work, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced. These measures will be taken to minimize the generation of odor.

g) Substratum contamination
Muddy water will be generated during dredging work and land formation excavation. Domestic waste water and oil-containing waste water will be generated.
Temporary rainwater drainage, sedimentation pond will be installed around the construction area. Its surface water shall be discharged to the Caspian sea after the sedimentation treatment.
In case dredging is conducted on installing intake equipment, the use of of the silt fence or sheet and of pump dredgers with less turbidity generation will be considered in order to minimize turbidity.

A wastewater treatment facility for workers, such as a septic tank and and temporary toilet, an oil separator for oily run-off water, will be installed in the worker's camp and construction area.

2) Natural environment

a) Terrestrial ecosystems and rare species

The site has a small sandy beach. Herbs and shrubs are scarce. Loss of habitat of animals and vegetation is expected. However similar environment extends into surrounding broad sandy beach areas. Limited impact on the ecosystems is expected.

Construction work will generate air pollution, noise and vibration, etc. that will have impact on the terrestrial ecosystems. However, the range of such impact will be very limited.

No precious species of flora/fauna inhabit the project site.

Mitigation measures for air pollution, noise and vibration will be implemented.

Bird hunting by workers shall be prohibited. The plant site is vegetated with plants living in the surrounding coast or plant species resistant to salt damage.

b) Marine ecosystems and rare species

The dredging work for cooling water facilities and land reclamation are likely to generate muddy water.

Dredging method generating less turbidity will be adopted. Waste water from the construction activity will be treated by the treatment system before discharge.

If sea grass will widely disappear by construction activities, creation of see grass bed will be conducted for fishes and benthos with cooperation of MENR.

3) Social environment

a) Local economy including employment and means of livelihood

Since the site is governmental land and not been used for farmland and residential area, .the construction and operation will have no impact.

Local people may be employed as workers by the power plant. It may purchase materials and equipment items in the local area.

Especially in the construction phase, project proponent will employ local residents as many as possible and use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible.

Job training will be provided as necessary for new employees.

b) Water use.

There are few large ships at the sea with shoals in front of the plant, where water depth gets 7m around 1.3km off the coast.

The fishing in front of the project site is prohibited. In addition, though some people enjoy fishing with small boats for a recreational purpose, any other recreation activities are not conducted along the seashore.

Muddy water may be generated from dredging work and land reclamation and excavation work, resulting in impact on the recreational fishing.

Dredging method generating less turbidity will be adopted. Waste water from the construction activity will be treated by the treatment system before discharge.

Public awareness will be conducted as dredging plans and construction schedule among the local people.

c) Existing social infrastructure and social service

Inflows of workers may need to build lodging houses, medical treatment facilities, sewer systems and other infrastructure.

Especially in the construction phase, the project proponent will employ- as possible. Workers coming from other than the local area shall be accommodated in the rented housing in the surrounding area to minimize the area of the worker’s camp.

Traffic during construction is expected to increase.
Project proponent will conduct the traffic control plan including route-setting and training safe operation of vehicles.

d) Unfair distribution of damage and benefit
If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.
The employment of the local people shall be conducted under publicized employment conditions to prevent unfair employment.

e) HIV/AIDS and other infectious diseases
A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc. Local people should be recruited for simple work as much as possible so to minimize the risk of infectious diseases being transmitted from external workers. Pre-employment and periodic medical check-ups should be conducted for external workers (technical workers, etc).

f).Work environment (including labor safety)
Workers may have accidents during service.
Project proponent will develop the safety and sanitation management plan and implement the regular medical checkup.
Project proponent will subcontract a security firm to deploy security guards.

4) Other
a) Accident
Traffic accidents may occur during operation of vehicles.
Large machines shall be transported through the sea to the possible extent.
Land transportation shall use the existing highways and other existing roads shall be used as much as possible.
Land traffic and marine traffic accidents during construction work may occur. As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving will be implemented. People in the surrounding villages shall be informed of the bus schedules. For vessel operation, marking buoys will be set around the construction area for marine safety. Vessel schedules shall be announced to fishermen, etc.

b) Impact across the borders and on climatic change
CO_2 is generated during construction, but the impact is limited to a temporal period.
Periodic checkup and maintenance of heavy machine and Vehicles will be conducted.

(2) Operation phase

1) Pollution

a) Air quality

Emission gas

Nitrogen oxides (NOx) will be generated by the operation of gas turbine of the power plant. Low-NOx Burner will be adopted in this turbine, and exhaust concentrations will be kept below emission standards a of the IFC/WB EHS guidelines.

Table 6.2-1Emission Concentration and Emission Standard

Item	Unit	Proposed Concentration	IFC/WB EHS guidelines (Thermal power plants; 2008)
NOx	mg/Nm^3	＜510	510

Note: O_2＝15% equivalent

(Source: JICA Study Team)

The prediction on impact regarding dispersion of air pollutant is approached by mathematical models.

The model regarding dispersion of air pollutant is Gaussian models.

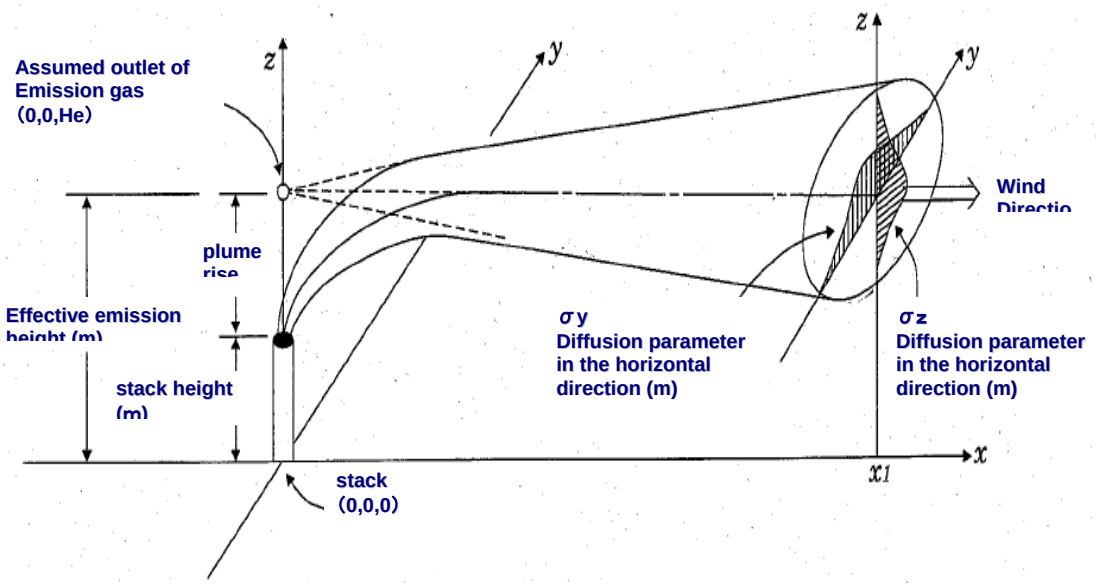


Figure6.2-2 Gaussian Diffusion Model Diagram

Reference: Lecture of Air Environment Prediction, Shinichi Okamoto, 2001

Emission specifications

Since natural gases will be used as fuels, sulfur oxides and dust (PM: particle matters) will not be generated.

Table 6.2-2 shows the exhaust volume, temperature, speed, and emissions of nitrogen oxides (NOx) emitted from the stack are assumed to become NO_2 respectively.

Table 6.2-2 Emission Specifications

Item	Unit	CCPP 1	CCPP 2
Emission volume (wet)	Nm^3/h	$2,193\times10^3$	$2,193\times10^3$
Exhaust temperature	ºC	95	95
Exhaust speed	m/s	25	25
Stack height	m	80	80
Diameter of stack	m	6	6
NOx	kg/h	135.9	135.9

Notes: The values indicate the values under the maximum continuous load.

(Source: JICA Study Team)

Meteorological data from Sumgayit meteorological station about 20 km southeast of the project site was used for exhaust gas dispersion model on annual average and 24–hour values.
Meteorological data for 3 years (2011-2013) was, which had 365 days of wind speed and wind direction data, was used in the simulation.
As for a 1-hour value, a dispersion model was simulated on the conditions of the stabilities and wind speed.
Figures 6.2-2 to Figure 6.2-4 show the prediction concentrations in ambient air quality, considering background concentration and the contributed concentration (annual average value, daily average value and 1-hour value) for this project based on the simulation. The outlines of the contributed concentration based on the simulation are described below.

- **Annual average value**

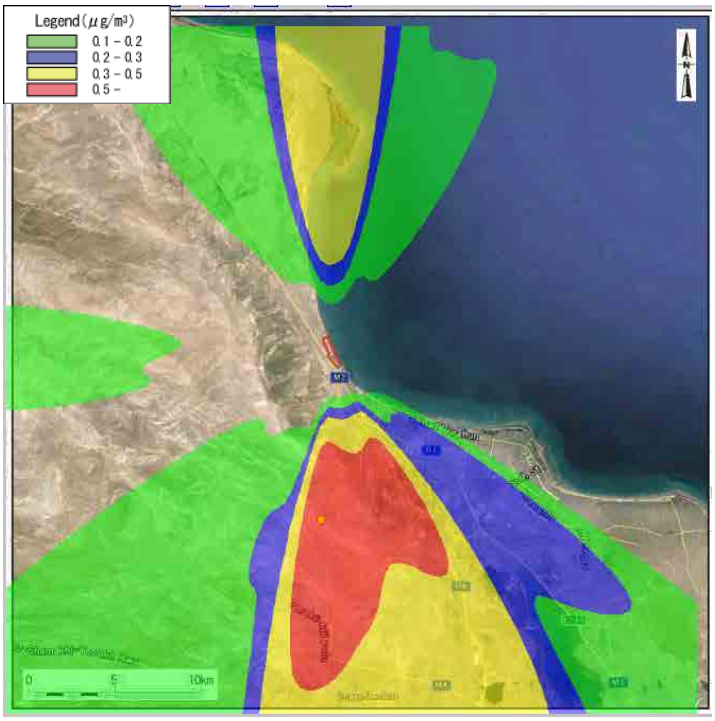
The contributed concentration from the power plant is0.6-0.7 $\mu g/m^3$ at a maximum, which is far below the measurement full limits of air quality ($1\mu g/m^3$).
The contributed concentration are less than 1/60 of IFC/WB guideline values and environmental standard values of the EU which is 40 $\mu g/m^3$..
The contributed concentration to Sumgayit, which is located 20km away in the southwest from the plant, is extremely low at 0.1-0.3$\mu g/m^3$.

- **24 hour value**

The contributed concentration from the power plant is 4.4- 7.7$\mu g/m^3$ at a maximum for 2011-2013. The contributed concentrations are less than 1/10 of Japanese ambient air quality standard values which is 75 to 110 $\mu g/m^3$.
Predicted concentration, taking into account the background concentration, is 64.4 to 90.7$\mu g/m^3$ and satisfies the ambient air quality standard of Japan.
The contributed concentration to Sumgayit is also extremely low at <1$\mu g/m^3$.

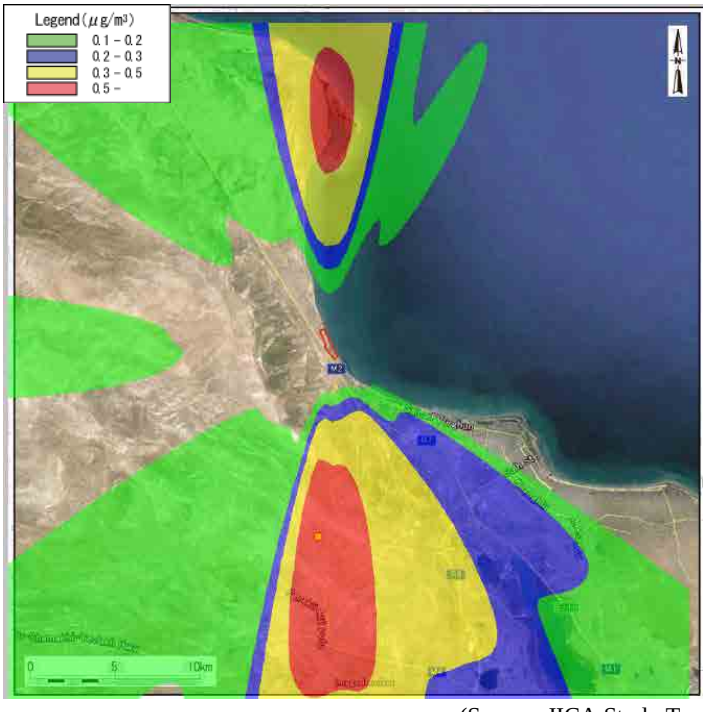
- **1 hour value**

In the case of atmospheric stability B, C and D, Contributed concentration from the power plant is 19.0 $\mu g/m^3$ at a maximum. The contributed concentrations are less than 1/10 of the IFC/WB guideline value and EU ambient air quality standard value which is 200$\mu g/m^3$.
Predicted concentration, taking into account the background concentration, is 75.9 to 119.0 $\mu g/m^3$ and satisfies the IFC/WB guideline value and EU ambient air quality standard value.
The contributed concentration to Sumgayit is also extremely low at 1-5$\mu g/m^3$.



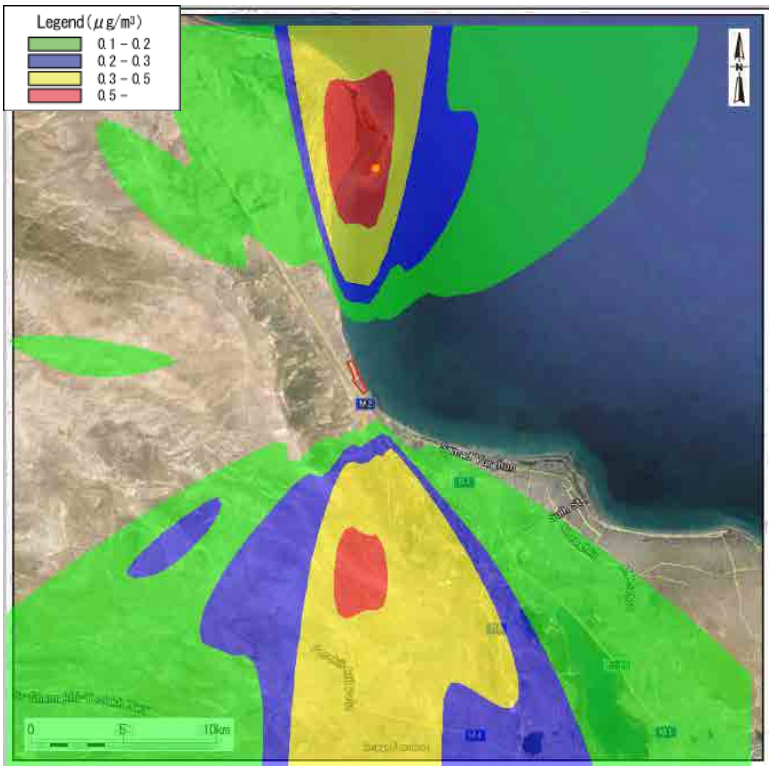
(Source: JICA Study Team)

Figure 6.2-2 (1) Dispersion concentration of NO_2 (Annual Average, 2011)



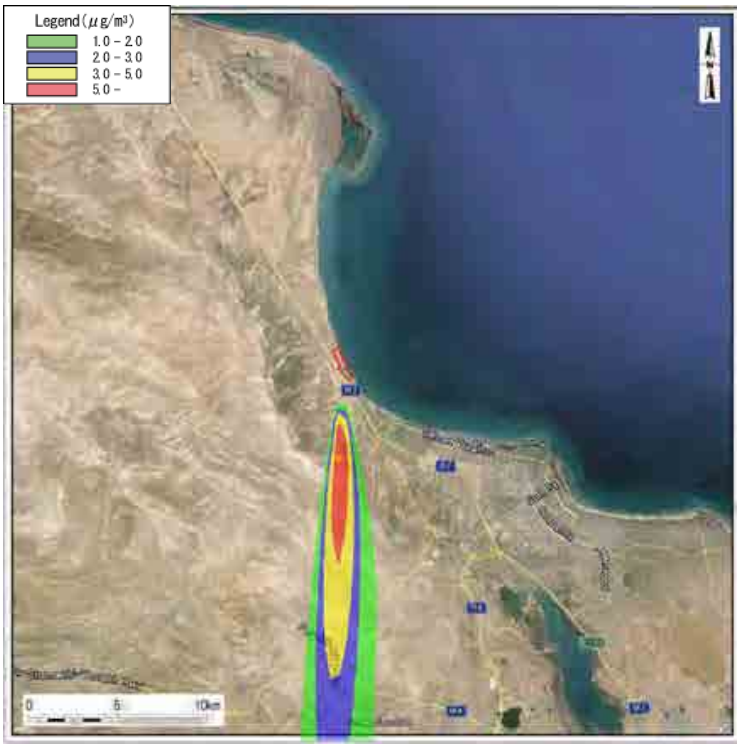
(Source: JICA Study Team)

Figure 6.2-2 (2) Dispersion concentration of NO_2 (Annual Average, 2012)



(Source: JICA Study Team)

Figure 6.2-2 (3) Dispersion concentration of NO_2 (Annual Average, 2013)



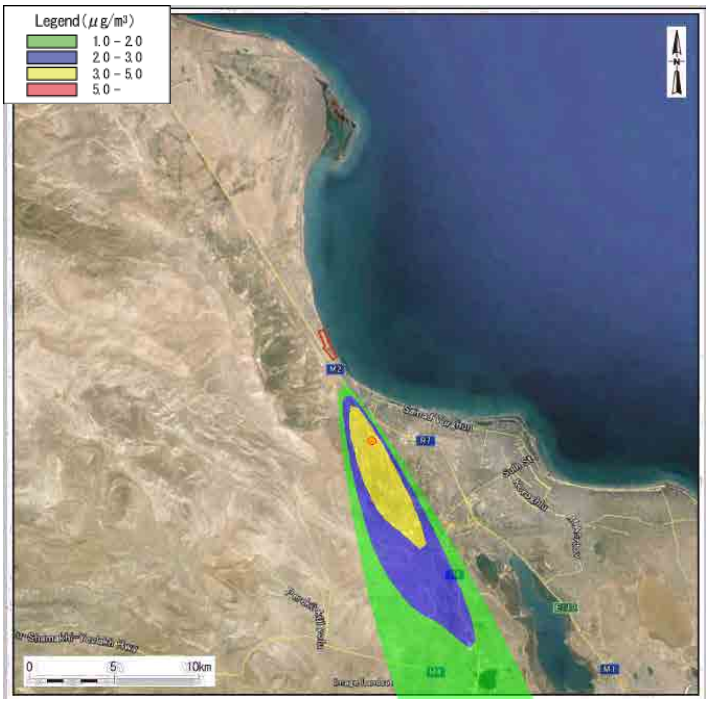
(Source: JICA Study Team)

Figure 6.2-3 (1) Dispersion concentration of NO2 (24 hr Maximum, 2011)



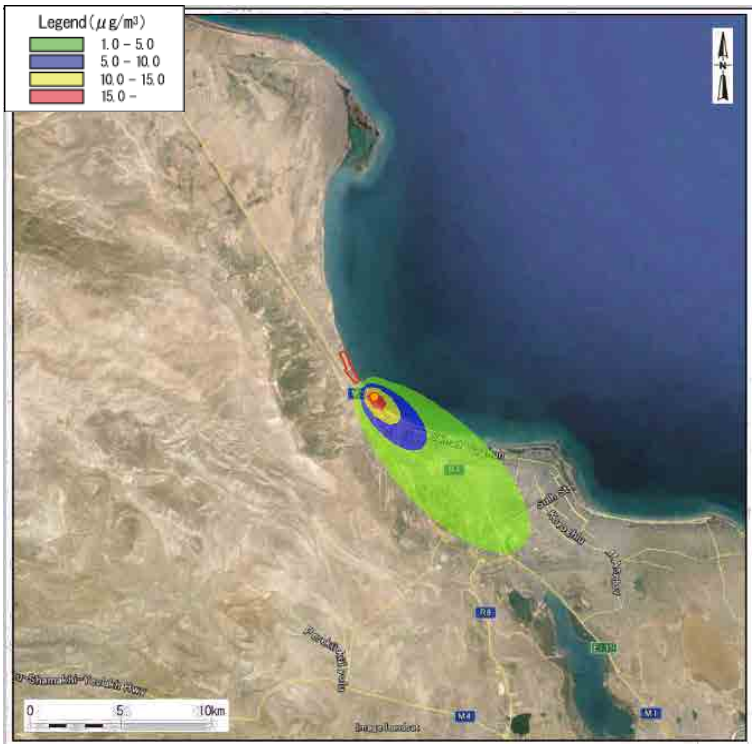
(Source: JICA Study Team)

Figure 6.2-3 (2) Dispersion concentration of NO2 (24 hr Maximum, 2012)



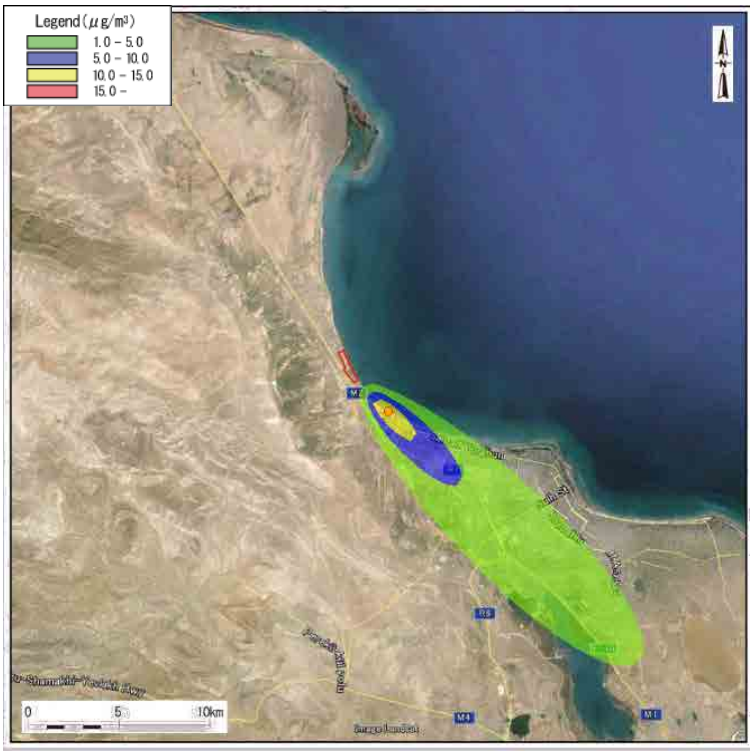
(Source: JICA Study Team)

Figure 6.2-3 (3) Dispersion concentration of NO2 (24 hr Maximum, 2013)



(Source: JICA Study Team)

Figure 6.2-4 (1) Dispersion concentration of NO_2 (B (Max) ,3.9m/s:1 hr Maximum)



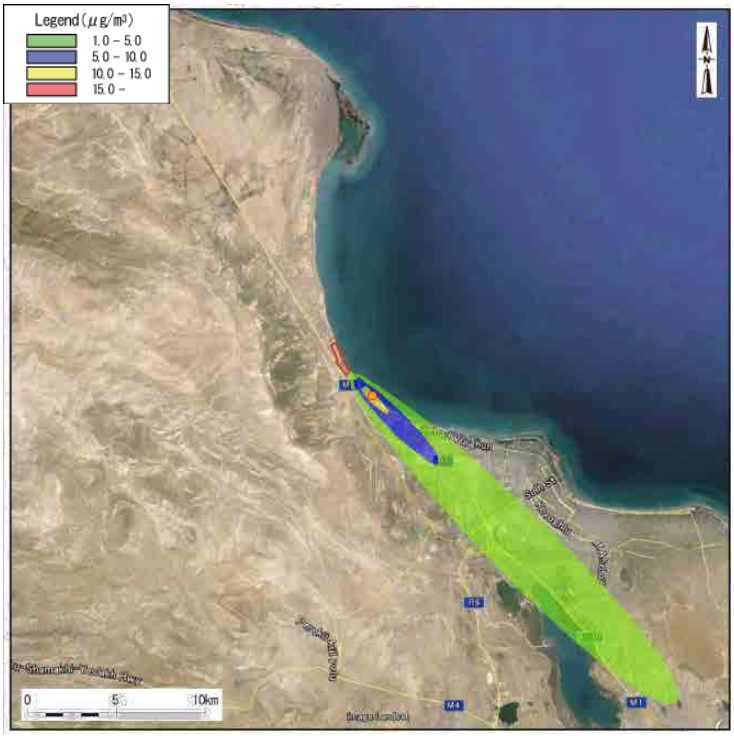
(Source: JICA Study Team)

Figure 6.2-4 (2) Dispersion concentration of NO_2 (C (Max) , 5.9m/s:1 hr Maximum)



(Source: JICA Study Team)

Figure 6.2-4 (3) Dispersion concentration of NO_2 (D (Max) , 15m/s:1 hr Maximum)



(Source: JICA Study Team)

Figure 6.2-4 (4) Dispersion concentration of NO_2 (D (Max) , 30m/s:1 hr Maximum)

b) Water quality

In the operation of Power plant ,thermal water from condenser , wastewater from raw water treatment plant (desalination plant) and regeneration waste water from demineralization plant, blow water from HRSG ,oily drainage wastewater surrounding tank of lubricant and domestic sewage from office and accommodation for staff.
Main pollutants from waste water are following;

- thermal water from condense：temperature rise, residual chlorine
- waste water from raw water treatment plant：high salinity
- regeneration waste water from demineralization plant：SS, acid , alkali
- blow water from HRSG：SS, acid , alkali
- oily drainage wastewater surrounding tank of lubricant：oil
- domestic sewage ：SS, organic matter

Thermal water

Water intake/discharge method shall be selected to prevent the recirculation of intake/discharge, promote the mix with the surrounding sea water, and minimize the area of water temperature rise.
Cooling water shall be taken from a lower water layer 6m deep, where water temperature is low at the low rate of the approximately 0.2m/s, with an intake tower installed at the point about 1.3km (7m depth) offshore from the center of the site. Observed current flows are mostly from 0.3 to 0.6m/s around the site and higher than intake flow speed, so intake of cooling water have a little impact to marine flow. Then, it shall be discharged at the high rate of 2.5m/s from the coast near the southern part of the project site.

A diffusion estimation model of thermal effluents from the power plant is calculated.
The seabed topographic data in the said sea area were set based on the bathymetric data implemented in the said sea area. The seabed topographic data were rebuilt as mesh data so that they will contribute to flow calculations and diffusion calculations.
The geometry of the coast line, etc. was read from the separately provided map, etc. to create digital data. Figure 6.2-5 shows the created seabed topography. For the flow calculation, the data were sectionalized basically at the 100m mesh and at the 200m mesh near the discharge.

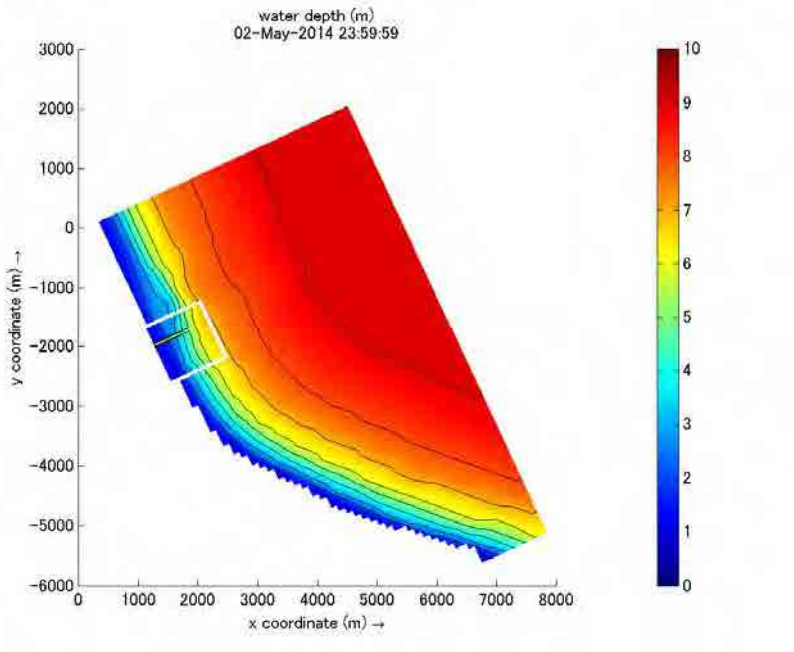


Figure 6.2-5 Sea Bed Topography

＜Prediction result＞

Figure 6.2-6 shows the calculation results of dispersion of thermal effluent. In the case of the southeast current at 0.3m/s, the surface water temperature increases to 5℃, compared with 14℃ at the intake (namely 19℃), in the areas within about 180m from the water outlet in the direction of offshore and about 100m in the direction of the coast. This is below the Azerbaijan standard which allows the increase of more than 5℃ within 500m.

In the case of the southeast current at 0m/s, the surface water temperature increases to 5℃ in the areas within about 350m from the water outlet in the direction of offshore and about 450m in the direction of the coast. This is also below the Azerbaijan standard.

Thermal effluent moves and spreads around 0-3m depth just after water discharge and spreads further with the water temperature decreasing gradually. In the case of the southwest current at 0m/s, the area of the temperature rise is wide as above. Nevertheless, in the area 300m offshore from the outfall more than five degree rise ranges between 0m and 1m deep and more than three degree rise ranges between 0m and 2m. Namely, this area of the temperature rise does not reach the seabed.

This prediction was conducted based on the worst case scenario, which is that the water temperatures at intake point and discharge point are same.

Practically, water will be intake at 6m below surface level, and water temperature at intake point is reported 1 to 2℃ lower than the surface water temperature of discharge point, according to the water temperature data around the proposed power plant during spring and summer season.

Therefore, the range or area of temperature increase becomes smaller than the prediction result in spring and summer season.

The appropriate amount of chlorine will be added into cooling water to prevent shellfish from adhering to pipes, so that residual chlorine concentration in thermal effluent will be below the IFC/WB guidelines (0.2mg/L).

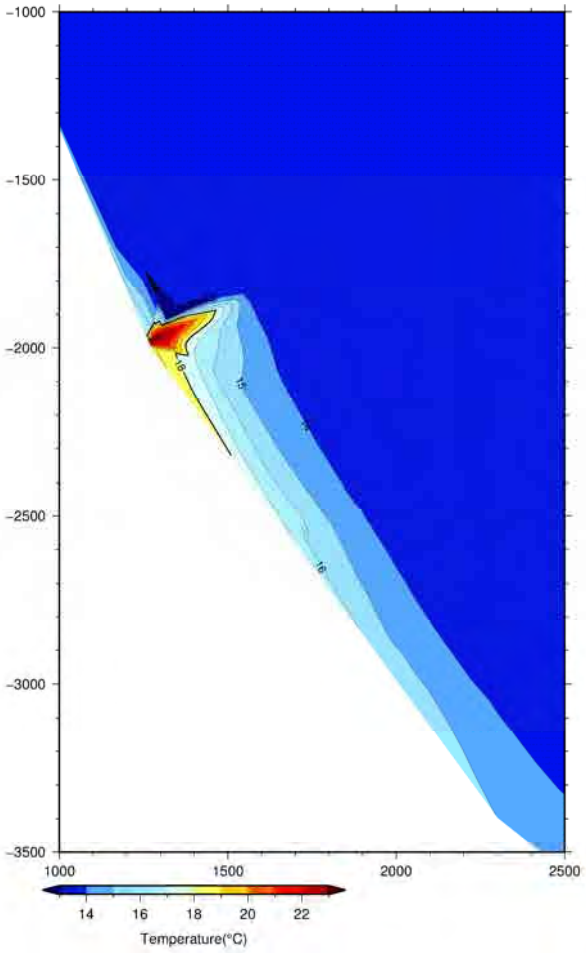


Figure 6.2-6 (1) Dispersion of Thermal Effluent (Current speed 0.3m/s:SE)

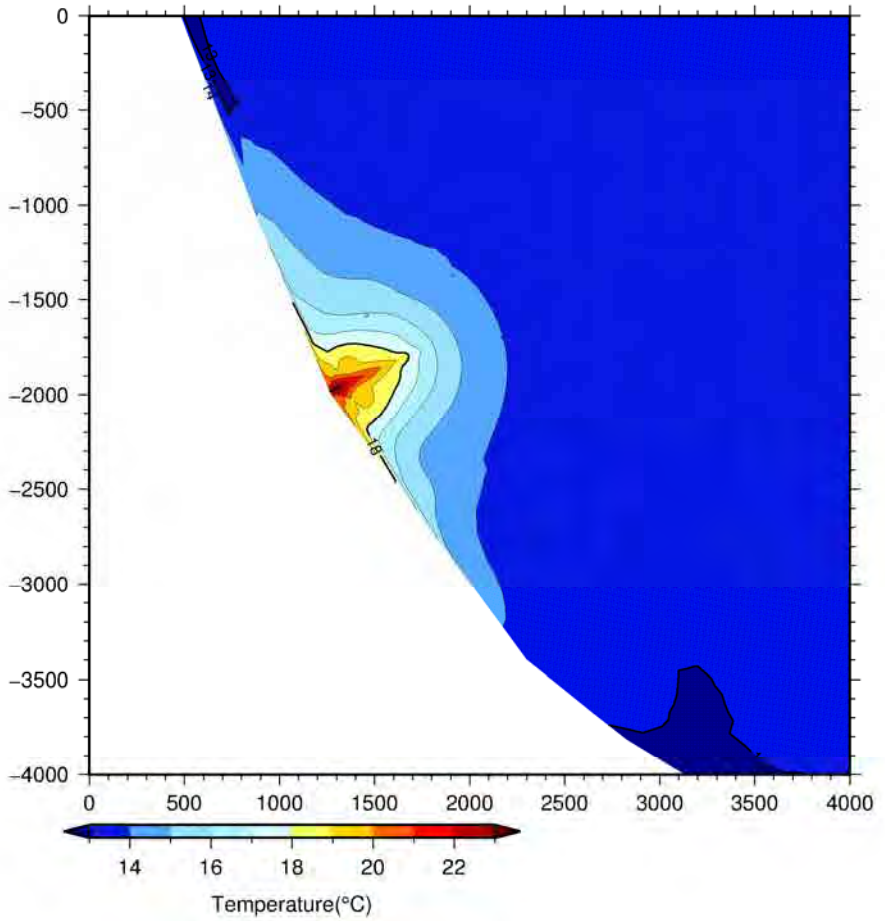


Figure 6.2-6 (2) Dispersion of Thermal Effluent (Current speed 0m/s)

Plant wastewater, oil-containing wastewater, and domestic wastewater
Wastewater from raw water treatment plant (desalination plant) and regeneration waste water from demineralization plant, blow water from HRSG,, oily drainage wastewater surrounding tank of lubricant and domestic sewage will collect in the wastewater treatment system. The wastewater treatment system will consist of neutralization, coagulating sedimentation, filtration, oil separator and aeration, which is described in Figure 2.2 9.

Wastewater will be managed and treated appropriately to comply with water quality of Azerbaijan regulations and IFC/EHS Guideline values for thermal power plants. Treated wastewater will be mixed and diluted with a large volume of thermal effluents.

The impact on water quality by the power plant operation is considered to be insignificant, because the impact intensity, duration and coverage area will be low, long term and limited, respectively.

c) Waste
General waste and hazardous waste will be generated. Workers in the power plant will produce sewerage and garbage. Waste oil will be generated from the operation and maintenance of the facilities. Sludge will be generated through precipitation treatment at the supply water treatment facility and the wastewater treatment facility.

Separating waste collection, recycling and reuse of waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to the related regulations. Hazardous waste will be treated under the related regulations.
Specifically, paper wastes and iron scraps will be recycled. Other general wastes will be collected by Sumgayit city and carried to existing disposal fields.
All of the hazardous waste will be disposed by a waste management company approved by the government at disposal fields in Sumgayit which are permitted by the government in accordance with the Azerbaijan legislation.
.
The above measures will be taken to ensure that water pollution or sanitary problems resulting from waste do not arise.

d) Soil contamination
Lubrication oil spilled during operation of the power plant are likely to cause contamination in the soil.
Project proponent will store oil and chemical materials in a storage tank and area with dyke of concrete and method to prevent permeation into ground.

e) Noise and Vibration
<Noise>
Noise impact from the plant operation is predicted. There are residences near the project site, and sufficient consideration must be given to minimizing noise impact. The level of noise resulting from the operation of the major equipment was simulated using the following estimation model.

Noise level estimation model
An estimation of the noise level was made according to Construction Phase.

Result of simulation
Figure 6.2-7 shows the distribution of noise levels.
Noise level generated by power plant operation is 34 - 48dB (A) at the boundary of the power plant site and 38 - 45 dB (A) at the residence.

The noise levels at all the points satisfy the day-time and night-time noise level standard of Azerbaijan and IFC/WB guideline.
Maintenance of equipment will be conducted and low noise type equipment and adequate enclosures will be installed.
Noise influence on residential areas to the south of the site will be reduced with tree-planting around employees' house and the site boundary within the south of the site.
Furthermore, sound insulating walls will be installed as necessary.



(Source: JICA Study Team)

Figure 6.2-7 Results of Simulating Noise Level rom Power Plant

<Vibration>

Vibration impact from the plant operation is predicted. There are residences near the project site, and sufficient consideration must be given to minimizing vibration impact. The level of vibration resulting from the operation of the major equipment was simulated using the following estimation model.

Vibration level estimation model

An estimation of the vibration level was made according to Construction Phase.

Result of simulation

Vibration level generated by power plant operation is 0 - 25dB at the boundary of the power plant site and 6- 19 dB (A) at the residence.

The vibration levels at all points is low level and satisfy with standard of Japan (Day:55dB, Night:45dB).

Furthermore, all the predicted values are enough below the threshold level, around 50dB, at which human being can feel vibration. Almost all of them are also below the minimum measured level of vibration (25dB).

Buildings will be constructed with strong foundation.

Maintenance of equipment will be conducted and low vibration type equipment and adequate enclosures will be installed.

f) Odor

In case domestic waste from the workers' camp is not appropriately treated, the rotting waste may produce a foul odor. Before starting the construction work, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced. These measures will be taken to minimize the generation of odor.

g) Substratum contamination

Sediment pollution may occur in the case power plant wastewater and domestic wastewater flows into the sea.

Wastewater will collect in wastewater treatment system. It will be managed and treated appropriately to comply with water quality regulations.

2) Natural environment

a) Terrestrial ecosystems and rare species

The site has a small sandy beach. Herbs and shrubs are scarce. Loss of habitat of animals and vegetation is expected. However similar environment extends into surrounding broad sandy beach areas. Limited impact on the ecosystems is expected.

Precious plants, amphibians, reptiles, mammals and birds on the Red Book of Azerbaijan have not been seen in the power plant site.

Power plant will generate air pollution, noise and vibration, etc. that will have impact on the terrestrial ecosystems. However, the range of such impact will be very limited.

Mitigation measures for air pollution, noise and vibration will be implemented.

Bird hunting by workers shall be prohibited.

The south of the site near the employees' house and the site boundary is vegetated with plants living in the surrounding coast or plant species resistant to salt damage.

b) Marine ecosystems and rare species

Taking in organisms by cooling water intake, pollutants discharged from plant waste water and oil-containing waste water, and rises in the temperature of thermal water are expected to have impact on marine organisms.
Cooling water shall be taken at the low rate to minimize intake of fish and other marine organisms. Smaller fish in the sea area have sufficient swimming ability in comparison to the flow rate of water intake, and it is considered they will not be affected as a consequence.

Plankton is likely to die and damage from water intake because of no mobility. However, according to the biological monitoring results conducted over 30 years at a power plant in Japan, relatively-prompt reproduction of plankton was observed and little impact on plankton was ensured.

Water intake/discharge method shall be selected to minimize the area of water temperature rise.
According to the diffusion simulation, the area of 5^{o} C or higher temperature rise is 100m from the water outlet, which is very limited, and well meets the environmental standard (500m) of Azerbaijan.
Results of monitoring in Japan also reported that fish can avoid unfamiliar water temperature with their mobility. Conversely, there are many reports on species which gather around outfall. Benthonic organisms and sea grass without mobility will be affected most significantly. This impact can be seen only in range of a more than three degree rise in water temperature near outfall and there is no impact in areas of a less than three degree water temperature rise.
There are accumulations of *Zostera noltii* on the coastal line. In the area 300m offshore from the outfall, more than five degree rise ranges between 0m and 1m deep and more than three degree rise ranges between 0m and 2m. Namely, this area of the temperature rise does not reach the seabed so the impacts can be localized.
If sea grass will widely disappear by thermal water, creation of see grass bed will be conducted for fishes and benthos with cooperation of MENR.

All waste water is treated at the treatment system so that the concentration of pollutant in waste water meets the standard of IFC/WB EHS Guidelines and other standards before discharge.

c) Marine hydrology
Because cooling water will be intake and discharged, there will be changes in flow conditions in the vicinities of the discharged.

The thermal effluent calculation includes the flow rate change estimation.
The existing and future water flow speed distribution is shown in Figure 6.2-8.
Water temperature rise due to condenser shall be maintained ⊿9° C to minimize the amount of cooling water.
Water shall be taken at the low rate of 0.2m/s which is not much faster compared with the current speed in the present marine area. That means water flow change will not be affected by water intake.
According to the flow rate change estimation, the flow speed at the point about 100m away from the water outlet is almost same as the surrounding speed. Therefore, the environmental impact will be localized.

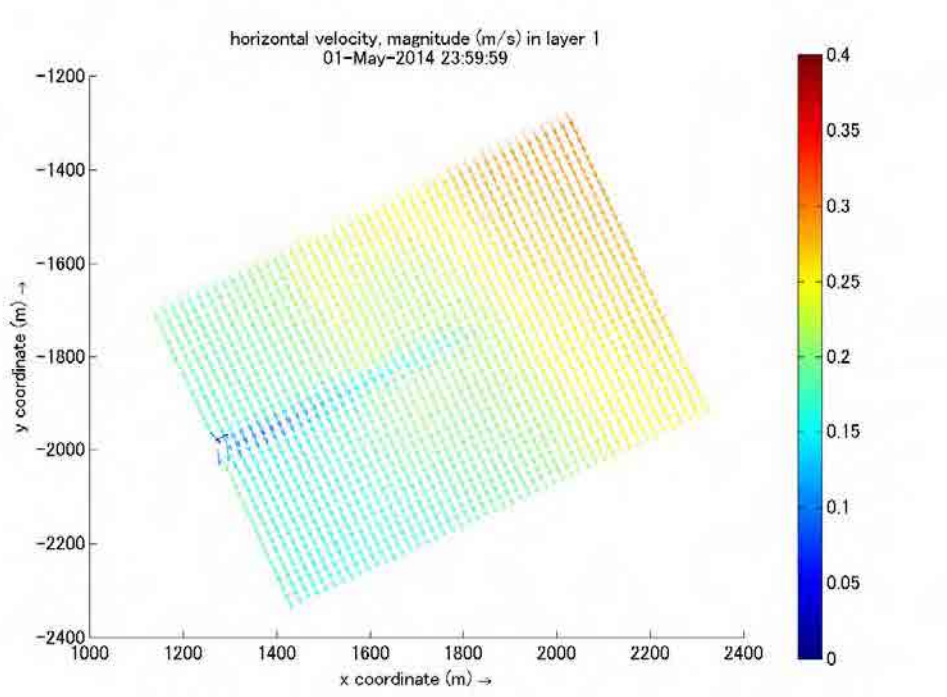


Figure 6.2-8 (1) Flow condition without thermal effluent (The present：Current speed 0.3m/s:SE)

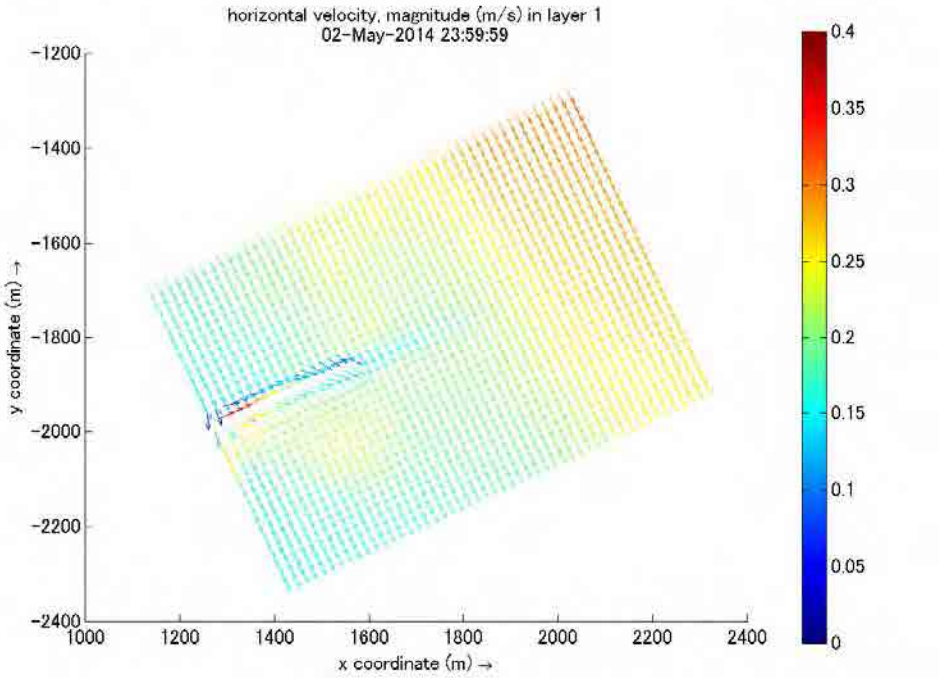


Figure 6.2-8 (2)　Flow condition with thermal effluent (The future：Current speed 0.3m/s:SE)

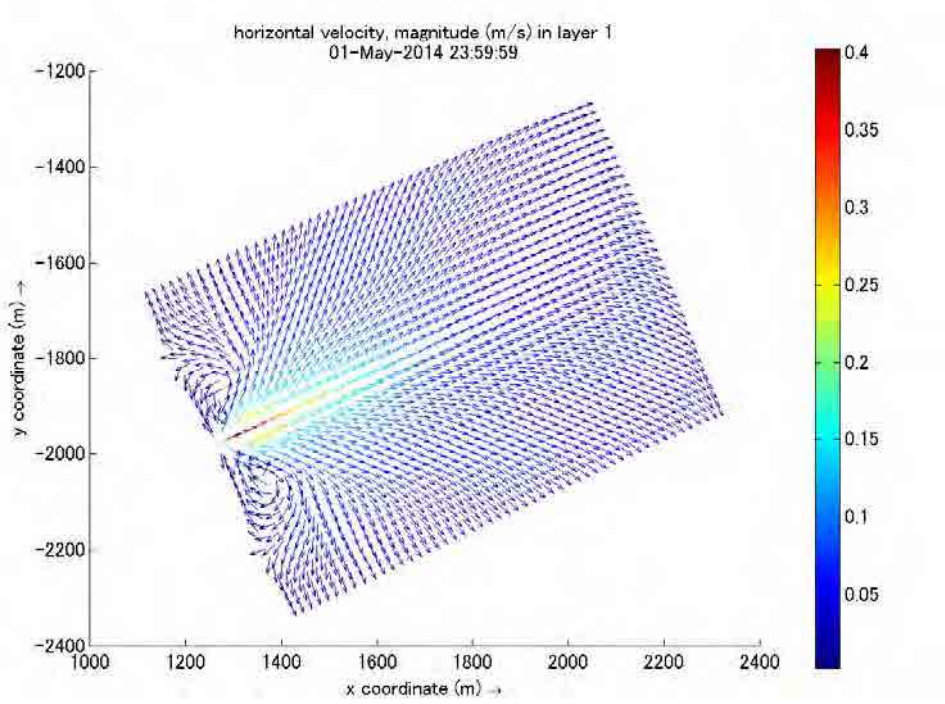


Figure 6.2-8 (3)　Flow condition with thermal effluent (Current speed 0m/s)

(3) Social environment

a) Local economy including employment and means of livelihood

Since the site is governmental land and not been used for farmland and residential area, .the operation will have no impact.

Local people may be employed as workers by the power plant. It may purchase materials and equipment items in the local area.

Project proponent will employ local residents as many as possible and use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible.

Job training will be provided as necessary for new employees.

b) Water use.

There are few large ships at the sea with shoals in front of the plant, where water depth gets 7m around 1.3km off the coast.

The fishing in front of the project site is prohibited. In addition, though some people enjoy fishing with small boats for a recreational purpose, any other recreation activities are not conducted along the seashore.

Installation of water taking and discharging facilities and changes in flow conditions may have impact on navigation of small boats of recreational fishing..

Water shall be taken at the low rate of 0.2m/s which is not much faster compared with the current speed in the present marine area. That means water flow change will not be affected by water intake.

According to the flow rate change estimation by the discharged thermal water, the flow speed at the point about 100m away from the water outlet is almost same as the surrounding speed. Therefore, the environmental impact will be localized.

The location of offshore water intake equipment shall be marked with a buoy installed around the equipment.

Taking organisms by cooling water intake, pollutants discharged from plant waste water and oil-containing waste water, and rises in the temperature of Thermal water may cause impact on the recreational fishing.

Cooling water shall be taken at the low rate to minimize intake of fish and other marine organisms. Water intake/discharge method shall be selected to minimize the area of water temperature rise.

According to the diffusion simulation of thermal water, the area of 5^{o} C or higher temperature rise is very limited, and well meets the environmental standard of Azerbaijan.

All waste water is treated at the treatment system so that the concentration of pollutant in waste water meets the standard of IFC/WB EHS Guidelines and other standards before discharge.

c) Existing social infrastructure and social service

Lodging houses, medical treatment facilities, sewer systems and other infrastructure may be needed for workers.

The housing for the workers shall be organized within the site.

In the period of regular maintenance in which larger number of workers are expected, properly control maintenance schedule and processes and the traffic control plan including route-setting will be conducted

d) Unfair distribution of damage and benefit

If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.

The employment of the local people shall be conducted under publicized employment conditions to prevent unfair employment.

e).Work environment (including labor safety)
Workers may have accidents during service.
Project proponent will develop the safety and sanitation management plan and implement the regular medical checkup.
Project proponent will subcontract a security firm to deploy security guards.

4) Other
a) Accident
Fire and traffic accidents by operation of facilities and / or vehicles may be occurred.
Project proponent will develop gas-leakage prevention management plan.
Gas-leakage alarm system and fire-fighting facility will be installed.
The land transportation at the periodic inspection shall be basically conducted using the existing highways and other roads.

b) Impact across the borders and on climatic change
CO_2 is produced by the project operation, but with high-efficiency CCPP, CO_2 generation per kWh is lower than in the conventional power generation system and the cross-boundary pollution and impact on climate change will be little.

6.2.2 Transmission line and substation

(1) Construction phase

1) Pollution
a) Air quality
Generation of dust is expected by land preparation, and generation of air pollutants (SOx and NOx, etc.) is predicted from the operation of heavy machinery and trucks, but the impact will be not large.
Because area of tower base will be not large and numbers of heavy machinery and trucks will be few.
Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce exhaust gas discharged from construction machinery and vehicles.

b) Waste
Waste generated from the construction work will include metal chips, waste plastic, wood shavings, waste glass and waste oil. Furthermore, household waste discarded from the camping site of the workers will include cans, bottles and garbage. If such waste is inadequately handled, sea water may be contaminated, and sanitation problems may arise.

Because numbers of workers and heavy machinery and trucks will be few, so but the volume of waste will be not large.

Development of waste management program including education of workers to encourage reduction and reuse of waste will be promoted.
Non-recyclable and hazardous waste will be stored and disposed at appropriate sites according to related regulations.

c) Soil contamination
Soil pollution will possibly be caused by leakages of oil and chemical materials at the construction site. Oil and chemical materials will be stored at an appropriate storage site to

prevent any permeation into the ground. These measures will minimize the impact of any soil contamination.

d) Noise and Vibration

Operation of heavy equipment and trucks will cause impact from the temporary noise. But the impact will be not large, because area of tower base will be not large and numbers of heavy machinery and trucks will be few.

Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce noise and vibration from construction machinery and vehicles.

e) Odor

In case domestic waste from the workers' camp is not appropriately treated, the rotting waste may produce a foul odor.

Because numbers of workers will be few, so but the volume of waste will be not large. Before starting the construction work, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced. These measures will be taken to minimize the generation of odor.

2) Natural environment

a) Terrestrial ecosystems and rare species

Loss of habitat of animals and vegetation is expected. However similar environment extends into surrounding broad semi desert areas.

Because area of tower base will be not large, the impact will be not large. Limited impact on the ecosystems is expected.

Precious plants, amphibians, mammals on the Red Book of Azerbaijan have not been seen on the transmission route.

Some precious species, Spur-thighed tortoise in reptile and Long-legged buzzard in birds, were observed. However, these live not only in the vicinity of the site.

The transmission line shall be constructed along the existing transmission line to the possible extent in order to minimize the area of alteration.

Six observed kinds of migratory birds flew more than 100m high, which are enough above the transmission lines (about 40m). Moreover, there are no rivers and lakes along them. Therefore, impact by bird strike is expected to be low.

It will be monitored whether bird strike will happen during the maintenance. Lights and signs, etc. will be installed in order to avoid bird strikes, if needed.

3) Social environment

a) Local economy including employment and means of livelihood

Since the site is governmental land and not been used for farm land and residential area, .the construction and operation will have no impact.

In the construction phase, project proponent will employ local residents as many as possible and use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible.

Job training will be provided as necessary for new employees.

b) Existing social infrastructure and social service

Inflow of some numbers of workers and traffic is expected to increase during construction. Project proponent will conduct the traffic control plan including route-setting and training safe operation of vehicles.

c) Unfair distribution of damage and benefit

If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.

The employment of the local people shall be conducted under publicized employment conditions to prevent unfair employment.

d) HIV/AIDS and other infectious diseases

Inflow of small numbers of workers is expected. A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc. Local people should be recruited for simple work as much as possible so to minimize the risk of infectious diseases being transmitted from external workers. Pre-employment and periodic medical check-ups should be conducted for external workers (technical workers, etc).

e).Work environment (including labor safety)

Workers may have accidents during service.

Project proponent will develop the safety and sanitation management plan and implement the regular medical checkup.

Project proponent will subcontract a security firm to deploy security guards.

4) Other

a) Accident

Traffic accidents may occur during operation of vehicles.

As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving will be implemented. People in the surrounding villages shall be informed of the bus schedules.

b) Impact across the borders and on climatic change

CO_2 is generated during construction, but the impact is limited to a temporal period.

Periodic checkup and maintenance of heavy machine and Vehicles will be conducted.

(2) Operation phase

1) Pollution

a) Noise and vibration

Noise will generate from transformer in the substation. There are no residences near the substation site, impact is not so large.

Maintenance of equipment will be conducted and low noise type equipment will be installed.

2) Natural environment

a) Terrestrial ecosystems and rare species

The power transmission line may cause bird strikes.

Though the transmission line is within a migratory path of migrant birds, it shall be constructed along the existing transmission line to the possible extent in order to minimize.

As the transmission of this project is about 40m high at the highest, it will not influence on migrant birds flight.

In the case there is evidences of bird strikes at the periodic check, installing lights or signs to prevent birds from striking the transmission lines is considered , if need.

3) Social environment

a) Work environment (including labor safety)

Workers may have accidents during maintenance.

Safety standards based on laws will be complied with and safety and sanitation management plan will be developed and Manual will be established for labor accident prevention including safety education and training.

4) Others

a) Accident

Steel towers may fall down due to a storm, heavy rain, etc. Regular inspection of transmission tower will be conducted.

6.2.3 Gas pipeline

(1) Construction phase (including of pre-construction phase)

1) Pollution

a) Air quality

Generation of dust is expected by land preparation, and generation of air pollutants (SOx and NOx, etc.) is predicted from the operation of heavy machinery and trucks, but the impact will be not large. Because numbers of heavy machinery and trucks will be few. Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce exhaust gas discharged from construction machinery and vehicles.

b) Water pollution

The part of gas pipeline will be built in river side , soil of some embankments and earth cuts may overflow into the river.

Gas pipeline route was selected avoiding any steep sloped areas.

Preventing soil loss by stabilizing any slopes of construction areas with concrete will be conducted, as necessary based on geological survey

c) Waste

Waste generated from the construction work will include metal chips, waste plastic, wood shavings, waste glass and waste oil. Furthermore, household waste discarded from the camping site of the workers will include cans, bottles and garbage. If such waste is inadequately handled, sea water may be contaminated, and sanitation problems may arise.

Because numbers of workers and heavy machinery and trucks will be few, so but the volume of waste will be not large.

Development of waste management program including education of workers to encourage reduction and reuse of waste will be promoted.

Non-recyclable and hazardous waste will be stored and disposed at appropriate sites according to related regulations.

d) Soil contamination

Soil pollution will possibly be caused by leakages of oil and chemical materials at the construction site. Oil and chemical materials will be stored at an appropriate storage site to prevent any permeation into the ground. These measures will minimize the impact of any soil contamination.

e) Noise and Vibration

Operation of heavy equipment and trucks will cause impact from the temporary noise. But the impact will be not large, because area of tower base will be not large and numbers of heavy machinery and trucks will be few.

Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce noise and vibration from construction machinery and vehicles.

f) Odor

In case domestic waste from the workers' camp is not appropriately treated, the rotting waste may produce a foul odor.

Because numbers of workers will be few, so but the volume of waste will be not large. Before starting the construction work, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced. These measures will be taken to minimize the generation of odor.

2) Natural environment

a) Terrestrial ecosystems and rare species

Loss of habitat of animals and vegetation is expected. However similar environment extends into surrounding broad semi desert areas.

Because area of tower base will be not large, the impact will be not large. Limited impact on the ecosystems is expected.

There are precious kinds of plants and amphibians on the Red Book of Azerbaijan on the gas pipeline route. Some precious species, Spur-thighed tortoise in reptile, Long-legged buzzard and White-tailed eagle in birds, were observed but these inhabit not only the vicinity of the route.

During the construction period, impacts will be short-term because the pipeline will be buried in the underground and filled just after excavation.

3) Social environment

a) Local economy including employment and means of livelihood ,Land use and utilization

Since the site is governmental land and not been used for farm land and residential area, .the construction and operation will have no impact.

Local people may be employed as workers by the power plant. It may purchase materials and equipment items in the local area.

Project proponent will employ local residents as many as possible and use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible.

Job training will be provided as necessary for new employees.

b) Existing social infrastructure and social service

Inflow of some numbers of workers and traffic is expected to increase during construction.

Project proponent will conduct the traffic control plan including route-setting and training safe operation of vehicles.

c) Unfair distribution of damage and benefit

If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.

The employment of the local people shall be conducted under publicized employment conditions to prevent unfair employment.

d) HIV/AIDS and other infectious diseases

Inflow of small numbers of workers is expected. A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc.

Local people should be recruited for simple work as much as possible so to minimize the risk of infectious diseases being transmitted from external workers. Pre-employment and periodic medical check-ups should be conducted for external workers (technical workers, etc).

e).Work environment (including labor safety)

Workers may have accidents during service.

Project proponent will develop the safety and sanitation management plan and implement the regular medical checkup.

Project proponent will subcontract a security firm to deploy security guards.

4) Other

a) Accident

Traffic accidents may occur during operation of vehicles.
As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving will be implemented. People in the surrounding villages shall be informed of the bus schedules.

b) Impact across the borders and on climatic change
CO_2 is generated during construction, but the impact is limited to a temporal period.
Periodic checkup and maintenance of heavy machine and Vehicles will be conducted.

(2) Operation phase

1) Social environment
Workers may have accidents during maintenance.
Safety standards based on the laws are complied with and safety and sanitation management plan will be developed and Manual will be established for labor accident prevention including safety education and training.

2) Others
a) Accident
Gas leakage may occur from the pipeline.
Gas-leakage prevention management plan will be developed and Gas-leakage alarm system automatic control system will be installed.
Regular inspection of the pipeline will be conducted.

EIA ANNEX 6-1

Air Quality Simulation by Model

Annex 6-1 Air Quality simulation by model

Emission gas

Nitrogen oxides (NOx) will be generated by the operation of gas turbine of the power plant. Low-NOx Burner will be adopted in this turbine, and exhaust concentrations will be kept below emission standards a of the IFC/WB EHS guidelines.

Table 6.1-1 Emission Concentration and Emission Standard

Item	Unit	Proposed Concentration	IFC/WB EHS guidelines (Thermal power plants; 2008)
NOx	mg/Nm^3	＜510	510

Note: O_2＝15% equivalent

(Source: JICA Study Team)

The prediction on impact regarding dispersion of air pollutant is approached by mathematical models. The model regarding dispersion of air pollutant is shown in the following formula, Gaussian models.

$$C(x,y,z)=\frac{Q_p}{2\pi\ \sigma_y\sigma_z U}\cdot\exp\left(-\frac{y^2}{2\sigma_z^{\ 2}}\right)\left[\exp\left\{-\frac{(z-He)^2}{2\sigma_z^{\ 2}}\right\}+\exp\left\{-\frac{(z+He)^2}{2\sigma_z^{\ 2}}\right\}\right]\times 10^6$$

C : Ground concentration at a point R (m) below the downwind axis

Q p : Emission volume (g/s)

σ y : Parameter in the horizontal direction (m)

σ z : Parameter in the vertical direction (m)

u : Wind speed (m/s)

R : Horizontal distance between emission source and calculated point (m)

z : Ground height

He: Effective stack height (m)

He＝H+ΔH

H: Stack height (m)

ΔH: Emission gas elevation height (m): following CONCAWE formula

$\Delta H = 0.175\ QH^{1/2}u^{-3/4}$

ΔH: Emission elevation height (m)

QH: Exhaust heat (cal/s)

u : Wind speed at the top of stack (m/s)

$QH = \rho \cdot Q \cdot Cp \cdot \Delta T$

ρ : Emission gas density at 0 ℃ (cal/s) (1.293×10^{3} g/m^{3})

Q: Amount of exhaust gas per unit time (Nm^3/s)

Cp: Constant pressure specific heat (0.24cal/K/g)

ΔT: Difference between emission gas temperature and atmospheric temperature (K)

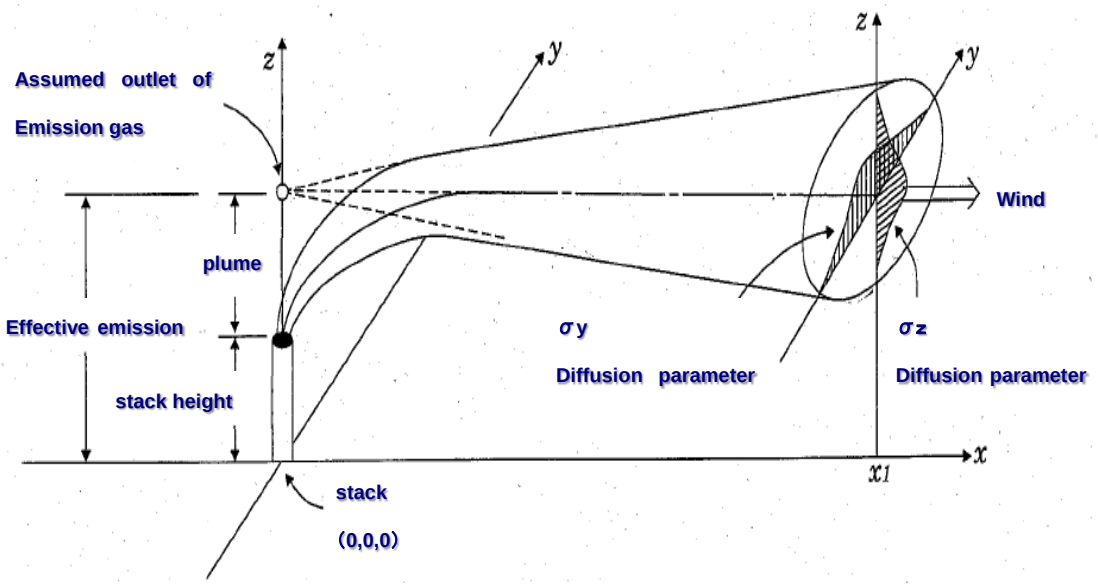


Figure6.1-1 Gaussian Diffusion Model Diagram

Reference: Lecture of Air Environment Prediction, Shinichi Okamoto, 2001

Emission specifications

Since natural gases will be used as fuels, sulfur oxides and dust (PM: particle matters) will not be generated.

Table 6.1-2 shows the exhaust volume, temperature, speed, and emissions of nitrogen oxides (NOx) emitted from the stack are assumed to become NO_2 respectively.

Table 6.1-2 Emission Specifications

Item	Unit	CCPP 1	CCPP 2
Emission volume (wet)	Nm^3/h	$2{,}193\times10^3$	$2{,}193\times10^3$
Exhaust temperature	ºC	95	95
Exhaust speed	m/s	25	25
Stack height	m	80	80
Diameter of stack	m	6	6
NOx	kg/h	135.9	135.9

Notes: The values indicate the values under the maximum continuous load.

(Source: JICA Study Team)

Meteorological Conditions

Atmospheric stabilities at the stack outlet level tend toward neutral compared to the stabilities at ground level, according to the Pasquill stability categories shown below and wind speed. In simulating a dispersion model, atmospheric stabilities at the stack outlet level was set on rather the neutral side than the stabilities at ground level; for example, stability “A” was replaced with stability “B”, stability “B” was replaced with “C” and “C” was replaced with “D”.

Table 6.1-3 Pasquill Stability Categories

Wind speed at Ground Level U (ms^{-1})	Daytime				Nighttime (Rate of Solar Radiation = 0)
	Rate of Solar Radiation Q (unit 0.01 kWm^{-2})				
	60 – Q	30 - 59	15 - 29	1 - 14	
U – 2.0	A	A-B	B	D	F
2.0 - 2.9	A-B	B	C	D	E
3.0 - 3.9	B	B-C	C	D	D
4.0 - 5.9	C	C-D	D	D	D
6.0 – U	C	D	D	D	D

Note: This category shows the stability of the atmosphere proposed by Pasquill. Category A indicates very unstable atmospheric condition; category B unstable atmospheric condition; category C less unstable; category D neutral; category E less stable; and category F stable.

(Source: http://www.env.go.jp/recycle/misc/facility_assess/mat02.pdf)

Geographic effects

The surrounding geography more than 5km away from the site in the direction of west can be higher than the site.

In “Environmental Impact Assessment Guidelines for Power Plant” (2007) published by Ministry of Economy, Trade and Industry of Japan, the impacts of geography on the exhaust gas dispersion shall be considered in case upland with a condition below is within a 5km radius from the smoke source.

・maximum altitude / Effective stack height (Actual stack height + Emission gas elevation height) $\geqq 0.6$

In this project, effective stack height is expected to be about 200m and there is no mountainous area above 120m within 5km. Therefore, the geographic effects are not considered here.

Consideration of stack height

Unless stack height is relatively high, compared to the surrounding buildings, a phenomenon called downdraft may occur by entrainment to the ground at the downstream of the buildings as shown in Figure 6.1-2, sometimes resulting in high ground concentration of pollutant.

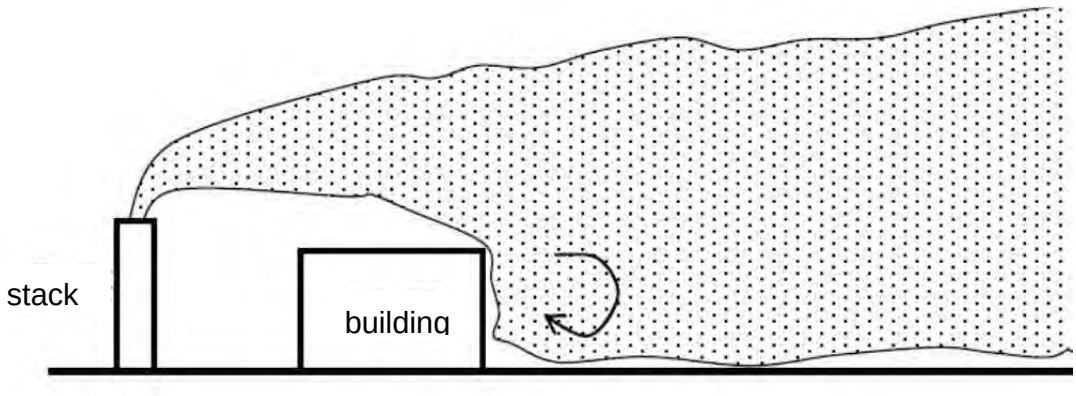


Figure 6.1-2 Diagram of Downdraft

In case that value of HG calculated by the formula shown below is higher than the stack height, the effect of downdraft needs to be considered.

HG = H + 1.5L
H = Height of nearby structure(s) above the base of the stack.(m)
L = Lesser dimension, height (h) or width (w), of nearby structures at wind flow side
"Nearby structures" = Structures within/touching a radius of 5L but less than 800 m.

With regards to this project, the highest HG value is 75m (Turbine Building); whereas, stack height is set as 80m, which is higher than the highest HG value.

Consideration according to the occurrence of downwash

When the exhaust gas velocity is lower than 1.5 times of the wind speed on stack height, there is a high concentration area of air pollutants in the ground occurs on the downwash by entrainment to the ground near stack, as shown in Figure 6.2-5.

The exhaust gas velocity at this project is 25m/s, and downwash may occur in case wind speed at stack height (80m) is 17m/s or more.

Approximately 17m/s of wind speed at the top of stack is estimated approximately 8m/s of wind speed at the height of 3m above ground level. According to the result of meteorology survey, frequency of occurrence for approximately 8m/s of wind speed is about 30%, and downwash is taken into consideration at the prediction.

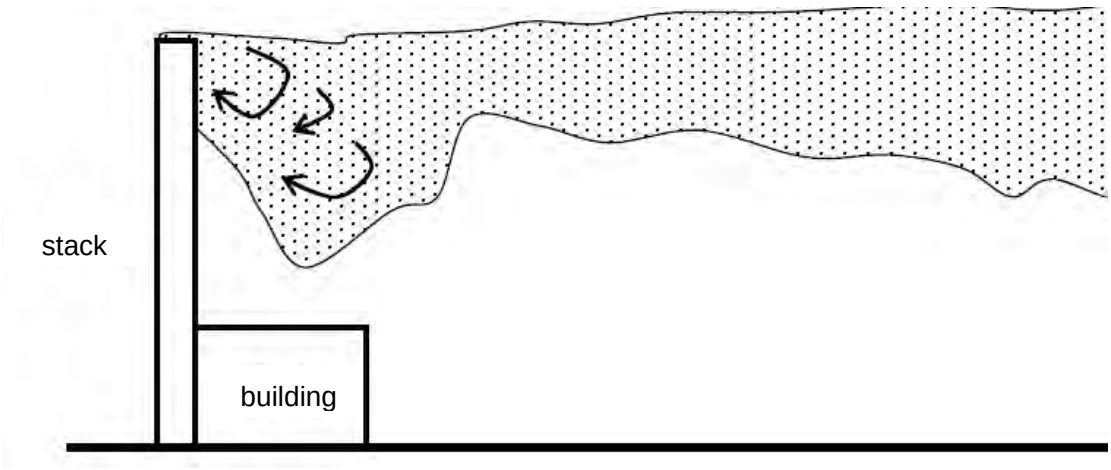


Figure 6.1-3 Diagram of Downwash

Meteorological data from Sumgayit meteorological station about 20 km southeast of the project site was used for exhaust gas dispersion model on annual average and 24–hour values.

Meteorological data for 3 years (2011-2013) was, which had 365 days of wind speed and wind direction data, was used in the simulation.

As for a 1-hour value, a dispersion model was simulated on the conditions of the stabilities and wind speed.

Table 6.1-4 and Figures 6.1-4 to Figure 6.1-6 show the prediction concentrations in ambient air quality, considering background concentration and the contributed concentration (annual average value, daily average value and 1-hour value) for this project based on the simulation. The outlines of the contributed concentration based on the simulation are described below.

The background concentration used in this study was from the short-term survey results of the existing conditions in May; therefore, these survey results are not suitable to be directly compared with the standard values of the annual average values.

- **Annual average value**

The contributed concentration from the power plant is0.6-0.7 μg/m^3 at a maximum, which is far below the measurement full limits of air quality (1μg/m^3).

The contributed concentration are less than 1/60 of IFC/WB guideline values and environmental standard values of the EU which is 40 μg/m^3..
The contributed concentration to Sumgayit, which is located 20km away in the southwest from the plant, is extremely low at 0.1-0.3μg/m^3.

- **24 hour value**

The contributed concentration from the power plant is 4.4- 7.7μg/m^3 at a maximum for 2011-2013. The contributed concentrations are less than 1/10 of Japanese ambient air quality standard values which is 75 to 110 μg/m^3.
Predicted concentration, taking into account the background concentration, is 64.4 to 90.7μg/m^3 and satisfies the ambient air quality standard of Japan.
The contributed concentration to Sumgayit is also extremely low at <1μg/m^3.

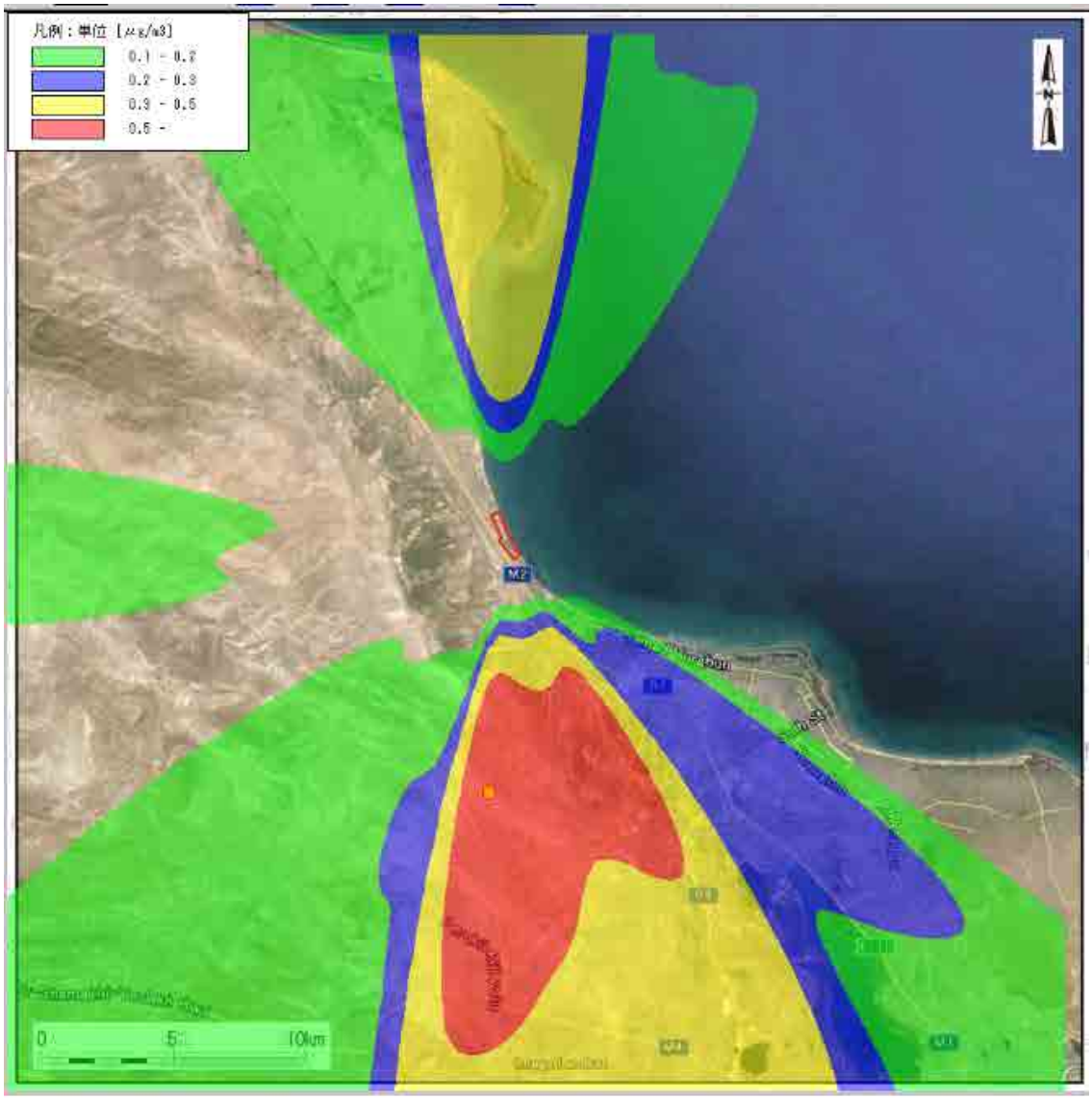
- **1 hour value**

In the case of atmospheric stability B, C and D, Contributed concentration from the power plant is 19.0 μg/m^3 at a maximum. The contributed concentrations are less than 1/10 of the IFC/WB guideline value and EU ambient air quality standard value which is 200μg/m^3.
Predicted concentration, taking into account the background concentration, is 75.9 to 119.0 μg/m^3 and satisfies the IFC/WB guideline value and EU ambient air quality standard value.
The contributed concentration to Sumgayit is also extremely low at 1-5μg/m^3.

Table 6.1-4 Dispersion Concentration of NO_2

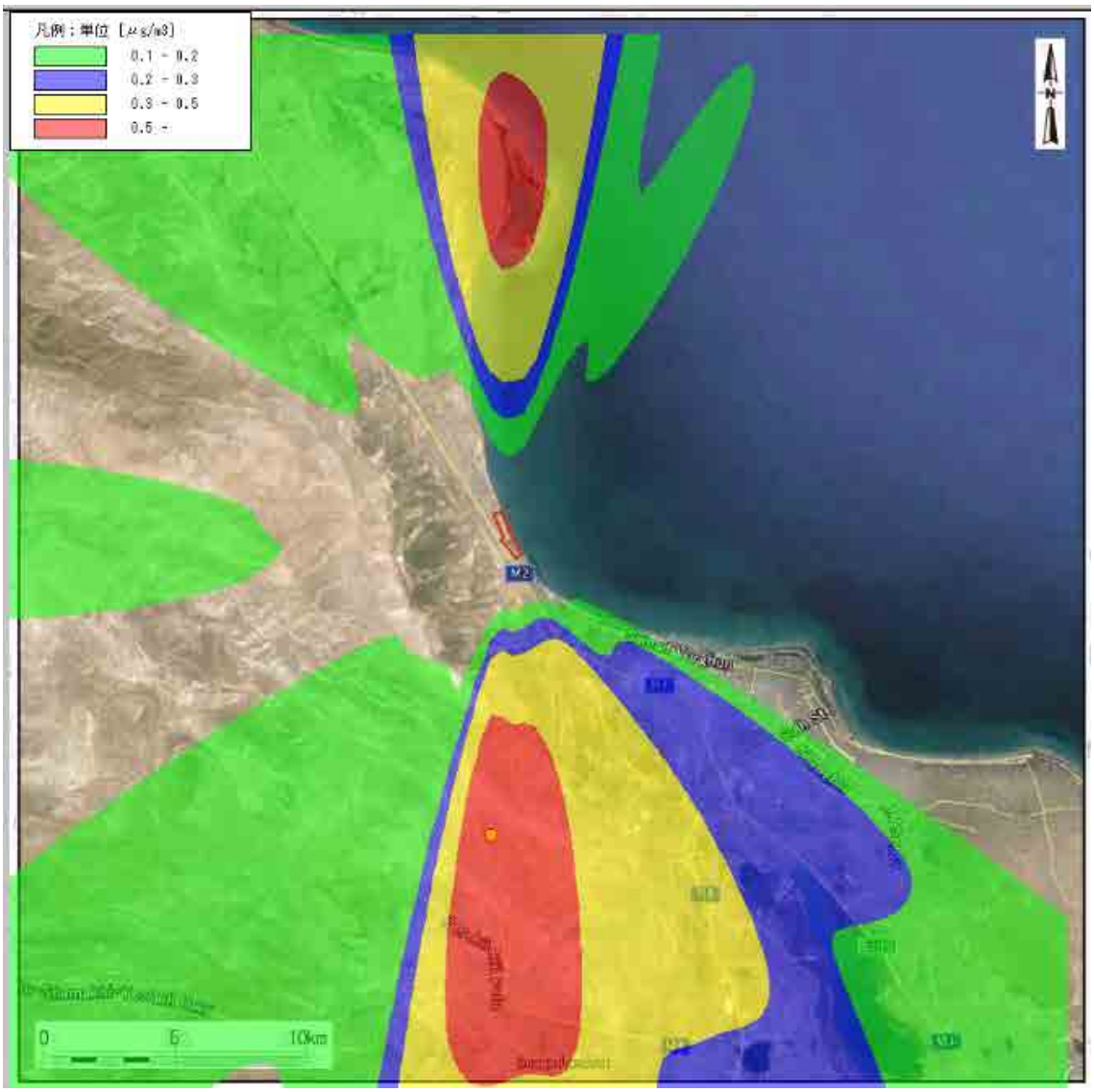
Time scale	Year	Background concentration ($\mu g/m^3$) (1)	The highest concentration ($\mu g/m^3$) (2)	The appearance distance from stack (km)	Prediction concentration in ambient air quality ($\mu g/m^3$) (1)+(2)	IFC guideline value (General 2007) ($\mu g/m^3$)	EU Standards（Japanese Standards） ($\mu g/m^3$)
Yearly Average	2011	-	0.7	8.6	-	40	40
	2012		0.6	9.7	-		
	2013		0.6	10.0	-		
24hr Average (Max)	2011	60-83	7.7	4.3	67.7-90.7	-	(75-110)
	2012		4.5	6.6	64.5-87.5		
	2013		4.4	5.4	64.4-87.4		
1hr Average (Max)	B,3.9m(Max)	70-100	19.0	2.1	89.0-119.0	200	200
	C,5.9m/s(Max)		14.4	3.0	84.4-114.4		
	D,15m/s(Max)		5.9	6.8	75.9-105.9		
	Down wash D, 30m/s(Max)		13.1	2.5	83.1-113.1		

Note: This survey result indicates only short-term result in rainy and dry season and is not suitable to be directly compared with the standard value of the annual average value.



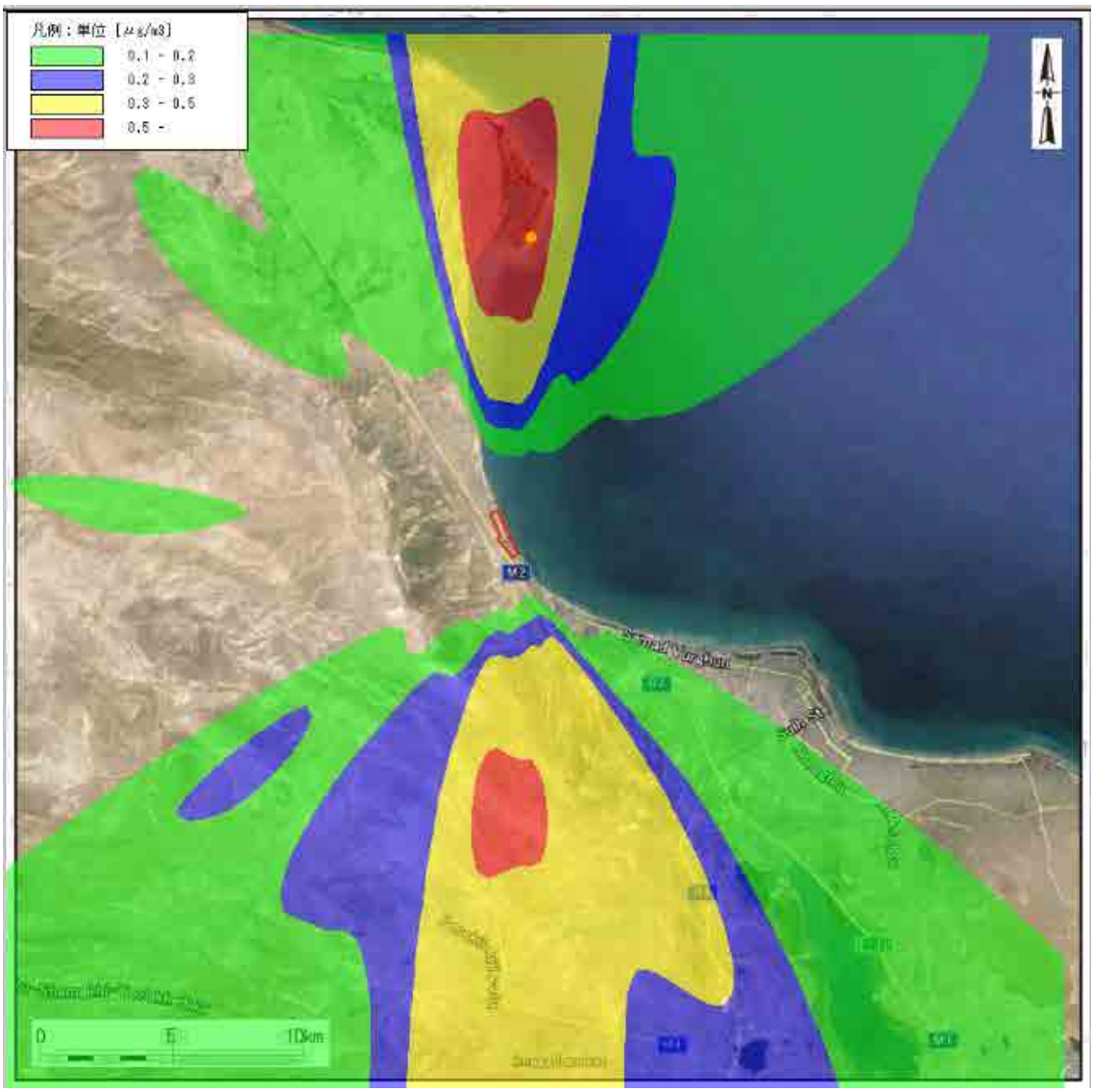
(Source: JICA Study Team)

Figure 6.1-4 (1) Dispersion concentration of NO_2 (Annual Average, 2011)



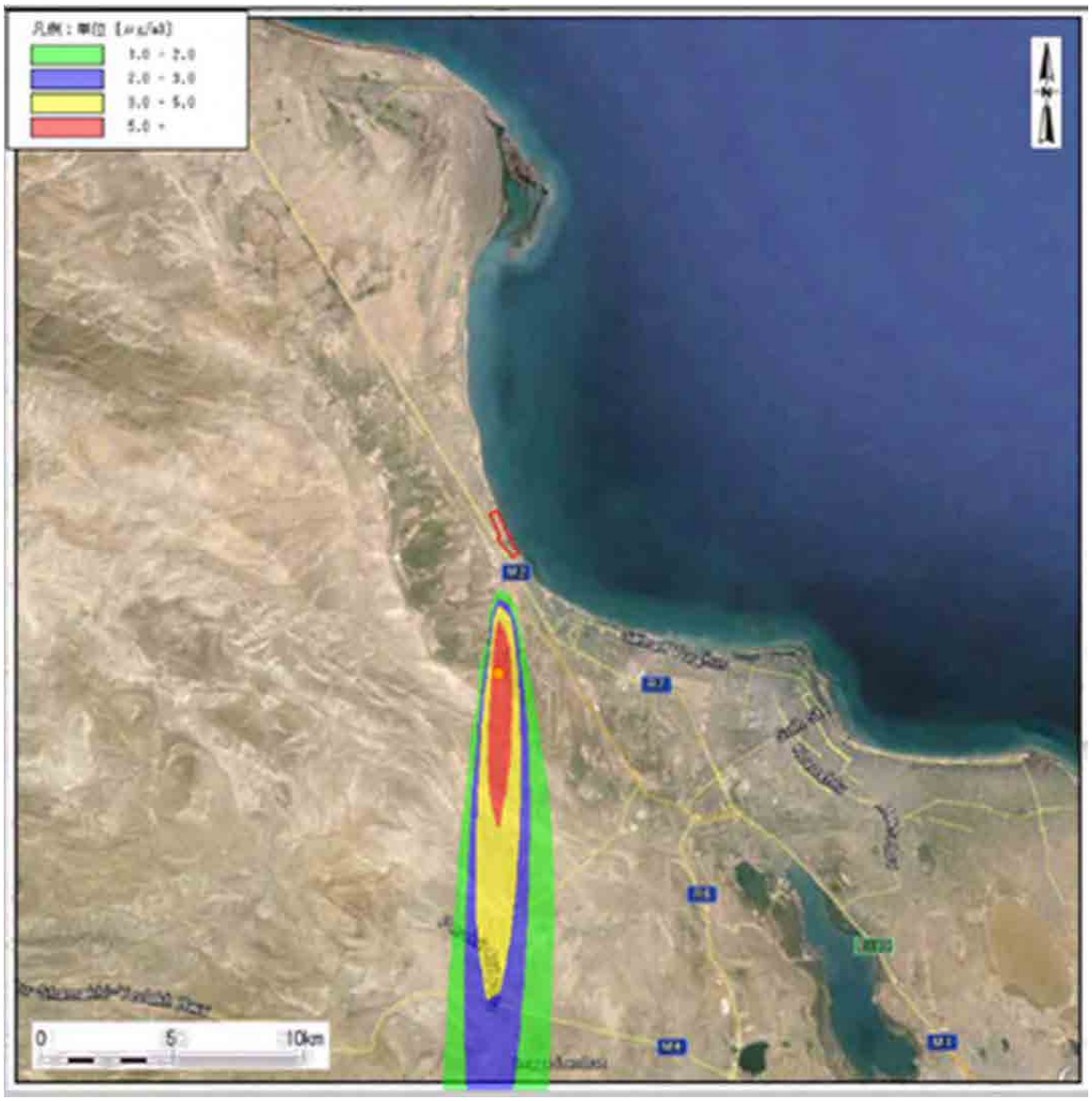
(Source: JICA Study Team)

Figure 6.1-4 (2) Dispersion concentration of NO_2 (Annual Average, 2012)



(Source: JICA Study Team)

Figure 6.1-4 (3) Dispersion concentration of NO_2 (Annual Average, 2013)



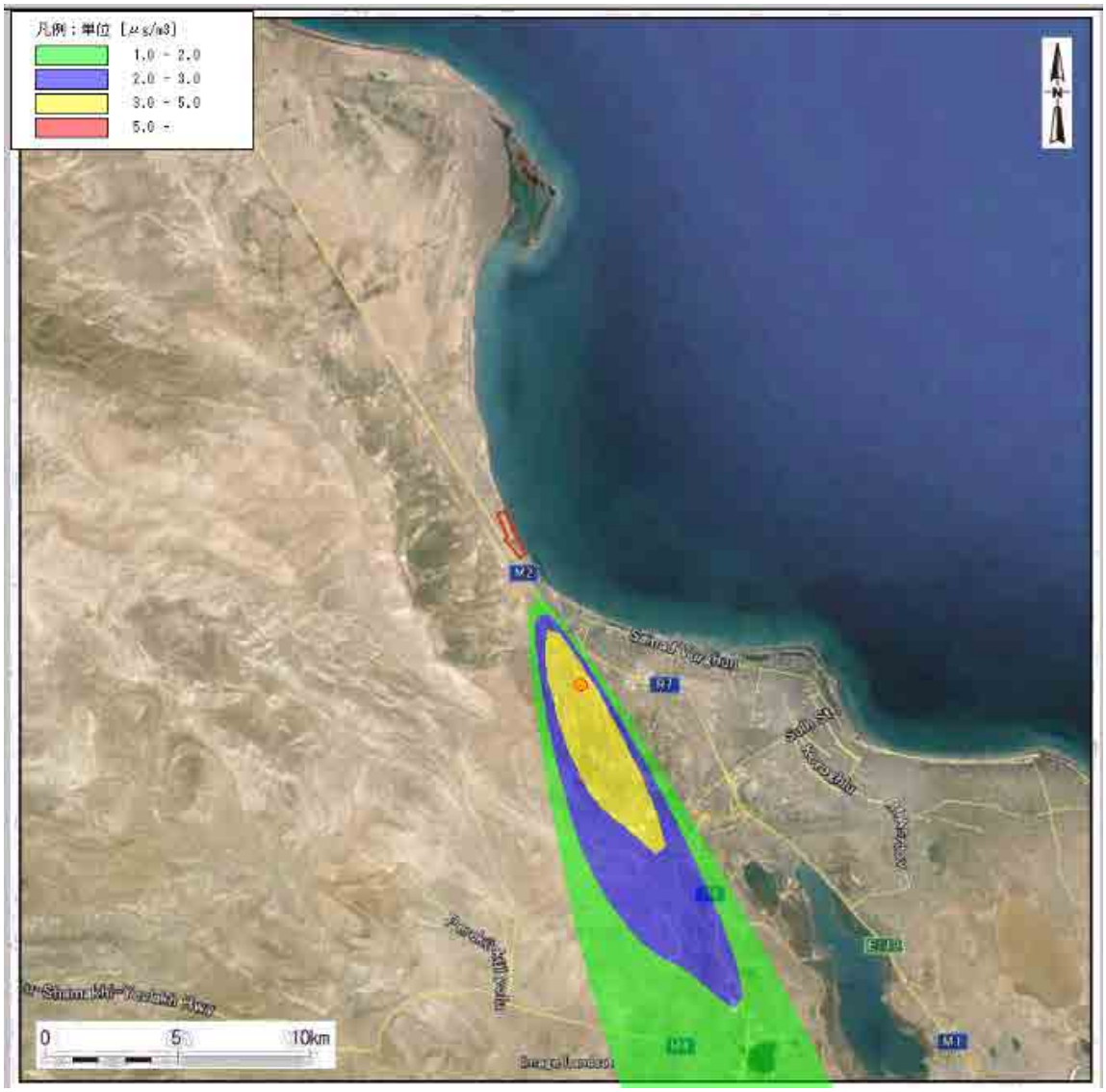
(Source: JICA Study Team)

Figure 6.1-5 (1) Dispersion concentration of NO_2 (24 hr Maximum, 2011)



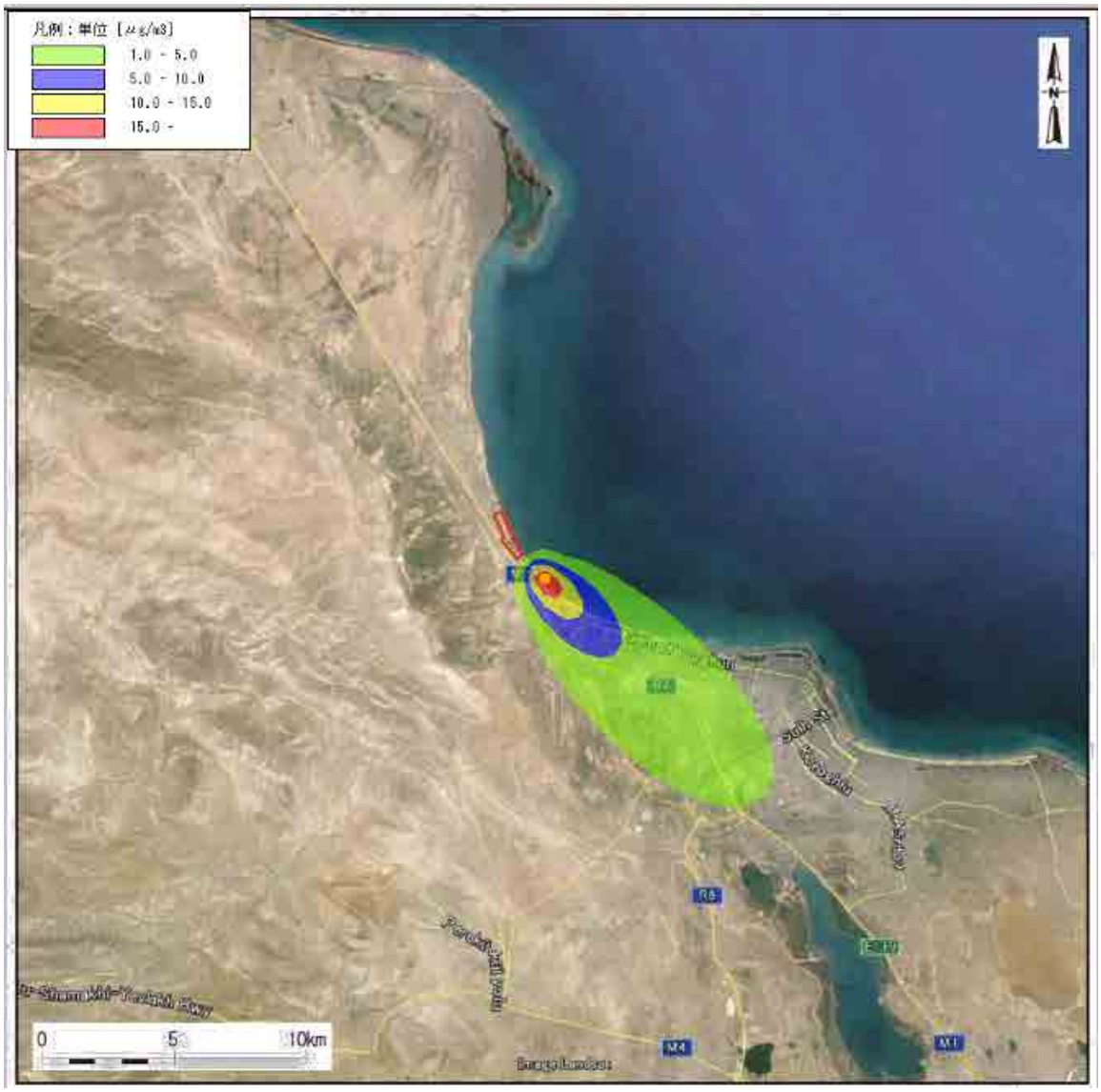
Source: JICA Study Team)

Figure 6.1-5 (2) Dispersion concentration of NO_2 (24 hr Maximum, 2012)



(Source: JICA Study Team)

Figure 6.1-5 (3) Dispersion concentration of NO_2 (24 hr Maximum, 2013)



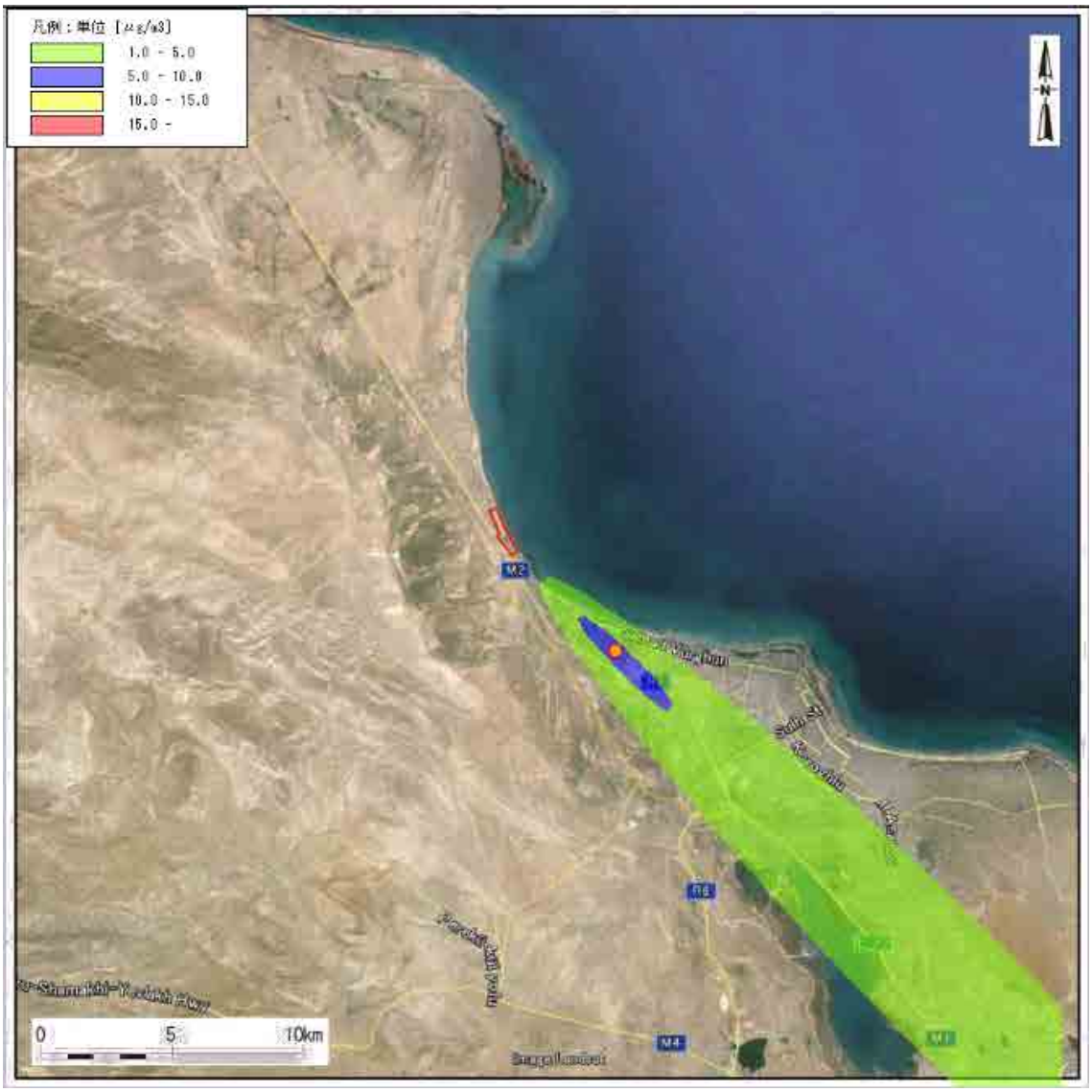
(Source: JICA Study Team)

Figure 6.1-6 (1) Dispersion concentration of NO_2 (B (Max) ,3.9m/s:1 hr Maximum)



(Source: JICA Study Team)

Figure 6.1-6 (2) Dispersion concentration of NO_2 (C (Max) , 5.9m/s:1 hr Maximum)



(Source: JICA Study Team)

Figure 6.1-6 (3) Dispersion concentration of NO_2 (D (Max) , 15m/s:1 hr Maximum)



(Source: JICA Study Team)

Figure 6.1-6 (4) Dispersion concentration of NO_2 (D (Max) , 30m/s:1 hr Maximum)

EIA ANNEX 6-2

Noise Simulation by Model

Annex 6-2 Noise and Vibration simulation by model

< Construction Phase>

<Noise>

Operation of heavy equipment and trucks will cause impact from the temporary noise. In particular, pile driving will cause impact from the strong noise into surrounding broader areas. There is some house of residence located near the project site, and sufficient consideration must be given to minimizing any noise impact.

The level of noise resulting from the operation of the construction machinery was simulated using the following estimation model.

Noise level estimation model

Noise predictions were carried out accordance to International Standard ISO 9613, Acoustics-Attenuation of Sound during Propagation Outdoor.

The ISO Propagation model calculates the predicted sound pressure level by taking the source power level for equipment in separate octave bands and subtracting a number of attenuation factors according to the following equation:

$$Lp = Lw - A_{geo} - A_{atm} - A_{gr} - A_{bar}$$

In which,

Lp :	predicted sound pressure level
Lw:	sound pressure level
A_{geo}:	geometrical divergence ($20xLog_{10}r^2+8$)
r :	Distance
A_{atm} :	atmospheric absorption
A_{gr} :	ground effect
A_{bar} :	barrier attenuation
A_{misc}:	miscellaneous other effect

Noise level data of noise source

The major construction machinery used in the construction work will include trucks and back hoes for excavation, crawler crane, truck cranes, trailer and forklift for transportation of the equipment and material, mixers for producing concrete and other machine as air compressor and generator.

Piling work for the basis will not be conducted because the project site has an adequate foothold.

Table 6.2-1 shows the noise level of the construction machinery and the number of machines.

The noise level calculation covers constructions of turbine equipment and an heat recovery steam generator in block 1, a turbine building in block 2, a control center building, an intake pump building, and electric transformer equipment.

Table 6.2-1 Noise Level of Major Construction Machinery

Works	Machine	Capacity	Power level (dB)	Number of machines
Block 1 Installation of turbine equipment	Crawler crane	25-650 t	97	2
	Truck crane	45-300 t	109	4
	Forklift	800 t	105	1
	Trailer	30-50 t	113	6
	Truck	2-11 t	109	10
Block 1 Installation of heat recovery steam generator	Crawler crane	25-650 t	97	2
	Truck crane	45-300 t	109	4
	Forklift	800 t	105	1
	Trailer	30-50 t	113	6
	Truck	2-11 t	109	10
Block 2 Construction of turbine building	Crawler crane	25-650 t	97	2
	Truck crane	45-300 t	109	4
	backhoe	1.0-4.0m^3	102	10
	concrete pumping truck	100m^3/h	110	3
	truck-mixer	4m^3	101	9
Construction of control center building	Crawler crane	25-650 t	97	1
	Truck crane	45-300 t	109	2
	backhoe	1.0-4.0m^3	102	5
	concrete pumping truck	100m^3/h	110	2
	truck-mixer	4m^3	101	5
	Air compressor	10.6m^3/min	106	1
	Generator	60-600kVA	101	5
Construction of intake pump building etc.	backhoe	1.0-4.0m^3	102	3
	concrete pumping truck	100m^3/h	110	1

Works	Machine	Capacity	Power level (dB)	Number of machines
	truck-mixer	4m3	101	3
Installation of electric transformer equipment	Crawler crane	25-650 t	97	2
	Truck crane	45-300 t	109	7

Note: EIA statements of recent gas turbine power plant in Japan

(Source; JICA Study Team)

Calculation conditions

The calculation was conducted in respect to the construction of the power generation plant. All the aforementioned machines were assumed to be operating simultaneously. Construction activities will be actually conducted, leveling out the construction amount and scale, based on the construction schedule; therefore, all the machinery will not be operated simultaneously.

The totals of 16 points used for simulation were selected at the boundary of power plant site and another 5 points at the nearly residences and commercial facilities were also selected for simulation.

This calculation takes account of the barrier effect as the vicinity of the west side of the site boundary is about 10m above the surrounding terrain.



(Source: JICA Study Team

Figure 6.2-1 Location of Simulation Points

Results of simulation

Table 6.2-2 shows the result of simulating the noise level for each sampling point during the operation of the plant equipment. Figure 6.2-2 shows the distribution of noise levels. Noise level generated by construction activities is 37 to 57 dB(A) at the boundary of the power plant site and 44 to 51 dB(A) at the residence.

The noise levels at 2 points in resides exceed the night-time noise level standard of Azerbaijan and IFC/WB guideline.

Construction work is not implemented at night in principle. The noise levels at all points in resides not exceed the day-time noise level standard of Azerbaijan and IFC/WB guideline.

Noise impact caused by construction activities will be mitigated by managing the construction schedule in order to level out the construction amount and scale as well as introducing up-to-date low-noise equipment's.

Large equipment transportation will be mainly conducted by shipping, and schedule management will maintain level amounts of the vehicles.

Measures for reducing generation of noise, such as speed reduction of vehicles in residential areas, will be taken, whereby vehicle noise impact will be minimized. Thus, all efforts will be made to minimize the noise impact.

Monitoring on noise levels will also be necessary.

Table 6.2-2 Results of Simulating Noise Levels from Construction Work

Place	Simulation Points	Noise Levels (dBA)	Azerbaijan Standard	IFC/WB EHS Guidelines: General
Project Boundary	No. 1	37	Day 65 Night 55	Day 70 Night 70
	No. 2	40		
	No. 3	42		
	No. 4	46		
	No. 5	49		
	No. 6	51		
	No. 7	51		
	No. 8	47		
	No. 9	45		
	No.10	50		
	No.11	47		
	No.12	44		

Place	Simulation Points	Noise Levels (dBA)	Azerbaijan Standard	IFC/WB EHS Guidelines: General
	No.13	57		
	No.14	57		
	No.15	48		
	No.16	48		
Commercial Facility	No.17	50	-	Day 70 Night 70
Settlement	No.18	48	Day 55 Night 45	Day 55 Night 45
Commercial Facility	No.19	52	-	Day 70 Night 70
Settlement	No.20	51	Day 55 Night 45	Day 55 Night 45
Settlement	No.21	44	Day 55 Night 45	Day 55 Night 45

Reference: Recommendations on Environment Protection in Road and Bridge Design, Moscow, 1995 and IFC/WB EHS Guidelines General, 2007

(Source: JICA Study Team)



(Source: JICA Study Team)

Figure 6.2-2 Results of Simulating Noise Level from Construction Work

<Vibration>

Operation of heavy equipment and trucks will cause impact from the temporary vibration. In particular, pile driving will cause impact from the strong vibration into surrounding broader areas. There is some residences located near the project site, and sufficient consideration must be given to minimizing any vibration impact.

The level of vibration resulting from the operation of the construction machinery was simulated using the following estimation model.

Vibration level estimation model

Following model normally used in Japan calculates the predicted vibration level by taking the source power level for equipment in separate octave bands and subtracting a number of attenuation factors according to the following equation:

$$Lp = Lo - 10Log10(r/r_o) - 8.68\,\alpha\,(r - r_o)$$

In which,

Lp :	predicted level
Lo:	Vibration level at the benchmark of r_0(m) from the vibrating points (dB)
r :	Distance from vibrating sources to the prediction points (m)
ro :	Distance
α	Invariable of internal damping (0.01) 0.01 is set as the invariable for calculation to make internal damping lowest. This decision takes account of the boring survey results finding soil texture either sandiness or clay.

Vibration level data of vibration source

The major construction machinery used in the construction work will include trucks and back hoes for excavation, crawler crane, truck cranes, trailer and forklift for transportation of the equipment and material, mixers for producing concrete and other machine as air compressor and generator.

Piling work for the basis will not be conducted because the project site has an adequate foothold.

Table 6.2-3 shows the level of the construction machinery and the number of machines.

The vibration level calculation covers constructions of turbine equipment and an heat recovery

steam generator in block 1, a turbine building in block 2, a control center building, an intake pump building, and electric transformer equipment.

Table 6.2-3 Vibration Level of Major Construction Machinery

Works	Machine	Capacity	Vibration level at 7m from source (dB)	Number of machines
Block 1 Installation of turbine equipment	Crawler crane	25-650 t	52	2
	Truck crane	45-300 t	52	4
	Forklift	800 t	55	1
	Trailer	30-50 t	64	6
	Truck	2-11 t	64	10
Block 1 Installation of heat recovery steam generator	Crawler crane	25-650 t	52	2
	Truck crane	45-300 t	52	4
	Forklift	800 t	55	1
	Trailer	30-50 t	64	6
	Truck	2-11 t	64	10
Block 2 Construction of turbine building	Crawler crane	25-650 t	52	2
	Truck crane	45-300 t	52	4
	backhoe	1.0-4.0 m^3	55	10
	concrete pumping truck	100 m^3/h	45	3
	truck-mixer	4 m^3	45	9
Construction of control center building	Crawler crane	25-650 t	52	1
	Truck crane	45-300 t	52	2
	backhoe	1.0-4.0 m^3	55	5
	concrete pumping truck	100 m^3/h	45	2
	truck-mixer	4 m^3	45	5
	Air compressor	10.6 m^3/min	55	1
	Generator	60-600 kVA	51	5
Construction of intake pump building etc.	backhoe	1.0-4.0 m^3	55	3
	concrete pumping	100 m^3/h	45	1

Works	Machine	Capacity	Vibration level at 7m from source (dB)	Number of machines
	truck			
	truck-mixer	4 m^3	45	3
Installation of electric transformer equipment	Crawler crane	25-650 t	52	2
	Truck crane	45-300 t	52	7

Note: EIA statements of recent gas turbine power plant in Japan

(Source: Study Team)

Calculation conditions

The totals of 16 points used for simulation were selected at the boundary of power plant site and another 5 points the nearly residences and commercial facilities were also selected for simulation.

The calculation was conducted at the same point as Vibration simulation.

Results of simulation

Table 6.2-4 shows the result of simulating the vibration level during the construction of the plant equipment.

Vibration level generated by construction activities is 19 to 48 dB at the boundary of the power plant site and 25 to 40 dB at the residence.

The vibration levels at all points is low level and satisfy with standard of Japan.

Furthermore, all the predicted values are enough below the threshold level, around 50dB, at which human being can feel vibration.

Vibration impact caused by construction activities will be mitigated by managing the construction schedule in order to level out the construction amount and scale as well as introducing up-to-date low-vibration equipment's.

Large equipment transportation will be mainly conducted by shipping, and schedule management will maintain level amounts of the vehicles.

Measures for reducing generation of vibration, such as speed reduction of vehicles in residential areas, will be taken, whereby vehicle vibration impact will be minimized. Thus, all efforts will be made to minimize the vibration impact.

Table 6.2-4 Results of Simulating Vibration Levels from Construction Work

Place	Simulation Points	Vibration Levels (dB)	Japanese Standard
Project Boundary	No. 1	19	Day 60 Night 55
	No. 2	23	
	No. 3	27	
	No. 4	32	
	No. 5	38	
	No. 6	46	
	No. 7	41	
	No. 8	48	
	No. 9	48	
	No.10	40	
	No.11	34	
	No.12	28	
	No.13	29	
	No.14	29	
	No.15	18	
	No.16	19	
Commercial Facility	No.17	40	Day 60 Night 50
Settlement	No.18	36	Day 55 Night 45
Commercial Facility	No.19	40	Day 60 Night 50
Settlement	No.20	26	Day 55 Night 45
Settlement	No.21	25	

(Source: JICA Study Team)

< Operation Phase>

<Noise>

Noise impact from the plant operation is predicted. There are residences near the project site, and sufficient consideration must be given to minimizing noise impact. The level of noise resulting from the operation of the major equipment was simulated using the following estimation model.

Noise level estimation model

An estimation of the noise level was made according to Construction Phase.

Noise level data of noise source

The major equipment used in the power plant operation include the turbine, pumps, air compressors, transformer and cooling tower. The noise source level generated from the generation facility is shown in boiler, coal mill, forced draft fan, gas duct etc. for power plant facility and demineralization plant, water treatment equipment, wastewater treatment equipment, ash conveyer, etc. for utility facility.

Table 6.2-**5** shows the noise level of the major equipment and the number of equipment.

Table 6.2-5 Noise Level and the Number of the Major Equipment

Item	Equipment Type	Noise Power Level (dB)	Number of Equipment
Power plant facility	Turbine building	70.0	2
	Intake air filter for gas turbine	75.0	2
	HRSG	78.0	2
	Main transformer	80.0	2
	Station service transformer	75.0	2
	Exhaust air duct for gas turbine	80.0	2
	Gas compressor	85.0	2
	330/220kVconection transformer	80.0	2
	stack	90.0	2
Utility facility	Circulation water pump building	70.0	1
	Startup transformer	75.0	1
	Desalination facility	75.0	1
	Demineralization facility	75.0	1

Item	Equipment Type	Noise Power Level (dB)	Number of Equipment
	Waste water treatment facility	75.0	1

(Source: JICA Study Team)

Calculation conditions

Noise calculation was conducted for the power plant, taking into consideration the coal unloaders at the port. All the aforementioned machines are assumed to be operating simultaneously. The totals of 16 points used for simulation were selected at the boundary of power plant site and another 5 points the nearly residences and commercial facilities were also selected for simulation.

The calculation was conducted at the same point as the one in Construction Phase. This calculation paid attention to the barrier effect of the geography of the western part of the site, as well.

Result of simulation

Table 6.2-6 shows the result of simulating the noise level for each sampling point during the operation of the plant equipment. Figure 6.2-3 shows the distribution of noise levels.

Noise level generated by power plant operation is 34 - 48dB (A) at the boundary of the power plant site and 38 - 45 dB (A) at the residence.

The noise levels at all the points satisfy the day-time and night-time noise level standard of Azerbaijan and IFC/WB guideline.

Maintenance of equipment will be conducted and low noise type equipment and adequate enclosures will be installed.

Table 6.2-6 Results of Simulating Noise Levels from the Port Plant

Place	Simulation Points	Noise Levels (dBA)	Azerbaijan Standard	IFC/WB EHS Guidelines: General
Project Boundary	No. 1	34	Day 65 Night 55	Day 70 Night 70
	No. 2	35		
	No. 3	36		
	No. 4	39		
	No. 5	43		
	No. 6	44		
	No. 7	48		

Place	Simulation Points	Noise Levels (dBA)	Azerbaijan Standard	IFC/WB EHS Guidelines: General
	No. 8	41		
	No. 9	48		
	No.10	45		
	No.11	42		
	No.12	39		
	No.13	44		
	No.14	46		
	No.15	41		
	No.16	43		
Commercial Facilities	No.17	47	-	Day 70 Night 70
Settlement	No.18	45	Day 55 Night 45	Day 55 Night 45
Commercial Facilities	No.19	45	-	Day 70 Night 70
Settlement	No.20	38	Day 55 Night 45	Day 55 Night 45
Settlement	No.21	39	Day 55 Night 45	Day 55 Night 45

Reference: Recommendations on Environment Protection in Road and Bridge Design, Moscow, 1995 and IFC/WB EHS Guidelines General, 2007

(Source: JICA Study Team)



(Source: JICA Study Team)

Figure 6.2-3 Results of Simulating Noise Level rom Power Plant

<Vibration>

Vibration impact from the plant operation is predicted. There are residences near the project site, and sufficient consideration must be given to minimizing Vibration impact. The level of vibration resulting from the operation of the major equipment was simulated using the following estimation model.

Vibration level estimation model

An estimation of the vibration level was made according to Construction Phase.

Vibration level data of Vibration source

The vibration source level generated from the generation facility is shown in gas turbine and steam turbine , generator and pump equipment

Table 6.2-7 shows the vibration level of the major equipment and the number of equipment.

Table 6.2-7 Vibration Level and the Number of the Major Equipment

Item	Equipment Type	Vibration Level at 1m from source (dB)	Number of Equipment
Power plant facility	Gas Turbine	65.0	2
	Generator	54.0	2
	Steam turbine	54.0	2
	Water pump	59.0	2
Utility facility	Circulation water pump	53.0	1

(Source: Study Team)

Calculation conditions

The totals of 16 points used for simulation were selected at the boundary of power plant site and another 5 points the nearly residences and commercial facilities were also selected for simulation.

The calculation was conducted at the same point as the one in Construction Phase.

Result of simulation

Table 6.2-8 shows the result of simulating the vibration level for each sampling point during the operation of the plant equipment.

Vibration level generated by power plant operation is 0 - 25dB at the boundary of the power plant site and 6- 19 dB (A) at the residence.

The vibration levels at all points is low level and satisfy with standard of Japan.

Furthermore, all the predicted values are enough below the threshold level, around 50dB, at which human being can feel vibration. Almost all of them are also below the minimum measured level of vibration (25dB).

Buildings will be constructed with strong foundation.

Maintenance of equipment will be conducted and low vibration type equipment and adequate enclosures will be installed.

Table 6.2-8 Results of Simulating Vibration Levels from the Power Plant

Place	Simulation Points	Vibration Levels (dB)	Japanese Standard
Project Boundary	No. 1	0	Day 60 Night 55
	No. 2	3	
	No. 3	7	
	No. 4	12	
	No. 5	17	
	No. 6	23	
	No. 7	19	
	No. 8	24	
	No. 9	25	
	No.10	20	
	No.11	14	
	No.12	9	
	No.13	9	
	No.14	9	
	No.15	0	
	No.16	0	
Commercial Facilities	No.17	18	Day 60 Night 50
Settlement	No.18	15	Day 55 Night 45
Commercial Facilities	No.19	19	Day 60 Night 50
Settlement	No.20	6	Day 55 Night 45
Settlement	No.21	5	

(Source: Study Team)

EIA ANNEX 6-3

Thermal Water Simulation by Model

Annex 6-3 Thermal water simulation by model

<Thermal water>

Water intake/discharge method shall be selected to prevent the recirculation of intake/discharge, promote the mix with the surrounding sea water, and minimize the area of water temperature rise.

Cooling water shall be taken from a lower water layer 6m deep, where water temperature is low at the low rate of the approximately 0.2m/s, with an intake tower installed at the point about 1.3km (7m depth) offshore from the center of the site. Observed current flows are mostly from 0.3 to 0.6m/s around the site and higher than intake flow speed, so intake of cooling water have a little impact to marine flow. Then, it shall be discharged at the high rate of 2.5m/s from the coast near the southern part of the project site.

A diffusion estimation model of thermal effluents from the power plant is calculated based on the following formula.

(Momentum equation)

$$\frac{\partial u}{\partial t}+\frac{\partial u^2}{\partial x}+\frac{\partial uv}{\partial y}+\frac{\partial uw}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial x}+\mu\nabla^2 u+\gamma\frac{\partial^2 u}{\partial z^2}$$

$$\frac{\partial v}{\partial t}+\frac{\partial uv}{\partial x}+\frac{\partial v^2}{\partial y}+\frac{\partial vw}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial y}+\mu\nabla^2 v+\gamma\frac{\partial^2 v}{\partial z^2}$$

$$\frac{\partial w}{\partial t}+\frac{\partial uw}{\partial x}+\frac{\partial vw}{\partial y}+\frac{\partial w^2}{\partial z}=g-\frac{1}{\rho}\frac{\partial p}{\partial z}+\mu\nabla^2 w+\gamma\frac{\partial^2 w}{\partial z^2}$$

(Continuity equation)

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0$$

In which:

u,v,w	: current velocity in x, y, z
t	: time
P	: pressure
ρ	: water density
μ and ν	: coefficient of the horizontal and vertical eddy viscosity.

(Thermal diffusion equation)

$$\frac{\partial T}{\partial t}+u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}+w\frac{\partial T}{\partial x}=\frac{\partial}{\partial x}\left(Kx\frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(Ky\frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial z}\left(Kz\frac{\partial T}{\partial x}\right)$$

In which,

T	: temperature
Kx, Ky, Kz	: diffusion coefficient in x, y, z

The seabed topographic data in the said sea area were set based on the bathymetric data implemented in the said sea area. The seabed topographic data were rebuilt as mesh data so that they will contribute to flow calculations and diffusion calculations.
The geometry of the coast line, etc. was read from the separately provided map, etc. to create digital data. Figure 6.3-1 shows the created seabed topography. For the flow calculation, the data were sectionalized basically at the 100m mesh and at the 200m mesh near the discharge.

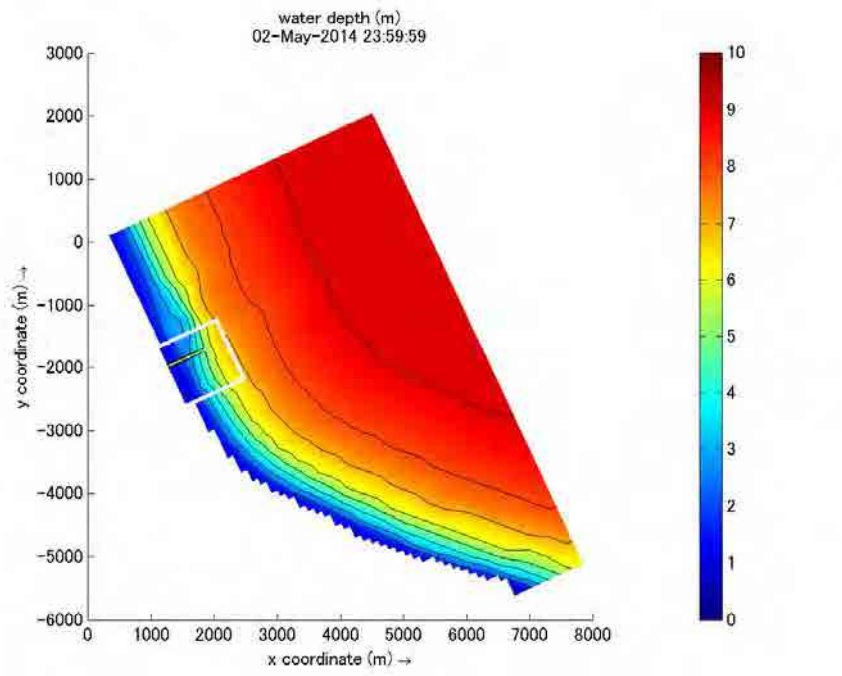


Figure 6.3-1 Sea Bed Topography

The calculation conditions are shown below;

<Discharge condition>

Item	Unit	Coolant water
Amount of discharge water	m^3/h	30,000
Velocity of discharge water	m/s	2.5
Maximum increase of outlet temperature	^oC	Δ9.0
Temperature of discharge water	^oC	40.0
Temperature of ambient seawater	^oC	14.1

*Temperature of ambient seawater is averaged at Sumgayit.

< Sea water and Air condition>

Item	Unit	Sea water
Current speed and direction	m/s	0.3 (SE) 0
Ambient temperature	°C	15.3
Wind direction	degree	N
Wind speed	m/s	7.7

＜Prediction result＞

Figure 6.3-2 shows the calculation results of dispersion of thermal effluent. In the case of the southeast current at 0.3m/s, the surface water temperature increases to 5℃, compared with 14℃ at the intake (namely 19℃), in the areas within about 180m from the water outlet in the direction of offshore and about 100m in the direction of the coast. This is below the Azerbaijan standard which allows the increase of more than 5℃ within 500m.

In the case of the current at 0m/s, the surface water temperature increases to 5℃ in the areas within about 350m from the water outlet in the direction of offshore and about 450m in the direction of the coast. This is also below the Azerbaijan standard.

This prediction was conducted based on the worst case scenario, which is that the water temperatures at intake point and discharge point are same.

Practically, water will be intake at 6m below surface level, and water temperature at intake point is reported 1 to 2℃ lower than the surface water temperature of discharge point, according to the water temperature data around the proposed power plant during spring and summer season.

Therefore, the range or area of temperature increase becomes smaller than the prediction result in spring and summer season.

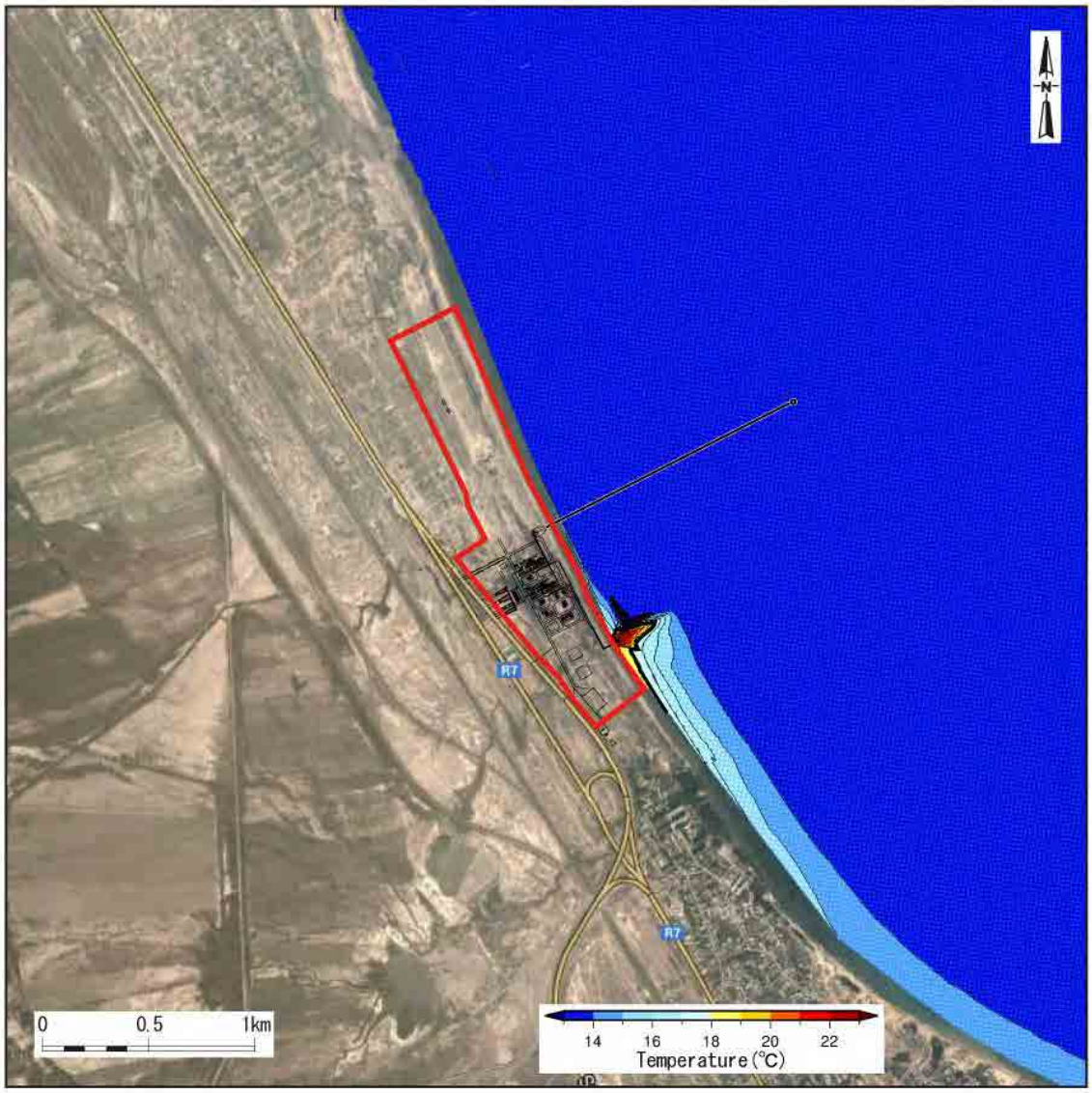


Figure 6.3-2 (1)　　Dispersion of Thermal Effluent (Current speed 0.3m/s:SE)

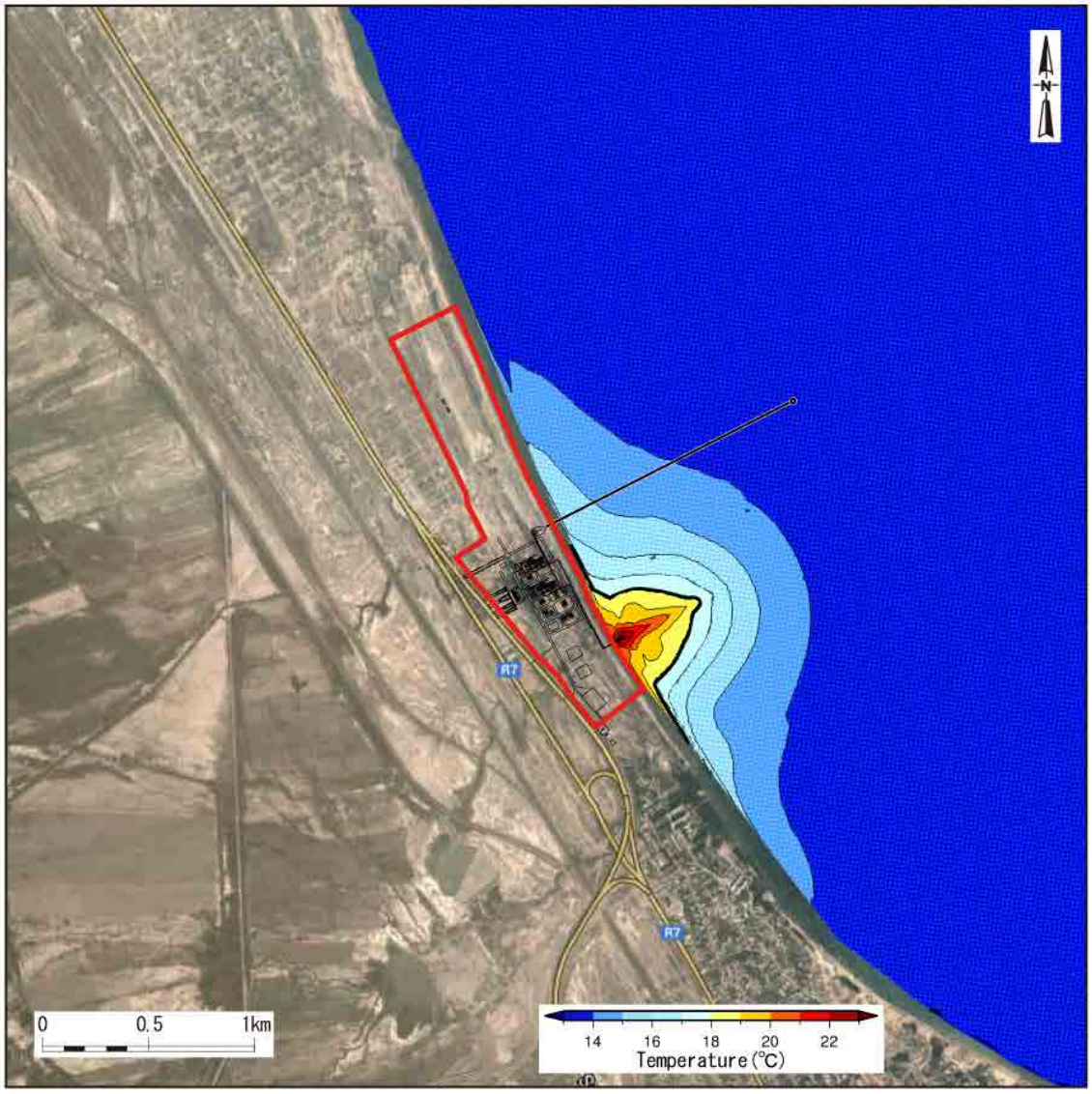


Figure 6.3-2 (2) Dispersion of Thermal Effluent (Current speed 0m/s)

2) Marine hydrology

Because cooling water will be intake and discharged, there will be changes in flow conditions in the vicinities of the discharged.

The thermal effluent calculation includes the flow rate change estimation. The existing and future water flow speed distribution is shown in Figure 6.3-3.

Water temperature rise due to condenser shall be maintained ⊿9° C to minimize the amount of cooling water. Water shall be taken at the low rate of 0.2m/s which is not much faster compared with the current speed in the present marine area. That means water flow change will not be affected by water intake.

According to the flow rate change estimation, the flow speed at the point about 100m away from the water outlet is almost same as the surrounding speed. Therefore, the environmental impact will be localized.

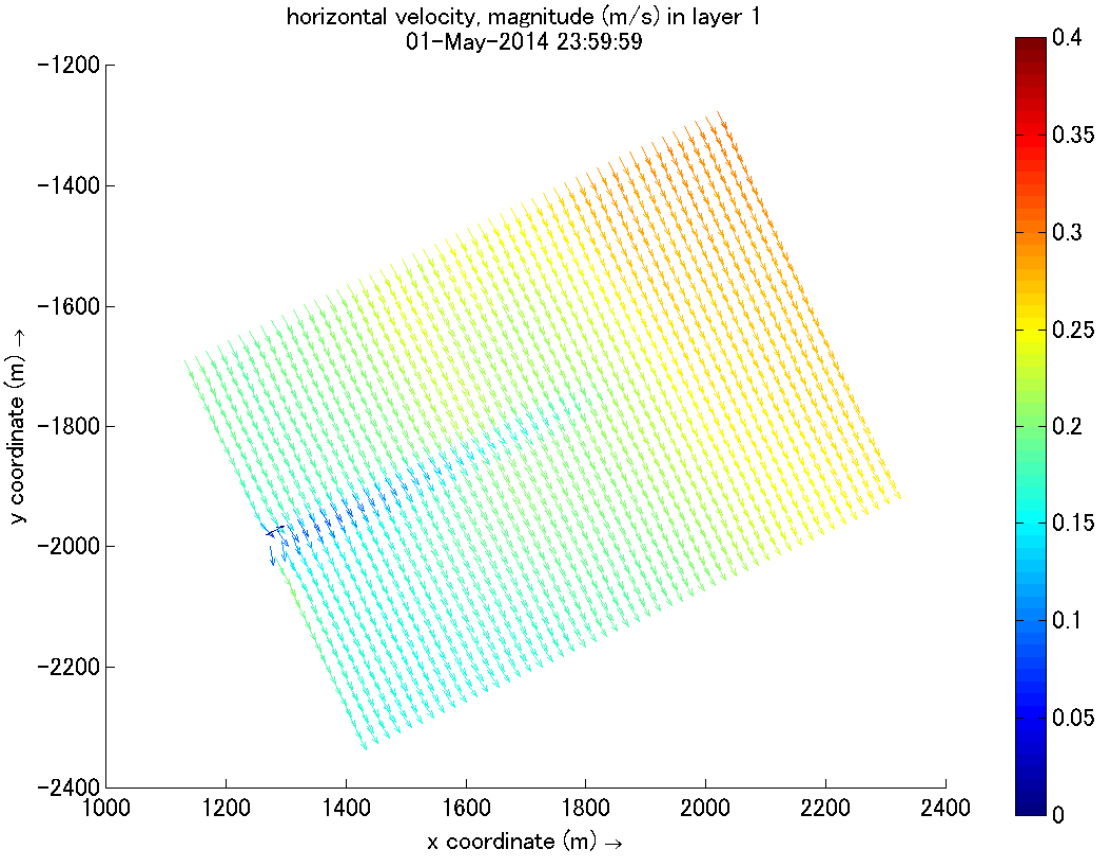


Figure 6.3-3 (1)　Flow condition without thermal effluent (The present：Current speed 0.3m/s:SE)

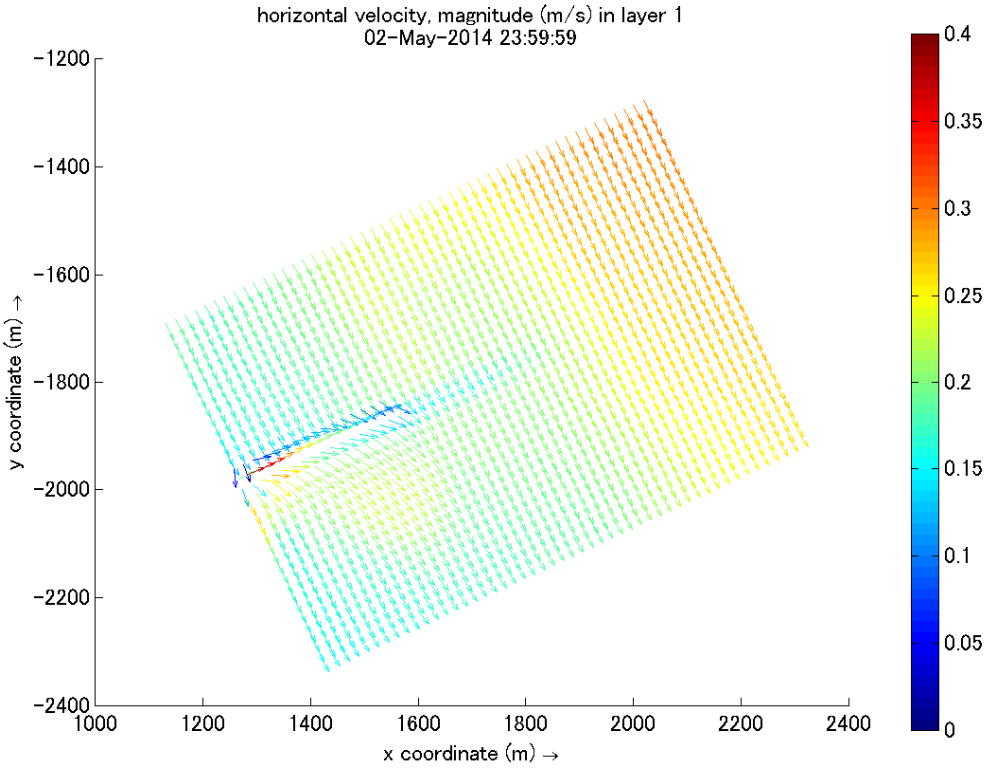


Figure 6.3-3 (2)　Flow condition with thermal effluent (The future：Current speed 0.3m/s:SE)

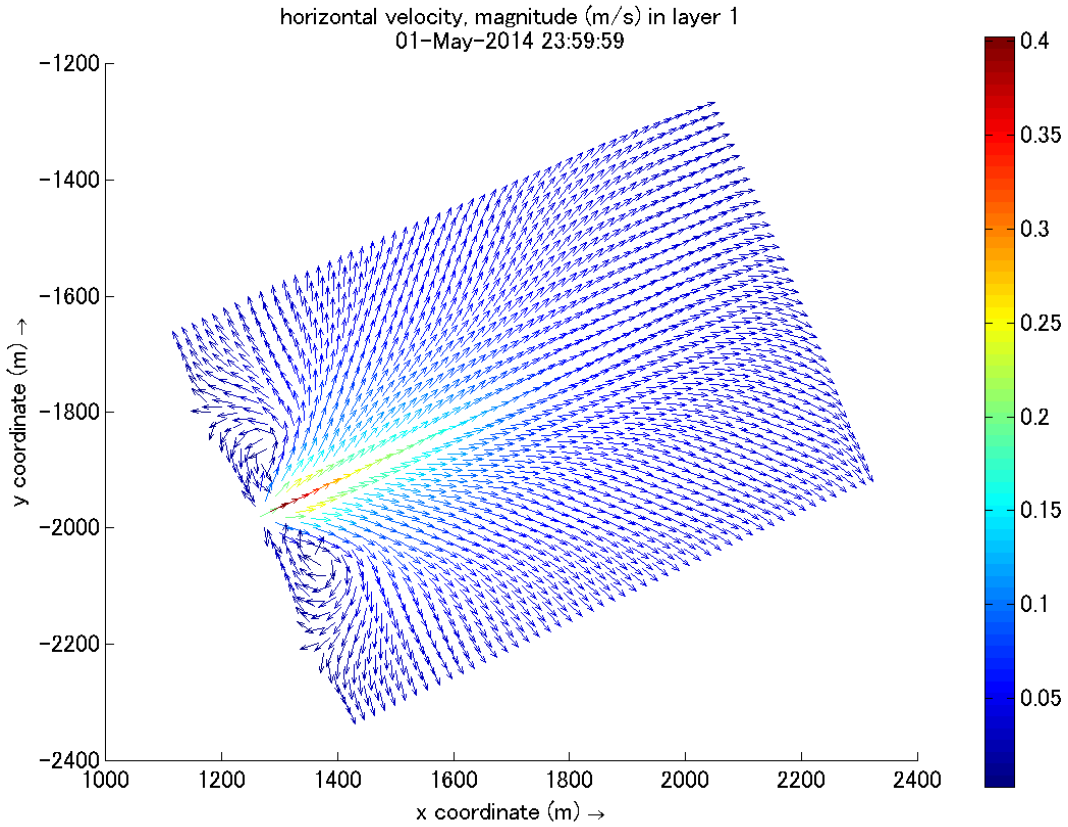


Figure 6.3-3 (3)　Flow condition with thermal effluent (Current speed 0m/s)

EIA

Chapter 7

Chapter 7

Analysis of Alternatives

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7. Analysis of Alternatives

7.1 Project Site

7.1.1 Power plant site

Selecting the site for this power generation construction project needs to satisfy two major conditions. The site must be close to an area that is expected to have considerable power consumption. The site must also be located near a shore on the Caspian Sea that allows to intake water. Azerenerji have selected and examined a Qobustan site, which is located in the southwestern direction to Baku, the capital of the country, as the other designated spot that satisfies these conditions.

When Azerenerji examined the designated project spot (Yashma spot) and the Qobustan spot, neither spots will ask local people to relocate themselves. Since these spots are neither farmland nor forest, the sites have no much difference in environmental social impacts from land acquisition and reclamation.

In addition, the project implementer has already started official procedure to acquire the site from government for the power plant project in the Yashma spot and decided designated substation spots and a power transmission route. Meanwhile, since the procedure for acquiring the Qobustan site takes time, Azerenerji foresee no smooth construction of a power plant and power supply. That is why Azerenerji have selected the Yashma spot (Table 7.1-1).

Table 7.1-1 Comparison of Alternative Sites

Item	Yashma site	Qobustan site
Technical and economic aspects	・The locations of the substations and transmission line route to supply power have already been planned. ・Water for cooling is available. ・The project implementer has acquired the site and is just waiting for the completion of the final land registration.	・The locations of the substations and transmission line route to supply power have already been planned. ・Water for cooling is available. ・This site is not acquired. It will take time to coordinate administrative agencies concerned and complete the required procedures.
Environmental social consideration	・Since this site is in no residential area, relocation of local people will not be needed. ・This site is not located in farmland but in wasteland close to the shore. ・This site is located in no forests and wetlands. ・The existing gas pipeline is far from this site. A land reclamation will be required to construct a new connection pipeline.	・Since this site is in no residential area, relocation of local people will not be needed. ・This site is not located in farmland but in wasteland close to the shore. ・This site is located in no forests and wetlands. ・A land reclamation will be required to construct a new connection pipeline.

(Source: Prepared by the survey team)



Figure 7.1-1 Locations of the Yashma and Qobustan Site

7.1.2 Transmission line and substation

The plans for transmission line and substation sites have already been decided by Azerenerji and alternative sites have not been considered.

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7.1.3 Gas pipeline

Azerenerji JSC submitted the official letter to SOCAR regarding the Yashma project. Required Gas volume is 200,000m^3/hour for the Yashma project as described in the official letter. Azerenerji JSC and the study team had meetings with SOCAR on the possibility of gas supply, and SOCAR, Azerenerji JSC and the study team conducted joint site surveys and discussions regarding some candidate sites. After these joint site surveys and discussions, they identified a possibility of gas pipeline routes from three candidate sites, ①Siazen, ②Khizi and ③ Sumgayit.

Figure 7.1-2 shows a gas pipeline map with the three candidate routes.
The Siazen site (gas compressor station) is located approx. 70km northwest of the Yashma site. The Siazen Gas Compressor Station has six (6) gas compressors with mechanical drive gas turbines.
Figure 7.1-3 shows an aerial photograph of the Siazen Gas Compressor Station. Khizi was selected as satisfying the minimal-length of a gas pipe from Yashma. Sumgayit is the closest candidate site, however, and there are some houses and community blocks in its vicinity..

Table 7.1-2 show comparison of three (3) Candidate Sites for Gas Supply
Khizi is superior to Siezen and Sumgayit as a candidate construction site for Gas Supply.



(Source: Google earth)

Figure 7.1-2 Gas Pipeline Map with Three Candidate Gas Pipeline Routes



(Source: Google earth)

Figure 7.1-3 Siazen Gas Compressor Station

Table 7.1-2 Comparison of Three (3) Candidate Sites for Gas Supply

Items	Candidate Site		
Name	**① Siezen**	**② Khizi**	**③ Sumgayit**
(1)Gas pipeline route	Yashma to Siezen Gas Compressor Station	Yashma to Khizi (selection of minimal-length)	Yashma to Sumgayit
(2)Distance	70 km	30-40 km	10-20 km
(3)Land form	Flat	Difference in elevation is approx. 700m from Yashma to tie-in point.	Flat
(3)Gas Supply Volume	Sufficient (Information from SOCAR)	Sufficient (Information from SOCAR)	Not Sufficent
(4)Gas Supply Pressure	Sufficient, but lower than Khizi (Information from SOCAR)	Sufficient (Information from SOCAR)	Not Sufficent
(5)Gas Compressor	New gas compressor will not be required (Information from SOCAR). There are 6 (Six) compressors in Siezen gas station.	New gas compressor will not be required (Information from SOCAR).	-
(6) Land acquisition for Right of Way (ROW) and Land	Clear (There is existing pipeline from Yashma to Siezen.)	Clear (Route selection & survey was done.)	Difficult (Some houses and communities block the way.)
(7)Pipeline Construction (transport the pipe to ROW, heavy equipment access)	Clear (There is a highway beside the existing pipeline.)	Clear (There is a highway beside the new pipeline route and no residential area)	Difficult (Some houses and communities block the way.)
(8)Project Cost	Higher than Khizi	Lower than Siezen	'-
Evaluation	Future Candidate	Acceptable	Not Acceptable

7.2 Technology Options

7.2.1 Power plant

(1) Fuel types

Natural gas is inexpensive compared with oil. Because Azerbaijan is rich in natural gas reserves, natural gas is the most-consumed fuel for thermal power plants in the country. Since the currently available gas pipeline networks extend in all directions of the country, the cost to construct a fuel storage facility and a port for natural gas-fired power plant will be lower than the cost to construct such facilities for an oil-fired or coal-fired power plant.

Compared with an oil-fired or coal-fired power plant, the natural gas-fired power plant emits into the atmosphere less SOx, dust and CO_2. In addition, since the required site area is smaller than that of the other types of power plant, the land acquisition and reclamation will have less impact (Table 7.2-1).

Table 7.2-1 Comparison of Fuel Types

Item	Natural gas	Oil	Coal
Technical aspect	・If gas is supplied through the pipeline, no port and harbor facilities for LNG tankers are needed to construct. ・The above case will require neither large-scale LNG tanks nor an ash dump site to build. ・Natural gas is applicable to high-efficiency combined cycle power generation which employs F-class gas turbine technology and achieves thermal efficiency more than 55%.	・The construction of port and harbor facilities will be needed for ships that will carry in and disembark oil fuel. ・Large-scale oil tanks will be needed to build. ・Heavy oil cannot be used as fuel for high-efficiency combined cycle power generation.	・The construction of port and harbor facilities will be needed for ships that carry in and disembark coal. ・A large-scale coal yard and an ash dump site will be needed to build. ・Commercial operation is not yet available for coal gas-fired high-efficiency combined cycle power generation.
Economic aspect	・The fuel unit price of natural gas is higher than coal but lower than oil. ・Compared with the cost to construct port, harbor, and fuel storage facilities, the cost to build a short-distant pipeline is very inexpensive. ・Azerbaijan has a lot of reserves and production volume of natural gas and the corresponding pipelines have been developed.	・The fuel unit price of oil is the most expensive of the three types of fuel. ・The cost to construct port, harbor and storage facilities will be expensive. ・A site will be needed for large-scale oil tanks. Azerbaijan has a lot of reserves and production volume of oil and the corresponding pipelines have been developed.	・The unit price will be inexpensive. ・The cost to construct port, harbor and fuel storage facilities will be expensive. ・To acquire sites for a coal yard and an ash disposal site is needed. Azerbaijan has no coal reserves.
Environmental social consideration	・Since this fuel type has neither ash content nor sulfur content, no dust and SOx will be generated. ・The CO_2 generation volume is least among the three types of fuel. ・Since the total site area is relatively small, impact from the land reclamation and compensation will be minor.	・Since this fuel type has ash content and sulfur content, dust and SOx will be generated. In addition, depending on the sulfur content, a desulfurizer will be needed. ・The CO_2 generation volume from oil is greater compared with that from natural gas. ・Since the total site area is relatively large, impact from land reclamation and compensation will be great.	・Since this fuel type has ash content, a dust collector will be needed. In addition, depending on the sulfur content, a desulfurizer will be needed. ・The CO_2 generation volume from coal will be greater than that from gas or oil. ・Since the total site area is relatively large, impact from land reclamation and compensation will be great.

(Source: Prepared by the survey team)

(2) Power generation systems

If natural gas is used as fuel for a power plant, the combined cycle power generation system is the highest in efficiency and economy. This is the reason we have selected the combined cycle power generation system (Table 7.2-2).

Table 7.2-2 Comparison of Power Generation Systems

Item	Combined cycle power generation	Conventional thermal power generation
Technical aspect	・There are a number of power plants utilizing this type of system in the world. ・Thermal efficiency of this system can be more than 55% with the use of F-class gas turbine.	・There are a number of power plants utilizing this type of system in the world. ・Thermal efficiency of this type will be less than 45% even with the most advanced generation of the technology. ・Construction period of conventional thermal power generation is longer than that of combined cycle thermal power generation by the number and kind of equipment.
Economic aspect	Since this power generation is efficient, cost per unit of electricity generated will be law.	Since this power generation is not so efficient as the combined cycle power generation, cost per unit of electricity generated will be high.
Environmental social consideration	・Since this power generation efficiency is high, CO_2 generation per unit of electricity generated will be small when compared with that of the conventional thermal power plant with the same output. (The ratio of power output from gas turbine to that of steam turbine is approximately 2. This is why the volume of water effluent from the steam turbine condenser will be small.)	・Since this power generation is not so efficient as combined cycle power generation, CO_2 generation per unit of electricity generated will be large. ・Cooling water volume will be large.

(Source: Prepared by the survey team)

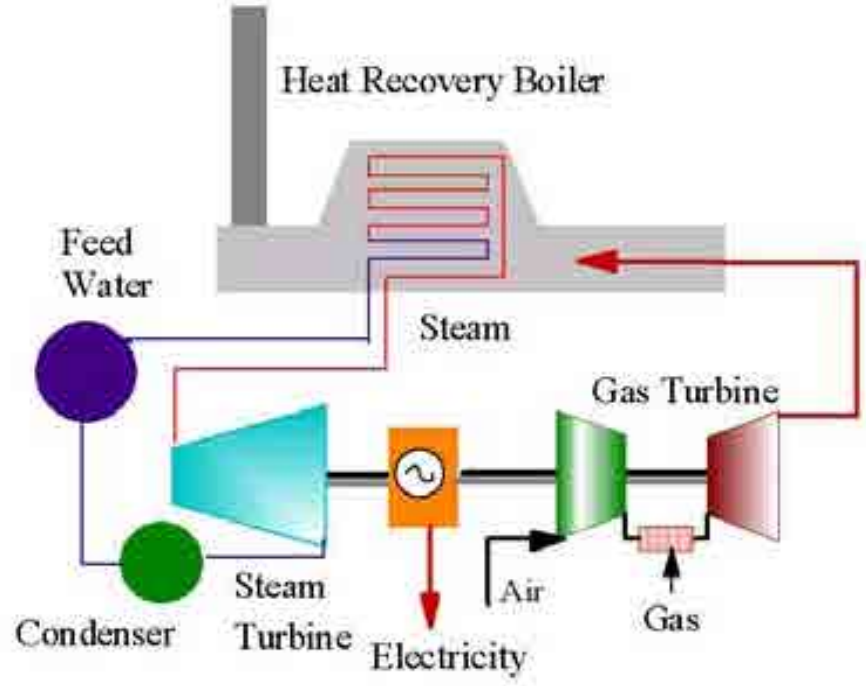


Figure 7.2-1 Mechanism of Combined Cycle Power Generation

(3) Cooling System

There are three (3) types of cooling systems (a once-through cooling system, an induced draft cooling tower cooling system, and an air cooled system) as possible cooling systems for the steam turbine condenser. The merits and demerits of the cooling system are variable depending upon the site conditions.

The once-through cooling system type is commonly employed when the site is located on a seaside, riverside or lakeside, and the circulating cooling water flow rate sufficient to cool the condenser is available economically without environmental impacts. The condenser pressure is normally the lowest among the above three (3) types. Therefore, the steam turbine power output is highest. This system is the most preferable from a plant performance point of view.

The induced draft cooling tower type is commonly used when sufficient circulating cooling water flow rate is not available economically but the water flow rate to compensate for the evaporation and blow-down losses is obtainable. Air cooled type is commonly used when the site is located in places such as deserts and inland areas where cooling water is scarce. The condenser pressure is normally the highest among the above three (3) types. Therefore, the steam turbine power output is lowest. The auxiliary power required to operate the cooling system is highest because many air draft fans must be operated. The installation footprint area for this system is the largest.

The schematic diagrams and the characteristics of the three (3) types of cooling systems are shown on the Figure 7.2-2 and Table 7.2-3 respectively.

The project site for Yashma Power Plant is located at a shore on the Caspian Sea and sufficient amount of sea water is available, hence the once-through type is adopted for the cooling system.

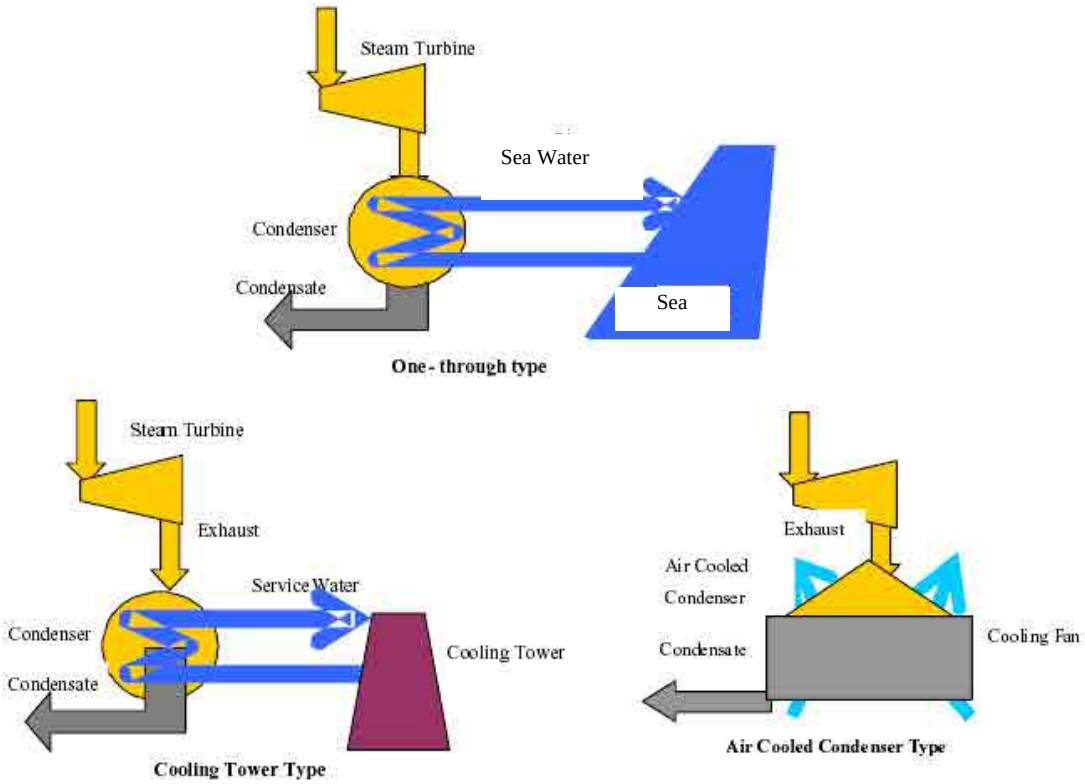


Figure 7.2-2 Three Method of the Cooling System

Table 7.2-3 Comparison of the Cooling Methods

Cooling methods	One-through method using sea water	cooling tower	Air cooled condenser
Types of cooling media	Sea water	Freshwater (River water or Underground water)	Air
Plant thermal efficiency	The best efficiency (Base)	Lower efficiency than One-through method (approximately - 0.3%)	The lowest efficiency (approximately -3%)
Thermal effluent	Generated	Hardly generated (generated when exchanging cooling water)	Not generated
Noise	The noise source is only the pumping equipment.	In addition to the pumping equipment, cooling fan makes loud noise.	In addition to the pumping equipment, cooling fan makes loud noise.

(Source: Prepared by the survey team)

7.3 No Project Scenario

7.3.1 Power plant

If this project is not implemented, expected power supply shortage will not be solved (Table 7.3-1).

There is no other options that old electric-generating facilities will be kept operating, which cannot contribute to CO_2 reduction.

Table 7.3-1 Comparison of Project Implementation and Zero Option

Item	If the project is implemented	Zero option
Technical aspect	・A power plant will be constructed in the project site.	・Nothing in particular
Economic aspect	・Although it requires construction costs, the project will contribute to economic development in the Azerbaijan Republic. In addition, the project will purchase construction materials and equipment in the local area and also offer working opportunities to local people, contributing to the local economy. ・The obsolete thermal power plant will be closed down and energy efficiency and fuel cost savings will be promoted..	・No construction cost will need. However, the economic growth in Azerbaijan will slow down or be negative due to the power supply shortage. In addition, no power construction project will offer neither working opportunities to local people nor contribute to the local economy. ・Because the obsolete thermal power plant cannot be closed down, promotion of energy efficiency or fuel cost savings will be delayed.
Environmental social consideration	・The new power plant will be constructed, which needs appropriate measures to relieve environmental impact.	・Nothing in particular.

(Source: Prepared by the survey team)

EIA

Chapter 8

Chapter 8

Environmental Management Plan and Monitoring Plan

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8. Environmental Management Plan and Monitoring Plan

8.1 Scope of EMAP and EMOP

The main objective of the environmental management plan (EMAP) and environmental monitoring plan（EMOP）is to ensure implementation of the mitigation measures planned to reduce the environmental impact by the construction and operation and to verify and record the environmental impact.

The EMAP and EMOP plan are worked out based on the following.

・Reduce the environmental impact to the permissible level by the mitigation measures during the period of construction and operation including of maintenance, so that a hazardous impact will not occur.

・Configure a responsible organization for the implementation of the mitigation measures

・Implement the EMAP and EMOP adequately during the period of construction and operation

The permissible level mentioned above is determined based on the national standard of Azerbaijan and International Guideline as IFC/WB EHS Guideline.

The Azerenerji is already certified on ISO 14001 and all standards & procedures will be implemented as during construction as operational phases of the project.
Environmental and Social Management System (ESMS) can also include general information PDCA (Plan-Do-Check-Act), waste management etc.

8.2 Work Plans and Schedules

8.2.1 Construction Phase

(1) Implementation system

At the construction phase, the project proponent which will order the construction of the power plant, the transmission line, and gas pipeline shall carefully consider the construction activity with supervision consultant and encourage the EPC contractor to well understand the necessary mitigation measures and to implement them.

The project proponent of the power plant, the transmission line, and the gas pipeline listed below.
The project cost of the gas pipeline will be paid by Azerenerji Joint Stock Company but the anticipated proponent will be SOCAR.

・Power Plant：the Project Institution Unit (PIU) / Yashma power plant
・Transmission Line：Azerenerji Joint Stock Company
・Gas Pipeline： SOCAR(Gas company)

In this regard, each proponent shall organized an environmental management unit prior to the construction activity and an expertise environmental management administrator shall be placed. The unit will discuss and prepare the mitigation measures with supervision consultant and the EPC contractor prior to the construction activity.

During construction activity in which large inflow of workers and vehicles is predicted, the environmental management unit shall promote the understanding of the surrounding community by consultation meeting and bulletin board about the contents and schedule of the construction activity and mitigation measures.

Moreover, the environmental management unit of each proponent shall also function as a grievance organization to understand and address opinions and grievances from local residents during construction phase, and conduct appropriate mitigation measures.
The bulletin board and public meeting provide residents with contact information for grievances from local residents
In order to confirm the implementation of the environmental management and to consider further mitigation measures, the EPC contractor should submit a regular report to the supervision consultant and environmental management unit on the implementation status of the management plan.

The environmental management administrator shall regularly conduct explanation to the local people and submit a report to MENR, JICA and other relevant organizations about the implementation status of the environmental management, in addition to the environmental monitoring described hereinafter.

Figure 8.2-1 describes the environmental management and monitoring implementation structure with the reporting flow in construction phase.

(2) Mitigation measures

The major environmental impact, mitigation measures, responsible organization, and expense for each environmental item in construction phase is listed in Table 8.2-1.

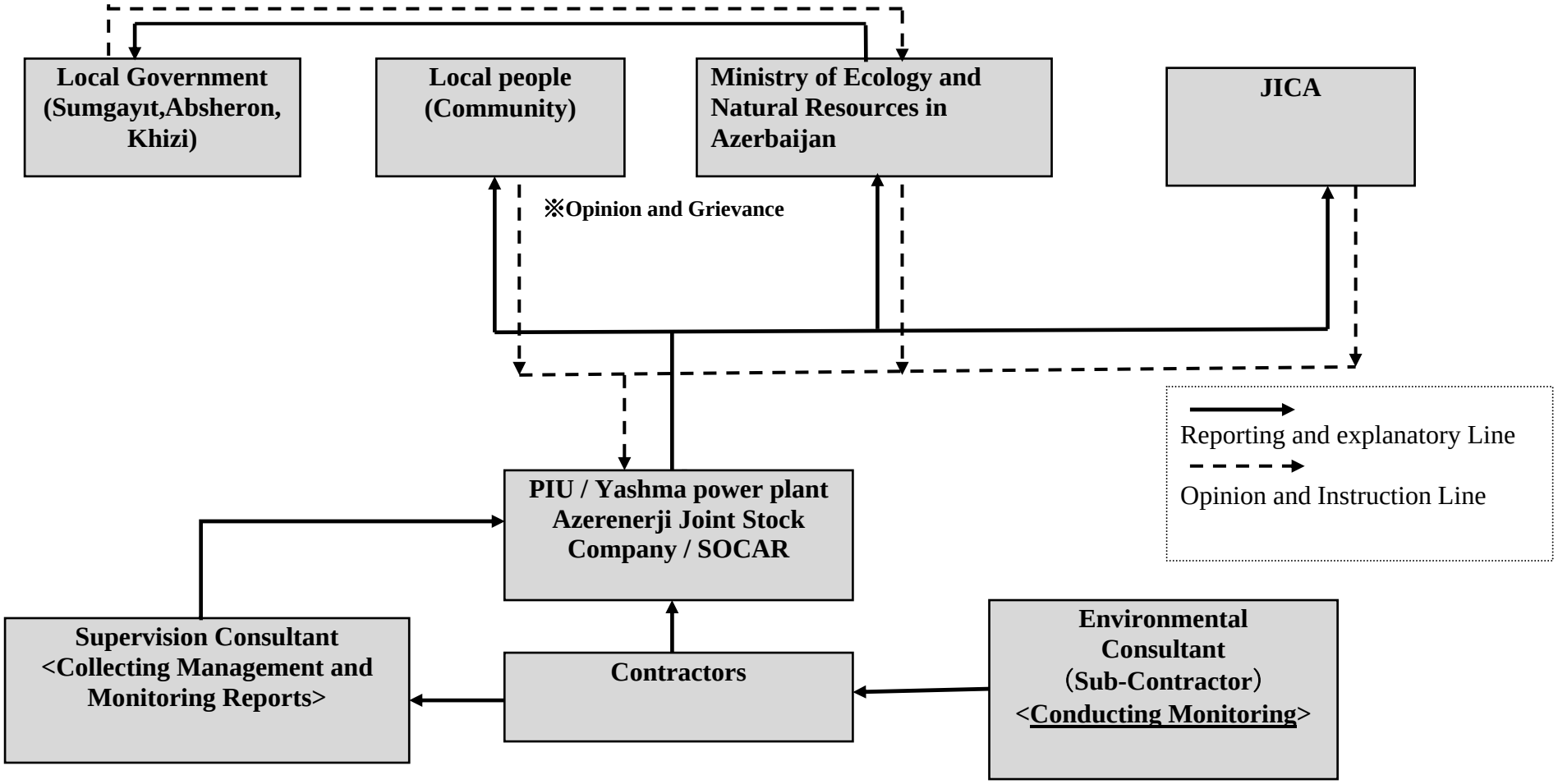


Figure 8.2-1 Environmental Management and Monitoring Implementation Structure in Construction Phase

Table 8.2-1(1) Major environmental impact and mitigation measures for construction phase (Thermal power plant)

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Construction phase					
Air pollution	- Civil engineering work, such as land formation, may cause dust, while heavy equipment and trucks are likely to discharge air pollutants (SOx, NOx, etc.).	- Rationalization of construction schedule: minimize heavy machine operation and material transportation - Periodic checkup and maintenance of heavy machine and vehicles - Shutdown of engine during waiting time - The rear deck of the sand-transport trucks shall be covered - Periodic car wash - Periodic watering of the site and surrounding road with the observation of dust caused by the strong winds - Monitoring of ambient air in the residential area compared to the standard of Azerbaijan and IFC/WB EHS Guidelines	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Water pollution and Substratum contamination	- Muddy water will be generated during dredging work and land formation excavation. - During construction, domestic waste water and oil-containing waste water will be generated. - If untreated waste water is discharged, it will cause substratum contamination.	- Installation of temporary rainwater drainage - Installation of temporary sedimentation pond and oil-separating system - Installation of septic tank and temporary toilet - To choose dredging method and equipment to that will minimize the turbidity, as anti-turbidity membrane, dredging pump etc. are installed. - Dredged soil is not dumped into the sea, but used for embankment within the site. - Monitoring of sea water quality compared to the standard of Azerbaijan	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Waste and Odor	- The construction work will generate general waste and hazardous waste. - If untreated waste water is discharged, it will cause substratum contamination.	- Development of waste management program including education of workers to encourage reduction and reuse of waste - Prohibition of illegal dumping - Separation of waste by waste type, storage in an appropriate storage site and legal disposal in an appropriate disposal site -Specifically, paper wastes and iron scraps will be recycled. Other general wastes will be collected by Sumgayit city and carried to existing disposal fields.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
		- All of the hazardous waste will be disposed by a waste management company approved by the government at disposal fields in Sumgayit which are permitted by the government in accordance with the Azerbaijan legislation. - The record of the amount of generated waste and the disposal site			
Soil contamination	- Lubrication oil and fuel, etc. spilled from construction vehicles and construction machinery, etc. are likely to cause contamination in the soil.	- Storage of oil and chemical materials in a storage site and method to prevent permeation into ground	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Noise and vibration	- Operation of heavy equipment and trucks will cause impact from the temporary noise and vibration. In particular, pile driving will cause impact from the strong noise and vibration into surrounding broader areas.	- Rationalization of construction schedule: minimize heavy machine operation and material transportation - Periodic checkup and maintenance of heavy machine and vehicles - Construction activity and traffic of vehicles is essentially limited to daytime - Use low-noise/vibration type equipment - Temporary soundproof wall around the project site, if need - Piling is not conducted. - Monitoring of noise level at site boundary and the residential area compared to the standard of Azerbaijan and IFC/WB EHS Guidelines	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Terrestrial ecosystem and rare species	- Loss of habitat of animals and vegetation is expected. - Air pollution, noise and vibration may be generated during construction	- The alteration of the site should be requisite minimum. - Rationalization of construction schedule: minimize heavy machine operation and material transportation - Periodic checkup and maintenance of heavy machine and vehicles - The rear deck of the sand-transport trucks shall be covered - Periodic car wash - Periodic watering of the site and surrounding road with the observation of dust caused by the strong winds, - Use low-noise/vibration type equipment	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
		- Piling is not conducted. -Bird hunting by workers shall be prohibited. -The plant site is vegetated with plants living in the surrounding coast or plant species resistant to salt damage.			
Marine ecosystems and rare species	- The dredging work for cooling water facilities and land reclamation are likely to generate muddy water.	- Installation of temporary rainwater drainage - Installation of temporary sedimentation pond and oil-separating system - Installation of septic tank and temporary toilet - To choose dredging method and equipment to that will minimize the turbidity, as use of the silt fence or sheet, dredging pump etc. are installed. - Dredged soil is not dumped into the sea, but used for embankment within the site. - Monitoring of sea water quality compared to the standard of Azerbaijan- If sea grass will widely disappear by construction activities, creation of see grass bed will be conducted for fishes and benthos with cooperation of MENR.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Local economy including employment and means of livelihood, Unfair distribution of damage and benefit	During construction and operation: - Since the site is governmental land and not been used for farmland and residential area, .the construction and operation will have no impact. Local people may be employed as workers by the power plant. It may purchase materials and equipment items in the local area. - If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.	- Employment of local residents as many as possible. - Use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible - Provision of job training for employment, if need - The employment of the local people shall be conducted under publicized employment conditions.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Water use	- Muddy water may be generated from dredging work and land reclamation and excavation work, resulting in impact on the recreational fishing.	- Installation of temporary rainwater drainage - Installation of temporary sedimentation pond and oil-separating system - Installation of septic tank and temporary toilet - To choose dredging method and equipment to that will	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
		minimize the turbidity, as use of the silt fence or sheet, dredging pump etc. are installed. - Dredged soil is not dumped into the sea, but used for embankment within the site. - Monitoring of sea water quality compared to the standard of Azerbaijan - Public awareness of dredging plans and construction schedule among the local people			
Existing social infrastructure and social service	- Inflows of workers may need to build lodging houses, medical treatment facilities, sewer systems and other infrastructure. - Traffic during construction is expected to increase.	- Employment of local residents as many as possible. - The rented houses in the surrounding area shall be used as much as possible. - Construct worker's camp with medical center and sewer systems, as required. - Properly control construction schedule and processes. - Determine the traffic control plan including route-setting - Training safe operation of vehicles.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
HIV/AIDS and other infectious diseases	- Influx of workers may generate infectious disease, HIV, conflict with local residents	- Installation of medical center and implementation of periodic medical check - Education and training on health care of the workers	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Work environment (including labor safety)	- Workers may have accidents during service. - Security guards may infringe on the security of surrounding people.	- Compliance of safety regulations and laws - Development of a safety and sanitation management plan - Establish a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Inspect and ensure that any lifting devices such as cranes are appropriate for the expected load. - Keep them well maintained and perform maintenance checks as appropriate during the period of construction.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Accident	- Traffic accidents may occur during operation of vehicles.	- Large machines shall be transported through the sea to the possible extent. - Land transportation shall use the existing highways	Continuously	Implementation; EPC Contractor, Environmental consultant	Expense is included in EPC contract cost by EPC Contractor.

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
		and other existing roads shall be used as much as possible. - In case of using the roads in the residential area, traffic of construction vehicles during school commuting hours shall be avoided - Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, horn)		Supervisor-consultant, PIU	
Impact across the borders and on climatic change	Temporary emission of CO_2 from heavy machines and vehicles	- Rationalization of construction schedule: minimize heavy machine operation and material transportation - Periodic checkup and maintenance of heavy machine and vehicles	-Before starting construction activity -Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.

Table 8.2-1(2) Major environmental impact and mitigation measures for construction phase (Transmission line and substation)

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Construction phase					
Air pollution	- Heavy equipment and trucks are likely to generate air pollutants	- Periodic checkup and maintenance of heavy machine and vehicles - Shutdown of engine during waiting time - Periodic car wash	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Waste and Odor	- The construction work will generate general waste and hazardous waste. - If untreated waste water is discharged, it will cause substratum contamination.	- Development of waste management program including education of workers to encourage reduction and reuse of waste - Prohibition of illegal dumping - Separation of waste by waste type, storage in an appropriate storage site and legal disposal in an appropriate disposal site	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Soil contamination	Lubrication oil and fuel oil spilled from construction vehicles and construction machinery, etc. are likely to cause contamination in the soil.	- Storage of oil and chemical materials in a storage site and method to prevent permeation into ground	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Noise and vibration	Operation of heavy equipment and trucks will cause impact from the noise and vibration.	- Periodic checkup and maintenance of heavy machine and vehicles - Construction activity and traffic of vehicles is essentially limited to daytime	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Terrestrial ecosystem and rare spccies	- Loss of habitat of animals and vegetation is expected -Air pollution, noise and vibration may be generated during construction	- The transmission line shall be constructed along the existing transmission line to the possible extent in order to minimize the area of alteration. -Prohibit disturbance, harassment, and hunting by workers -Implementation of mitigation measures for air pollution, noise and vibration	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Local economy including employment and means of livelihood, Unfair distribution of damage and benefit,	- The construction will lead to purchasing material and equipment items in the local area and also offer employment opportunities to local people. - If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.	- Employment of local residents as many as possible. - Use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible - Provision of job training for employment, if need - The employment of the local people shall be conducted under publicized employment conditions.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Existing social infrastructure and social service	- Inflow of some numbers of workers is expected. - Traffic is expected to increase during construction.	- Employment of local residents as many as possible. - Determine the traffic control plan including route-setting - Training safe operation of vehicles.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
HIV/AIDS and other infectious diseases	- Inflow of small numbers of workers is expected.	- Implementation of periodic medical check - Education and training on health care of the workers	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Work environment (including labor safety)	- Workers may have accidents during construction	- Compliance of safety regulations and laws - Development of a safety and sanitation management plan - Establish a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Inspect and ensure that any lifting devices such as cranes are appropriate for the expected load. - Keep them well maintained and perform maintenance checks as appropriate during the period of construction.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Accident	- Traffic accidents may occur during	- Land transportation shall use the existing highways	Continuously	Implementation;	Expense is included

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
	operation of vehicles.	and other existing roads as much as possible . - In case of using the roads in the residential area, traffic of construction vehicles during school commuting hours shall be avoided - Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, horn)		EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	in EPC contract cost by EPC Contractor.
Impact across the borders and on climatic change	Temporary emission of CO_2 from heavy machines and vehicles	- Periodic checkup and maintenance of heavy machine and vehicles	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.

Table 8.2-1(3) Major environmental impact and mitigation measures for construction phase (Gas pipeline)

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Construction phase (including of preconstruction phase)					
Air pollution	Heavy equipment and trucks are likely to generate air pollutants	- Periodic checkup and maintenance of heavy machine and vehicles - Shutdown of engine during waiting time - The rear deck of the sand-transport trucks shall be covered - Periodic car wash	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company)	Expense is included in EPC contract cost by EPC Contractor.
Water pollution, River ecosystem and rare species, Topography and geology	- The part of gas pipeline will be built in river side , soil of some embankments and earth cuts may overflow into the river.	- Gas pipeline route was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of construction areas with concrete, as necessary based on geological survey	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company)	Expense is included in EPC contract cost by EPC Contractor.
Waste and Odor	-The construction work will generate general waste and hazardous waste. - If untreated waste water is discharged, it will cause substratum contamination.	- Development of waste management program including education of workers to encourage reduction and reuse of waste - Prohibition of illegal dumping - Separation of waste by waste type, storage in an appropriate storage site and legal disposal in an appropriate disposal site	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Soil contamination	Lubrication oil and fuel oil spilled from construction vehicles and construction machinery, etc. are likely to cause contamination in the soil.	- Storage of oil and chemical materials in a storage site and method to prevent permeation into ground	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Noise and vibration	Operation of heavy equipment and trucks will cause impact from the noise and vibration.	- Prohibition of construction work during nighttime - Periodic checkup and maintenance of heavy machine and vehicles - Construction activity and traffic of vehicles is essentially limited to daytime	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Terrestrial ecosystem and rare spccies	- Loss of habitat of animals and vegetation is expected -Air pollution, noise and vibration may be generated during construction	- The gas pipeline shall be constructed along the existing road as much as possible to minimize the area of alteration. -Prohibit disturbance, harassment, and hunting by workers - Implementation of mitigation measures for air pollution, noise and vibration	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Topography and geology	-Soil flowage may occur.	- Gas pipeline route was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of construction areas with concrete, as necessary based on geological survey	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Local economy including employment and means of livelihood, Unfair distribution of damage and benefit	- The construction will lead to purchasing material and equipment items in the local area and also offer employment opportunities to local people. -If employing local people and/or outsourcing contracts are not fair, benefit may be unfairly distributed.	- Employment of local residents as many as possible. - Use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible - Provision of job training for employment, if need - The employment of the local people shall be conducted under publicized employment conditions.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Existing social infrastructure and social service	- Inflow of some numbers of workers is expected. - Traffic is expected to increase during construction.	- Employment of local residents as many as possible. - Determine the traffic control plan including route-setting - Training safe operation of vehicles.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant,	Expense is included in EPC contract cost by EPC Contractor.

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
				SOCAR(Gas company), Azerenerji	
HIV/AIDS and other infectious diseases	- Inflow of some numbers of workers is expected.	- Implementation of periodic medical check - Education and training on health care of the workers	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Work environment (including labor safety)	- Workers may have accidents during construction	- Compliance of safety regulations and laws - Development of a safety and sanitation management plan - Establish a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Inspect and ensure that any lifting devices such as cranes are appropriate for the expected load. - Keep them well maintained and perform maintenance checks as appropriate during the period of construction.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Accident	- Traffic accidents may occur during operation of vehicles.	- Land transportation shall use the existing highways and other existing roads shall be used as much as possible. - In case of using the roads in the residential area, traffic of construction vehicles during school commuting hours shall be avoided -Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, horn)	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
Impact across the borders and on climatic change	Temporary emission of CO_2 from heavy machines and vehicles	-Periodic checkup and maintenance of heavy machine and vehicles	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR(Gas company), Azerenerji	Expense is included in EPC contract cost by EPC Contractor.

8.2.2 Operation Phase

(1) Implementation system

The owners of the power plant, the transmission line, and gas pipeline are responsible for organizing an environmental management unit to develop and implement the environmental management plan as a mitigation measures.

The owners of the power plant, the transmission line, and the gas pipeline are listed below. With respect to the gas pipeline, the consultation on EMAP and EMOP will be required on the phase of sellout because it is supposed that it will be sold to SOCAR by Azerenerji Joint Stock Company.

- Power Plant： Yashma power plant
- Transmission Line： Azerenerji Joint Stock Company
- Gas Pipeline： SOCAR(Gas company)

An expertise environmental management administrator shall be placed so that the environmental management plan is appropriately implemented.

The environmental management administrator shall enhance the understanding of the environmental management plan to the project staffs prior to the operation, and continue regular education of the staffs during operation phase.

The environmental management unit shall also function as a grievance organization to understand and address the grievance from the local people during operation phase, and conduct appropriate mitigation measures.

Basic policy of the environmental management plan is to coordinate with the local community, and sufficient explanation of the positive mitigation measures for the local people is very important. Inviting the local residents and school children to a visiting tour of the high-technology power station in the future may be useful.

If there are requests from residents, consultation meeting will be carried out. The bulletin board and public meeting provide residents with contact information for the grievance from the local people.
The administrator shall report the contents and implementation status of the environmental management plan and the environmental monitoring plan described below to the director of the plant, and the director shall take final responsibility.

The environmental management administrator shall regularly conduct explanation to the local people and submit a report to MENR, JICA and other relevant organizations about the implementation status of the environmental management, in addition to the environmental monitoring described hereinafter.

Figure 8.2-2 describes the environmental management and monitoring implementation structure with the reporting flow in operation phase.

(2) Mitigation measures

The major environmental impact, mitigation measures, responsible organization, and expense for each environmental item in operation phase are listed in Table 8.2-2.

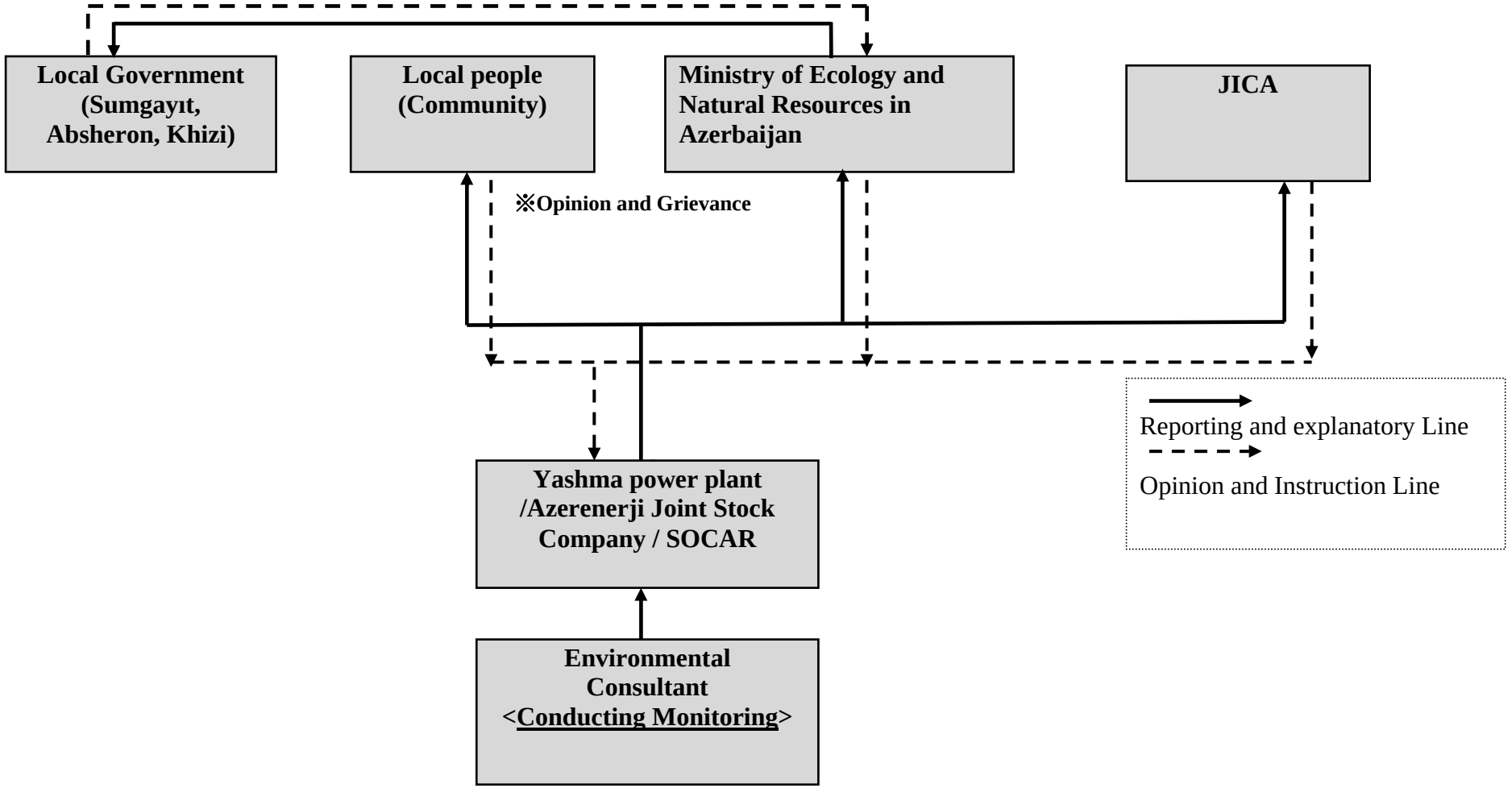


Figure 8.2-2 Environmental Management and Monitoring Implementation Structure in Operation Phase

Table 8.2-2(1) Major environmental impact and mitigation measures for operation phase (Thermal power plant)

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Operation phase					
Air pollution	- Operation of the power plant will emit NOx.	- Introduction of low NOx combustion appliances - Use of high stack - Monitoring exhaust gas and ambient air in the residential area compared to the standard of Azerbaijan and IFC/WB EHS Guidelines	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Water pollution and Substratum contamination	Thermal water, plant wastewater, domestic waste water and oil-containing waste water will be generated. - If untreated waste water is discharged, it will cause substratum contamination.	- In order to minimize the area of water temperature rise, cooling water shall be taken from 1.3km from the coast and a lower water layer 6m deep where water temperature is low, and be discharged at the high rate of 2.5m/s from the coast near the project site. - Installation of water treatment facility - Drain system will be introduced to gather oily rain water - Monitoring of thermal water , wastewater and sea water compared to the standard of Azerbaijan and IFC/WB EHS Guidelines	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Soil contamination	- Lubrication oil and fuel spilled during operation of the power plant are likely to cause contamination in the soil.	- Storage of oil and chemical materials in a storage site and method to prevent permeation into ground	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Waste and Odor	- General waste and hazardous waste will be generated. -If living waste is handled improperly, the discarded waste may cause bad smell.	- Prohibition of illegal dumping - Return waste oil to the suppliers to treat it appropriately - Separation of waste by hazard level, storage in an appropriate sites and legal disposal in an appropriate disposal site -Specifically, paper wastes and iron scraps will be recycled. Other general wastes will be collected by Sumgayit city and carried to existing disposal fields.	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
		All of the hazardous waste will be disposed by a waste management company approved by the government at disposal fields in Sumgayit which are permitted by the government in accordance with the Azerbaijan legislation. - The record of the generation amount of waste and the disposal site.			
Noise and vibration	-Operation of the plant will cause impact from the noise and vibration.	- Use low-noise equipment - Use of GT enclosure, GT intake silencer, turbine building, pomp building - Use of low-vibration equipment - Construction of buildings with strong foundation - Regular maintenance of the equipment - The south of the site near the employees' house and the site boundary is vegetated with plants living in the surrounding coast or plant species resistant to salt damage. - Monitoring of Noise level at site boundary and the residential area compared to the standards of Azerbaijan and IFC/WB EHS Guidelines - Furthermore, sound insulating walls will be installed as necessary.	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Terretrial ecosystem and rare spccies	Air pollution and noise/vibration resulting from power generation will cause negative effect to terrestrial organisms	- The alteration of the site should be requisite minimum. - Introduction of low NOx combustion appliances - Use of high stack - Use low-noise equipment - Use of GT enclosure, GT intake silencer, turbine building, pomp building - Use of low-vibration equipment - Construction of buildings with strong foundation - Regular maintenance of the equipment - Bird hunting by workers shall be prohibited.	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
		- The plant site is vegetated with plants living in the surrounding coast or plant species resistant to salt damage/			
Marine ecosystems and rare species	-Taking in organisms by cooling water intake, pollutants discharged from plant waste water and oil-containing waste water, and rises in the temperature of Thermal water are expected to have impact on marine organisms.	- Cooling water shall be taken at the low rate of 0.2m/s to minimize intake of fish and other marine organisms. - In order to minimize the area of water temperature rise, cooling water shall be taken from 1.3km from the coast and a lower water layer 6m deep where water temperature is low, and be discharged at the high rate of 2.5m/s from the coast near the project site. - Installation of water treatment facility - Drain system will be introduced to gather oily rain water - Monitoring of wastewater and sea water compared to the standard of Azerbaijan and IFC/WB EHS Guidelines - If sea grass will widely disappear by thermal water, creation of see grass bed will be conducted for fishes and benthos with cooperation of MENR.	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Marine hydrology	-Because Cooling water will be intake and discharged, there will be changes in flow conditions in the vicinities of the discharged.	- Water temperature rise due to condenser shall be maintained Δ9°C to minimize the amount of cooling water. - Water shall be taken at the low rate of 0.2m/s.	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Local economy including employment and means of livelihood	- Local people may be employed as workers by the power plant. It may purchase materials and equipment items in the local area. - If employing local people and/or outsourcing contracts	- Employment of local residents as many as possible. - Use of the services (i.e. laundry and catering service etc.) and products offered in the local community, as possible - Provision of job training for employment, if need - The employment of the local people shall be	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
	are not fair, benefit may be unfairly distributed.	conducted under publicized employment conditions.			
Water use	- Installation of water taking and discharging facilities may have impact on navigation of small boats for a recreational purpose. - Taking organisms by cooling water intake, pollutants discharged from plant waste water and oil-containing waste water, and rises in the temperature of thermal water may cause impact on the recreational fishing.	- The location of offshore water intake equipment shall be marked with a buoy installed around the equipment. - Cooling water shall be taken from the lower water layer 6m deep at the low rate of 0.2m/s to minimize intake of fish and other marine organisms, and to avoid adverse impact on the operation of fishery vessels. - In order to minimize the area of water temperature rise, cooling water shall be taken from 1.3km from the coast and a lower water layer 6m deep where water temperature is low, and be discharged at the high rate of 2.5m/s from the coast near the project site. - Installation of water treatment facility - Drain system will be introduced to gather oily rain water - Monitoring of wastewater and sea water compared to the standard of Azerbaijan and IFC/WB EHS Guidelines	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Existing social infrastructure and social service	-Lodging houses, medical treatment facilities, sewer systems and other infrastructure may be needed for workers.	- Employee's houses shall be prepared in the site. - Properly control maintenance schedule and processes. - Determine the traffic control plan including route-setting in maintenance - Training safe operation of vehicles.	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
Labor environment	- Workers may have accidents during service. - Security guards may infringe on the security of surrounding people.	- Compliance of safety regulations and laws - Development of a safety and sanitation management plan - Establish a manual for labor accident prevention including safety education and training	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
		- Provide workers with appropriate protective equipment - Keep them well maintained and perform maintenance checks as appropriate during the period of operation.			
Accident	-Fire and Traffic accident by operation of facilities and/or vehicles.	- Development of gas-leakage prevention management plan - Gas-leakage alarm system - Installation of stationary fire prevention system, fire hydrant, fire extinguisher, fire escape exit, fire alarm, fireproof compartment, emergency exit, etc. - Installation of automatic control system - Construction of fire-fighting facility - Inspection of equipment - During the land transportation at the periodic inspection, the existing highways and other roads shall be basically used. - In case of using the roads in the residential area for periodic inspection, traffic of construction vehicles during school commuting hours shall be avoided -Checking of traffic regulations, installation of traffic signs, driving safety education, speed restriction, checkup of vehicle equipment (brake, horn)	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
Global warming	CO_2 emission caused global warming is generated by operation of Yashma CCPP	- Adoption of high-efficiency combined cycle power generation system and maintenance of capacity of the facility	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant

Table 8.2-2 (2) Major environmental impact and mitigation measures (Transmission line and substation)

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Operation phase					
Noise and vibration	-The substation will generate noise.	- Use low-noise and low-vibration equipment - Regular maintenance of the equipment	Continuously	Azerenerji	Azerenerji
Terrestrial ecosystems and rare species	-The power transmission line may cause bird strikes.	- Installation of lights and signs, etc., if needed	Continuously	Azerenerji	Azerenerji
Work environment (including labor safety)	- Workers may have accidents during maintenance.	- Compliance of safety regulations and laws - Development of a safety and sanitation management plan - Establish a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment	Continuously	Azerenerji	Azerenerji
Accident	-Steel towers may fall down due to a storm, heavy rain, etc.	- Compliance of safety regulations and laws - Inspection of transmission tower	Continuously	Azerenerji	Azerenerji

Table 8.2-2 (3) Major environmental impact and mitigation measures (Gas pipeline)

Items	Potential impact	Mitigation measures	Implementation	Responsible organization	Budget
Operation phase					
Work environment (including labor safety)	- Workers may have accidents during maintenance.	- Compliance of safety regulations and laws - Development of a safety and sanitation management plan - Establish a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment	Continuously	SOCAR （Gas company）	SOCAR （Gas company）
Accident	- Gas leakage may occur from the pipeline.	- Development of gas-leakage prevention management plan - Gas-leakage alarm system - Installation of automatic control system --Regular Inspection of gas pipeline	Continuously	SOCAR （Gas company）	SOCAR （Gas company）

8.3 Environmental Implementation and Training

The environmental management administrator provides preliminary training on environmental management to the staffs prior to the beginning of the operation. The administrator should also provide appropriate updated training all through the operation phase.

8.4 Environmental Monitoring Plan

8.4.1 Monitoring Parameters

(1) Construction Phase

Table 8.4.1 shows the monitoring condition during the construction phase.
Main contents of the monitoring include;

- Air quality monitoring: SPM, SO_2, and NO_2 are used as parameters for the measurement.
  Air quality is monitored in the residential areas in principle.
- Waste water monitoring: pH, TSS, oil and grease is used as parameters for the measurement..
  Waste water is monitored at the outlet from the settling pond.
- Sea water monitoring: pH, TSS, oil and grease is used as parameters for the measurement.
  Sea water is monitored at the dredging site and the front sea area of the site.
- Under ground water monitoring: pH, TSS, oil and grease is used as parameters for the measurement.
  Under ground water is monitored at the site, in case spring appears due to the earthwork and turbidity can contaminate ground water as necessary.
- Noise monitoring: Noise level is used as the parameter for the measurement.
  Noise is monitored in the residential areas in principle.

If monitoring results of air quality, noise and water quality will be confirmed to exceed of Azerbaijan and IFC/WB standards by the construction of power station, additional mitigation measures should be conducted.

(2) Operation Phase

Table 8.4-1 shows the monitoring condition during the operation phase.
Main contents of the monitoring include;

- Gas emission monitoring: NOx are used as parameters for the measurement.
  Gas emissions are monitored in the Gas duct by Continuous Emission Monitoring System (CEMS).
- Air quality monitoring: NO_2 are used as parameters for the measurement.
  Air quality is monitored in the residential areas in principle.

- Waste water monitoring: Water temperature, pH, DO, SS, oil, BOD, and precious metals are used as parameters for the measurement.
  Thermal water is monitored at outlet of the condenser by automatic measuring
  Waste water is monitored at the outlet where the waste water is discharged from treatment plant.
- Water quality monitoring: Water temperature, DO, SS, oil, BOD, and precious metals are used as parameters for the measurement.
  Water quality is monitored at sea.
- Noise monitoring: Noise level is used as the parameter for the measurement.
  Noise is monitored on the boundary of the site and in the residential areas in principle.

If monitoring results of air quality, noise and water quality will be confirmed to exceed of Azerbaijan and IFC/WB standards by the operation of power station, additional mitigation measures should be conducted.

Table 8.4-1Items, location, method, frequency, responsibility and expense of the environmental monitoring plan for thermal power plant

No.	Item		Method	Location	Frequency	Responsibility	Budget
Construction phase							
1	Air quality	SO_2,NOx (NO, NO_2), Suspended particles (Dust)	Ambient air quality analyzers	The residential area in the south of the site.	Once a week at the maximum construction activity.	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
2	Waste water	pH, TSS, , oil and grease	Sample analysis	Outlet of waste treatment facility	Every week	Yashma Power Plant	Azerenerji/ Yashma Power Plant
3	Sea water quality	pH, TSS, oil and grease	Sample analysis	At the dredging site and the front sea area of the site.	At the dredging activity and drilling and filling.	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
4	Under ground water quality	pH, TSS, oil and grease	Sample analysis	the site.	At drilling and filling if need .	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
5	Waste	Waste management practice in storage and disposal	Contract and record	Project site and associated facilities	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
6	Noise	Noise level	Sound-level meter	Site boundary and the residential area in the south of the site.	Once a week at the maximum construction activity with interval of 1hr for 24hr of 1 day..	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.

7	Ecosystem (Sea grass) (Caspian seal)	Species, Weight ,habitat area	-Collecting samples at the site, analyzing at a lab -Observation -Observation	Shallow water area within 2km from outlet -Surrounding of Intake tower and facing of the site	Period of dredging work. -Same as above	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
8	Labor and working conditions	Conformity of laws and regulations	Inspection	Project site and associated facilities	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, PIU	Expense is included in EPC contract cost by EPC Contractor.
9	Grievances	Numbers, contents, and processing results of grievances	Recording	-	Continuously	PIU	PIU
Operation phase							
1	Air quality	NOx (NO_2,NO)	Ambient air quality analyzers	Decided after completion of detailed design	3 years from the start of the operation. Quarterly, Once a week	Yashma Power Plant	Azerenerji/ Yashma Power Plant
2	Exhaust gas	NOx, CO	Continuous Emission Monitoring System(CEMS)	Gas duct	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
3	Waste water	Temperature, Salinity, Residual chlorine - pH, DO, COD, SS, Oil and grease, Ammonia, Nitrite, Nitrate, Sulfate, Phenol, Chloride, Ca, Na, K, Phosphate, Fe, Cu, Zn, Cr, Pb , Cd, Hg, As,etc.	-Automatic measuring -Sample analysis	Outlet of the condenser Outlet of waste treatment facility	- Continuously - Every week	Yashma Power Plant	Azerenerji/ Yashma Power Plant

4	Sea water quality	- Temperature, pH, DO, COD, SS, Oil and grease, Ammonia, Nitrite, Nitrate, Sulfate, Phenol, Chloride, Ca, Na, K, Phosphate, Fe, Cu, Zn, Cr, Pb , Cd, Hg, As,etc.	Sample analysis	Decided after completion of detailed design	3 years from the start of the operation. Quarterly	Yashma Power Plant	Azerenerji/ Yashma Power Plant
5	Waste	Waste oil, sludge, domestic waste	Contract and record	Project site and associated facilities	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
6	Noise	Noise level	Sound-level meter	Site boundary and the residential area in the south of the site.	Quarterly a year with interval of 1hr for 24hr of 1day.	Yashma Power Plant	Azerenerji/ Yashma Power Plant
7	Ecosystem (Sea grass) (Caspian seal)	Species, Weight ,habitat area	-Collecting samples at the site, analyzing at a lab -Observation - Visual Observation by plant staff	Shallow water area within 2km from outlet -Surrounding of Intake tower and facing of the site	3 years from the start of the operation. Spring and summer -Same as above	Yashma Power Plant	Azerenerji/ Yashma Power Plant
8	Labor and working conditions	Conformity of laws and regulations and laws	Inspection	Project site and associated facilities	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant
9	Grievances	Numbers, contents, and processing results of grievances	Recording	-	Continuously	Yashma Power Plant	Azerenerji/ Yashma Power Plant

Table 8.4-1 (2) Items, location, method, frequency, responsibility and expense of the environmental monitoring plan for transmission line

No.	Item		Method	Location	Frequency	Responsibility	Budget
Construction phase							
1	Waste	The type and amount of waste	State on recycling and waste disposal	Throughout the construction site	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
2	Labor and working conditions	Conformity of laws and regulations and laws	Inspection	Throughout the construction site	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, Azerenerji	Expense is included in EPC contract cost by EPC Contractor.
3	Grievances	Numbers, contents, and processing results of grievances	Record	Throughout the construction site	Continuously	Azerenerji	Azerenerji
Operation phase							
1	Labor and working conditions	Conformity of laws and regulations and laws	Inspection	-	Continuously	Azerenerji	Expense is included in operation cost.
2	Grievances	Numbers, contents, and processing results of grievances	Record	-	Continuously	Azerenerji	Expense is included in operation cost.

Table 8.4-1 (3) Items, location, method, frequency, responsibility and expense of the environmental monitoring plan for gas pipeline

No.	Item		Method	Location	Frequency	Responsibility	Budget
Construction phase							
1	Waste	The type and amount of waste	State on recycling and waste disposal	Throughout the construction site	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR（Gas company）	Expense is included in EPC contract cost by EPC Contractor.
2	Labor and working conditions	Conformity of laws and regulations and laws	Inspection	Throughout the construction site	Continuously	Implementation; EPC Contractor, Environmental consultant Supervisor-consultant, SOCAR（Gas company）	Expense is included in EPC contract cost by EPC Contractor.
3	Grievances	Numbers, contents, and processing results of grievances	Record	Throughout the construction site	Continuously	SOCAR（Gas company）	SOCAR（Gas company）
Operation phase							
1	Labor and working conditions	Conformity of laws and regulations and laws	Inspection	-	Continuously	SOCAR（Gas company）	Expense is included in operation cost.
2	Grievances	Numbers, contents, and processing results of grievances	Record	-	Continuously	SOCAR（Gas company）	Expense is included in operation cost.

EIA

Chapter 9

Chapter 9

PUBLIC CONSULTATIONS

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9. PUBLIC CONSULTATIONS

9.1 INTRODUCTION

Public consultation forms an important part of the EIA study. The main objective of the consultation process is to apprise the local inhabitants about the proposed project and to seek their opinions regarding the possible impacts of the project. It was recognized that their opinions would be more useful as they are accustomed to construction and operation of a number of power plant units in the locality in last few years.

Public involvement is a fundamental principle of any environmental assessment study. The inclusion of the views of the affected and interested public helps to ensure that the decision making process is equitable and fair and leads to more informed choice and better environmental outcomes. The findings from the public consultations carried out as a part of the EIA study were utilized in the development of the EMP (presented in Chapter 9), especially in identifying the significant impacts of the proposed project and developing the corresponding mitigation measures.

9.2 APPROACH AND METHODS

Within the framework of the present study, public consultation process has been initiated with an explicit objective to ensure people's participation. More specifically this was aimed at improving the study, taking into account opinions from the people of the study area.

Consultation was undertaken at early stages of the EIA study so that potentially affected groups/people could provide meaningful input to the EIA. The dialogue, both formal and informal, was continued throughout the period. All consultations and meetings were documented including responses to the questionnaire.

9.3 PUBLIC CONSULTATION

9.3.1 First Stakeholders' Meeting

(1) Date and time
11th of Aril 2014, from 15:00 PM

(2) Place
Azerbaijan, Sumgait city, Sumgait Power Plant, Conference room

(3) Purpose of the meeting
_The role and objectives of the JICA and JICA study team
_Information on the impact on the environment and impact on socio-economic

(4) Participants
There were 46 participants including community members from Sumgait and Z. Tagiyev settlement, local press, Azerbaijani consultants and specialists from Sumgait Power Plant. Azerenerji announced the organization of the stakeholder meeting by local newspaper and direct contact to stakeholders.

(5) Language
Azerbaijani

Participant list:

No.	Ad, Soyad/Name, Surname	Təmsil etdiyiniz qurum/təşkilat və peşəniz/ Organisation/Company and profession
1		Sumgayit PP,Director
2		- (no inscription)
3		- (no inscription)
4		Lawyer
5		Azerboru , engineer
6		Jorat district, engineer
7		Nasosni district, H.Z. Tagiyev h.23, enginner
8		- (no inscription)
9		- (no inscription)
10		- (no inscription)
11		SOCAR engineer
12		Sumgayit city resident
13		Technician
14		- (no inscription)
15		Sumgayit PP, accountant
16		Accountant
17		Engineer
18		- (no inscription)
19		- (no inscription)
20		Kimyachilar district, housekeeper
21		- (no inscription)
22		- (no inscription)
23		- (no inscription)
24		- (no inscription)
25		- (no inscription)
26		- (no inscription)
27		- (no inscription)

No.	Ad, Soyad/Name, Surname	Təmsil etdiyiniz qurum/təşkilat və peşəniz/ Organisation/Company and profession
28		Resident of Sumgayit city, engineer-mechanic
29		- (no inscription)
30		- (no inscription)
31		- (no inscription)
32		Technician
33		Azerkimya , engineer electrician
34		H.Z. Tagiyev district h.4, 90
35		Sumgayit city, 10mk, h.21, 141
36		SOCAR technician
37		- (no inscription)
38		- (no inscription)
39		- (no inscription)
40		- (no inscription)
41		Jorat district, assistant
42		- (no inscription)
43		Resident of Sumgayit city 41a
44		- (no inscription)
45		- (no inscription)
46		- (no inscription)

(6) Summary of the meeting

1. Opening remarks, the project description -
2. Presentation of the project –
3. Questions and answers.

Main speech, questions and answers are the following;
;

Speakers;	Contents;
Director of Sumgait Power Plant	Opening of public meeting and welcoming guests. Presentation of participants. Determination of discussion topics and order of discussions. Informing participants about the importance of planned Yashma Combined Cycle Gas Turbine Power Plant Construction Project in context of dynamic economic development of Azerbaijan, realizing state programs in energy sector signed by President of Azerbaijan.
Team Leader of JICA study team	Opening remarks
JİCA Study Team member for Yashma project	Informing about Guidelines for Environmental and Social Considerations Environmental and Social Consideration of Japan International Cooperation Agency (JICA) (hereinafter, JICA guidelines), goal and duration of JICA project in Yashma, effectiveness of ecological friendly technologies of new Power Plant, Gas Pipeline and Transmission Line. Currently planned capacity of power plant is 900-950 MW. The plant will consist of two blocks and use natural gas as a fuel. According to the result of initial research the technologies which will be used in construction work will not greatly impact on the environment. The water which will be used at plant will be taken from Caspian Sea. Water is taken from the depths of the sea for cooling system. JICA needs to confirm the project satisfy the conditions of Azerbaijan and JICA concerning environmental and social impacts. JICA is interested to know about environment impacts and results of impacts to the environment. The final report will be provided to Ministry of Nature Resources of Azerbaijan and after approval it will be uploaded to JICA website for public disclosure. The presentation includes initial research materials on project description of power plant, transmission lines and substations, gas pipeline map, collected data by local consultants on marine environment, atmosphere, noise and vibration, fauna and flora, study of data on species listed in Azerbaijani Red book and IUCN listed species, Social Environment: land use, land traffic, sanitation, population & demography, education, public infrastructure, employment, income and expenditure, tourist site, cultural and heritage properties, minorities. In order to identify environmental impacts, the past database must be reviewed and field research will be conducted. Different modeling results will be prepared and presented to community in the next stakeholder meeting. After the first public meeting, field researches will start. Air quality research as well as noise measurement will be conducted throughout 24 hours in 2 places – Power Plant area and in nearest living area. JICA study team will prepare EİA report based on the data

Speakers;	Contents;
	collection work and field survey.
Question 1 from the local participants	"Could you tell about wastes, pollutions during construction activities? May I know about level of emissions?"
Answer 1 from JICA study team	"As the Power Plant will use natural gas as a fuel CO, CO_2, NOx etc. emissions are expected. All local and international standards will be met."
Question 2 from the local participants	"We wish you success and welcome to project staff. This is third project in Sumgayit which we know. Is that possible to use sea water in cooling system effectively and protect sea from negative impacts ?."
Answer 2 from JICA study team	"Intake water system is the same as in Shimal Power Plant and the water which will be taken from the depth of the sea will be discharged back to the sea without any negative impact. We will notify you about the results of the research in the second stakeholder meeting. "
Question 3 from the local participants	"Do you intend to plant trees around the new station?"
Answer 3 from JICA study team	"There is a plan to install tree-planting area in the project site. The tree-planting area was installed at various existing power plants. "
Question 4 from the local participants	"Is there such large-scale of the same type plant in other countries?"
Answer 4 from JICA study team	"Currently, Indonesia and Malaysia build bigger and stronger plants. Malaysia built in two blocks of 700 MW. "
Question 5 from the local participants	"How to handle the cooling system of the power plant in operation? Where is the water which will be taken from? "
Answer 5 from JICA study team	"The cooling system water will be taken from the depth of the sea. After the process of mineralization and other treatment we will use it in cooling system. "
Question 6 from the local participants	"Are you planning to conduct monitoring of emissions to the environment?"
Answer 6 from JICA study team	"Yes. Both water and air."

NB: There was no opinion or remark explaining the protestation against the project.



Figure 9-1 Pictures Taken during the First Stakeholder Meeting

9.3.2 Second Stakeholders' Meeting

(1) Date and time
4th of July 2014, from 12:00 AM

(2) Place
Azerbaijan, Sumgait city, Sumgait Power Plant, Conference room

(3) Purpose of the meeting
_Present the result of environmental impact assessment study
_Present management plan and monitoring plan
Question and answer about the result and plans

(4) Participants
There were 51 participants including community members from Sumgait and Z. Tagiyev settlement, local press, Azerbaijani consultants and specialists from Sumgait Power Plant. . Azerenerji announced the organization of the stakeholder meeting by local newspaper and direct contact to stakeholders.

(5) Language
Azerbaijani

Participant list:

№	Ad, Soyad/Name, Surname	Təmsil etdiyiniz qurum/təşkilat və peşəniz/ Organisation/Company and profession
1		Resident of Sumgayit city, engineer
2		Resident of Sumgayit city, housekeeper
3		Jorat district, assistant
4		Kimyachilar district, housekeeper
5		Resident of Sumgayit city, engineer-mechanic
6		Resident of Sumgayit city, engineer-mechanic
7		Resident of Sumgayit city, 8mk,h.10
8		Resident of Sumgayit city Kimyachilar district
9		Resident of Sumgayit city 41a
10		Azerenerji JSC
11		Investment Department , Azerenerji JSC
12		Investment Department, Azerenerji
13		Investment Department, Azerenerji
14		Azerenerji JSC, head of press center
15		Academy of Science, EcoNote
16		Lawyer
17		Engineer
18		Worker
19		Azerkimya , engineer electrician
20		Azerboru , engineer
21		SOCAR technician
22		Sumgayit PP, specilaist

№	Ad, Soyad/Name, Surname	Təmsil etdiyiniz qurum/təşkilat və peşəniz/ Organisation/Company and profession
23		H.Z. Tagiyev district, Sattar Bahl street
24		Sumgayit PP, accountant
25		Sumgayit city resident
26		Sumgayit city resident
27		Sumgayit city, engineer
28		Sumgayit city resident, engineer
29		Sumgayit city resident , gardener
30		Sumgayit city resident , gardener
31		Sumgayit PP, engineer
32		Rigger
33		Commodities expert
34		SOCAR engineer
35		Economist
36		Technician
37		Accountant
38		Painter
39		Assistant
40		Assistant
41		Technician
42		Jorat district, engineer
43		Nasosni district, H.Z. Tagiyev h.23, enginner
44		Sumgayit city, mk.3, 18/33, 9, doctor
45		H.Z. Tagiyev district h.4, 90
46		Sumgayit city, 10mk, h.21, 141
47		EcoNote, social specialist
48		"Azerbaijan Lights" newspaper
49		Sumgayit PP,Director
50		Sumgayit PP, BMM
51		Azerenerji JSC, Ekologist

(6) Summary of the meeting

1. Opening remarks, the project description -
2. Presentation of the project –
3. Speech by Governor of district –
4. Questions and answers.
5. Conclusion

Main speech, questions and answers are the following;

Speakers;	Contents;
Director of Sumgait Power Plant	Opening of the public meeting and welcoming guests. Presenting the participants. Introducing the discussion topics and their sequence. Informing participants about the purpose of the Second Public Meeting on the planned Yashma Combined Cycle Gas Turbine Power Plant Construction Project.
JİCA Study Team member for Yashma project	Presentation on Environmental Impact Assessments of Yashma Power Plant Project. Explanation about Guidelines for Environmental and Social Considerations of Japan International Cooperation Agency (JICA), goal and duration of the JICA project in Yashma, effectiveness of ecological friendly technologies of the new Thermal Power Plant, Gas Pipeline and Transmission Line. The current planned capacity of the power plant is 900-950 megawatts. The station will consist of two blocks. The natural gas will be used as a fuel. The technologies which will be used in the construction work won't cause any negative impacts on the environment. The water to be used for the cooling system at the plant will be taken from depth of the Caspian Sea. JICA explained the requirements to fulfill the conditions of Azerbaijan and JICA concerning environmental and social impacts. JICA is interested to identify and recognize the environment impacts. The project's energy efficient technologies, water treatment systems, quality of air, noise, temperature of water were explained. The project will be realized in the manner that will meet all ecological standards and protect the nature from negative impacts. The works will be conducted mainly during the daytime for protection of the local population from noise in the evening and night time. The local people will be employed in the temporary works.
Biodiversity Specialist of the project	He mentioned in his presentation about 19 plant species in the power plant area, 24 species in the transmission lines area and 30 species on the gas pipeline route. According to his information, there are no species, birds or fishes included in IUCN Red Book or the Red Book of Azerbaijan found in the territory of power plant,

	transmission line or gas pipelines. Only two species, Mediterranean tortoise and Red Falcon bird were mentioned as vulnerable in the Red Book of Azerbaijan.
Question 1 from the local participants	"We are concerned about dust and noise caused during the construction activities. How often monitoring will be conducted during the construction period? Do you consider providing online monitoring?"
Answer 1 from JICA study team	"We plan to conduct monitoring in the period of maximum construction activity. Contractors will conduct monitoring in selected period by online or other systematic monitoring equipment.."
Question 2 from the local participants	"How do you monitor the change of water temperature in the Caspian sea?"
Answer 2 from JICA study team	"We will install equipment to measure water temperature of thermal effluent. Water temperature will be measured around the site as well."
Question 3 from the local participants	"Do you have a special device for cooling the generator?"
Answer 3 from JICA study team	"Yes. We have all modern devices for proper use of the generator."
Question 4 from the local participants	"What kind of green activities are planned near the power station?"
Answer 4 from JICA study team	"On the south side of the Power Station many trees will be planted and other environment protection activities will be conducted."
Conclusion	Specialists from Sumgayit Power Station, community member from Jorat settlement, community members from Z.Tagiyev settlement were satisfied with the answers on their questions. Representatives from Sumgayit, Zeynallabdin Taghiyev settlement, settlement of Nasosniy, Jorat settlement of Sumgayit, as well as from Sumgayit Power Plant, Azerkimya, Azerboru, SOCAR companies, also teachers, journalists from newspaper "Azerbaijan ishiqlari", housekeepers from Z.Tagiyev settlement were glad to meet with representatives from JICA Study Team.



Figure 9-2 Pictures Taken during the Second Stakeholder Meeting

EIA ANNEX 9-1

1st Public Meeting Protocol

Public meeting Protocol

Azerbaijan, **Baku**
11.04.2014

Location:
Azerbaijan, Sumgait city

Place: Sumgait Power Plant, Conference room

Public meeting topic: First Stakeholder Meeting on Yashma Combined Cycle Gas Turbine Power Plant Construction Project

Public meeting participants:
There were 46 participants including community members from Sumgait and Z. Tagiyev settlement, local press, Azerbaijani consultants and specialists from Sumgait Power Plant. Azerenerji announced the organization of the stakeholder meeting by local newspaper and direct contact to stakeholders.

Working organ of the public meeting:
Chairperson: Director of Sumgait Power Plant

Presentation:

Director of Sumgait Power Plant

Opening of public meeting and welcoming guests. Presentation of participants. Determination of discussion topics and order of discussions.

Informing participants about the importance of planned Yashma Combined Cycle Gas Turbine Power Plant Construction Project in context of dynamic economic development of Azerbaijan, realizing state programs in energy sector signed by Prezident.

Team Leader of JICA study team

Opening remarks.

JİCA Study Team member for Yashma project

Informing about Guidelines for Environmental and Social Considerations Environmental and Social Consideration of Japan International Cooperation Agency (JICA) (hereinafter, JICA guidelines), goal and duration of JICA project in Yashma, effectiveness of ecological friendly technologies of new Power Plant, Gas Pipeline and Transmission Line. Currently planned capacity of power plant is 900-950 MW. The plant will consist of two blocks and use natural gas as a fuel. According to the result of initial research the technologies which will be used in construction work will not greatly impact on the environment. The water which will be used at plant will be taken from Caspian Sea. Water is taken from the depths of the sea for cooling system. JICA needs to confirm the project satisfy the conditions of Azerbaijan and JICA concerning environmental and social impacts. JICA is interested to know about environment impacts and results of impacts to the environment. The final report will be provided to Ministry of Nature Resources of Azerbaijan and after approval it will be uploaded to JICA website for public disclosure.

The presentation includes initial research materials on project description of power plant, transmission lines and substations, gas pipeline map, collected data by local consultants on marine environment, atmosphere, noise and vibration, fauna and flora, study of data on species listed in Azerbaijani Red book and IUCN listed species, Social Environment: land use, land traffic, sanitation, population & demography, education, public infrastructure, employment, income and expenditure, tourist site, cultural and heritage properties, minorities. In order to identify environmental impacts, the past database must be reviewed and field research will be conducted. Different modeling results will be prepared and presented to community in the next stakeholder meeting.

After the first public meeting, field researches will start.

Air quality research as well as noise measurement will be conducted throughout 24 hours in 2 places – Power Plant area and in nearest living area.

JICA study team will prepare EİA report based on the data collection work and field survey.

Questions and answers:

Questions from the local participants, representative of the industrial city of Sumgait and Z.Tagiev settlement .

Director of Sumgait Power Plant Mr. Mahir Kheyirkhabarov:

- They have always lived here. They have informaton about environmental impact of the power plant . I hope that this meeting was interesting for them .

Question 1.

- "Could you tell about wastes , pollutions during construction activities? May I know about level of emissions?"
- "As the Power Plant will use natural gas as a fuel CO, CO_2, NOx etc. emissions are expected. All local and international standarts will bemet."

Question 2.

- "We wish you success and welcome to project staff. This is third project in Sumgayit which we know. Is that possible to use sea water in cooling system effectively and protect sea from negative impacts."

"Intake water system is the same as in Shimal Power Plant and the water which will be taken from the depth of the sea will be discharged back to the sea without any negative impact. We will notify you about the results of the research in the second stakeholder meeting.

Question 3.

-Do you intend to plant trees around the new station ?

-"There is a plan to install tree-planting area in the project site. The tree-planting area was installed at various existing power plants. "

Question 4.

- Is there such large-scale of the same type plant in other countries?
- “Currently, Indonesia and Malaysia build bigger and stronger plants . Malaysia built in two blocks of 700 MW . ”

Question 5.

-How to handle the cooling system of the power plant in operation? Where is the water will be taken from?

- “The cooling system water will be taken from the depth of the sea. After the process of mineralization and other treatment we will use it in colling system. ”

Question 6.

- Are you plan to conduct monitoring of emissions to the environment ?
- “Yes. Both water and air .”
- It was very interesting to participate in your stakeholder meeting.

Wish you good luck in your future work!.

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EIA ANNEX 9-2

2nd Public Meeting Protocol

Public meeting Protocol

Azerbaijan, **Baku**
04.07.2014

Location:
Azerbaijan, Sumgait city

Place: Sumgait Power Plant, Conference room

Public meeting topic: First Stakeholder Meeting on Yashma Combined Cycle Gas Turbine Power Plant Construction Project

Public meeting participants:
There were 51 participants including community members from Sumgait and Z. Tagiyev settlement, local press, Azerbaijani consultants and specialists from Sumgait Power Plant. Azerenerji announced the organization of the stakeholder meeting by local newspaper and direct contact to stakeholders..

Working organ of the public meeting:
Chairperson: Director of Sumgait Power Plant

Presentation:

Director of Sumgayit Power Plant

Opening of the public meeting and welcoming guests. Presenting the participants. Introducing the discussion topics and their sequence. Informing participants about the purpose of the Second Public Meeting on the planned Yashma Combined Cycle Gas Turbine Power Plant Construction Project.

JİCA Study Team member for Yashma project

-Presentation on Environmental Impact Assessments of Yashma Power Plant Project.

−Explanation about Guidelines for Environmental and Social Considerations of Japan International

Cooperation Agency (JICA), goal and duration of the JICA project in Yashma, effectiveness of ecological friendly technologies of the new Thermal Power Plant, Gas Pipeline and Transmission Line. The current planned capacity of the power plant is 900-950 megawatts. The station will consist of two blocks. The natural gas will be used as a fuel.

The technologies which will be used in the construction work won't cause any negative impacts on the environment. The water to be used for the cooling system at the plant will be taken from depth of the Caspian Sea. JICA explained the requirements to fulfill the conditions of Azerbaijan and JICA concerning environmental and social impacts. JICA is interested to identify and recognize the environment impacts.

The project's energy efficient technologies, water treatment systems, quality of air, noise, temperature of water were explained. The project will be realized in the manner that will meet all ecological standards and protect the nature from negative impacts.

The works will be conducted mainly during the daytime for protection of the local population from noise in the evening and night time. The local people will be employed in the temporary works.

Biodiversity Specialist of the project

mentioned in his presentation about 19 plant species in the power plant area, 24 species in the transmission lines area and 30 species on the gas pipeline route. According to his information, there are no species, birds or fishes included in IUCN Red Book or the Red Book of Azerbaijan found in the territory of power plant, transmission line or gas pipelines. Only two species, Mediterranean tortoise and Red Falcon bird were mentioned as vulnerable in the Red Book of Azerbaijan.

During the public meeting environmental experts answered questions from Sumgayit city and Z.Tagiyev settlement community members.

Questions and answers:

Question 1.

"We are concerned about dust and noise caused during the construction activities. How often will monitoring will be conductedprovided during the construction period? Do you consider providing online monitoring?

"We plan to conductedprovide monitoring in the period of maximum construction activityselected areas. It`s more effective. Contractors will conduct provide monitoring in on the selected period byareas, also online or other systematic monitoring equipment"

Question 2.

"How do you monitor the change of water temperature in the Caspian sea?"

" We will install equipment to measure water temperature of thermal effluent. Water temperature will be measured around the site as well."

Question 3.

Do you have a special device for cooling the generator?

"Yes. We have all modern devices for proper use of the generator."

Question 4.

What kind of green activities are planned near the power station?

"On the south side of the Power Station many trees will be planted and other environment protection activities will be conducted."

Conclusion

Specialists from Sumgayit Power Station, community member from Jorat settlement, community members from Z.Tagiyev settlement were satisfied with the answers on their questions.

Representatives from Sumgayit, Zeynallabdin Taghiyev settlement, settlement of Nasosniy, Jorat settlement of Sumgayit, as well as from Sumgayit Power Plant, Azerkimya, Azerboru, SOCAR

companies, also teachers, journalists from newspaper "Azerbaijan ishiqlari", housekeepers from Z.Tagiyev settlement were glad to meet with representatives from JICA Study Team, ECONote and together with the director of Sumgayit Power Plant wished good luck to JICA and TEPSCO teams during the project.

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Chapter 10

Chapter10

Conclusions And Recommendations

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10. Conclusions and Recommendations

10.1 Conclusions

In this study, the effects of the project activities on physico-chemical, ecological and socio-economic parameters during both construction and operation phases have been assessed. The impacts have been identified, predicted and evaluated, and mitigation measures suggested for both construction and operation phases of the proposed power plant and other facility. The important physico-chemical environmental parameters that are likely to be affected by the project activities include air, water and noise pollution.

The study suggests that most of the adverse impacts on the physic-chemical environment are of low to moderate in nature and therefore, could be offset or minimized if the mitigation measures are adequately implemented. Since the project site is not ecologically sensitive area, the impacts of project activities are mostly small.

Some adverse impact during the operation phase of the plant will come from NO_2, emission from the power plant. However, low-NOx Burner will be adopted in this turbine, and exhaust concentrations will be kept below emission standards a of the IFC/WB EHS guidelines. High stack will be used and modeling study suggests that the effect of increased NO_2, in the ambient air due to emission from the proposed power plants will not be very significant.

Cooling water shall be taken from a lower water layer 6m deep where water temperature is low, 1.3km from the coast, and discharged at the high rate of 2.5m/s from the coast near the project site to minimize the area of water temperature rise.
According to the diffusion simulation, the area of 5o C or higher temperature rise is 100m from the water outlet, which is very limited, and well meets the environmental standard (500m) of Azerbaijan.

All waste water is treated at the treatment system so that the concentration of pollutant in waste water meets the standard of IFC/WB EHS Guidelines and other standards before discharge.

Noise level has been identified as significant potential impact of the proposed power plant during both the construction and operation phases. Maintenance of equipment will be conducted and low noise type equipment and adequate enclosures will be installed. The noise level is expected to come down to tolerable levels at residential area

There is no settlement in this designated area. Therefore, no population will be displaced and no resettlement will be required for the construction of the power plant and other facility.
During operation phase, no significant negative impact is anticipated on socio-economic environmental parameters.

10.2 Recommendations

The environmental assessment carried out for the proposed combined power plant at Yashma, suggests low to moderate scale of adverse impacts, which can be reduced to acceptable level through recommended mitigation measures as mentioned in the EMP. It is therefore recommended that the proposed Yashma CCPP may be installed, provided the suggested mitigation measures are adequately implemented. It is also recommended that the environmental monitoring plan be effectively implemented in order to identify any changes in the predicted impacts and take appropriate measures to off-set any unexpected

adverse effects.

Apart from risks associated with emissions, noise generation, solid waste, hazardous waste and wastewater disposal as a result of construction and operation activities, the gas fired power plant put human beings and the environment inside and outside of the plant to a certain degree of risk of accident and sometime loss of life.