Attachment - 1.4 Minutes of Meeting (3rd Mission)

MINUTES OF MEETING

OF

THE 3rd MISSION OF THE PREPARATORY STUDY

FOR DEVELOPMENT OF SOUTHERN LARGE SCALE

THERMAL POWER PLANT IN IRAQ

AGREED UPON BETWEEN

MINISTRY OF ELECTRICITY OF IRAQ

AND

THE STUDY TEAM OF

JAPAN INTERNATIONAL COOPERATION AGENCY

AMMAN, 27TH-30TH NOVEMBER, 2011

MINISTRY OF ELECTRICITY	JICA STUDY TEAM
30/11/2011	30 Nov. 2011
Adel H. MAHDI	Hideki YUKIMURA
Minister Advisor	Team Leader
Ministry of Electricity	JICA Study Team
Baghdad – Iraq	

MOE Team and JICA Study Team who have been implementing the Preparatory Study for Development of Southern Large Scale Thermal Power Plant (referred to as the "Study") held meetings at a conference room of Le Meridien in Amman.

A. Introductory Meeting

MOE Team and JICA Study Team have reviewed the current status and pending issues in the Study (Attachment-1).

The following items were presented by JICA Study Team for detailed discussion:

1. Follow-Up of EIA Study
2. Plant Design issues :
   - 2.1 Generating capacity and plant configuration of CCTPP
   - 2.2 Transmission Network Constraints
   - 2.3 Preliminary facility design
   - 2.4 Civil work design
   - 2.5 Cooling water design
   - 2.6 400kV substation design
3. Project Implementation issues
   - 3.1 Project Schedule including governmental permissions and approvals.
   - 3.2 Economic and Financial Evaluation.

The main points of the discussion and agreements reached during the meeting are as follows:

1. Follow-Up of EIA Study

- ✓ MOE has selected the Anbar University Engineering Consulting Bureau as a local consultant to perform the EIA Study.
- ✓ The items agreed on in the previous mission are presented, reviewed and confirmed by MOE Team, JICA Study Team and the Anbar University (Attachment- 2). The project descriptions of the Nasiryah Thermal and Nasiryah I (GE) need to be disclosed, and to be provided by MOE Team to JICA Study Team and the Anbar University.
- ✓ The contents of the EIA Study including the stakeholders' meetings and Report are discussed in details among MOE Team, JICA Study Team and the Anbar University in a separate session. The participants of the stakeholders' meetings are tentatively decided as follows; officials from Nasiryah City and others such as Ministry of Agriculture and Ministry of Environment; officials from municipalities, hospitals and schools nearby; and 15 tribal leaders. The three parties agree on the detailed

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schedule with tasks of the EIA Study from December 2011 to March 2012 (Attachment-3).

- ✓ The 4th Mission in the end of January 2012 will be the final opportunity to discuss the contents of the EIA Report among the three parties, and it is agreed that the representatives from the Anbar University will be invited to the 4th Mission.

2. Plant Design issues:

2.1 Generating capacity and plant configuration of Combined Cycle Thermal Power Plant (CCTPP)

- ✓ The generating capacity and plant configuration were thoroughly discussed among the participants based on the results from JICA study team's comparative studies from the power system development planning standpoint (Attachment-4).
- ✓ MOE Team eventually decided to select the 2-on-1 Multi-Shaft Configuration and to plan a 1,800MW class CCTPP (900MW/train X 2 trains) in the vicinity of the existing Nasiryah Thermal Power Plant.
- ✓ MOE Team expressed their intention to apply a larger class GT of nominal capacity 300MW in 2-on-1 Multi Shaft Configuration as Combined Cycle.
- ✓ MOE Team and JICA Study Team plan to consider that the project implementation might be scheduled into two phases taking in account of the power demand growth and budget preparation.

2.2 Transmission Network Constraints

- ✓ The transmission network constraints were discussed among the participants in consideration of the timing of commissioning of Nasiryah II CCTPP, based on the results from the power flow analysis made by JICA Study Team.(Attachment-5)
- ✓ MOE Team recognized that;
  - ➢ The network expansion in Iraqi power system needed to be done as planned, and
  - ➢ The reinforcement work for the lines from Nasiryah II CCTPP to Baghdad including Samawa-Najaf line should be executed with the highest priority.

2.3 Preliminary Facility Design

2.3.1 CCTPP Overall Schematic

Conceptual overall configuration of the combined cycle power plant of Nasiryah II is presented by JICA Study Team as the Overall Schematic Diagram shown in Attachement-6.

The configuration concept presented is basically agreed by MOE Team except for some comments shown below;

- ➢ Wet cooling towers with water pre-treatment is most probable method of the

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steam turbine condenser cooling at this stage of the study though further investigation will be required taking into account the actual site conditions.

- Bypass stacks and dampers between Gas Turbines and Heat Recovery Steam Generators for simple cycle operation of Gas Turbine Generators are required.
- Fire Fighting Facility to include the foam system for the Diesel Oil Tanks.
- MOE Team requests the diesel driven fire water pump which will directly intake the water from river with adequate filtration.
- MOE Team requests the Hydrogen Generation Plant and Nitrogen Generation Plant based on local condition of gas procurement.
- Water related systems need to be evaluated carefully with the actual site conditions.
- MOE Team requests JICA Study Team to take into account the local weather conditions such as frequent dust and sand storms in facility design.

2.3.2 Plot Plan

Conceptual plot plan of the combined cycle power plant of Nasiryah II is presented by JICA Study Team as shown in Attachements-7 and 8.

The plot plan presented is basically agreed by MOE Team except for some comments shown below;

- Bypass stacks and dampers between Gas Turbines and Heat Recovery Steam Generators for simple cycle operation of Gas Turbine Generators are required.
- Interface with the fuel gas pipeline to be indicated
- River water makeup pipeline to be indicated
- Area for 400kV connection between Generator Step Up Transformers and GIS facilities to be indicated.

2.3.3 Heat Balance

Conceptual heat balances of the combined cycle power plant of Nasiryah II in reference temperature conditions (30, 50 and 5 degC as design, Summer and Winter) are presented by JICA Study Team as shown in Attachement-9, 10 and 11.

The heat balances indicate the certain changes in output MW for different temperature conditions and are understood by MOE Team.

MOE Team has commented that summer maximum temperature in shadow is 55 degC.

2.3.4 Water Balance

Conceptual water balance of the combined cycle power plant of Nasiryah II is presented by JICA Study Team as shown in Attachement-12

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The water balance indicates the certain amount of water consumption for the cooling tower makeup and is understood by MOE Team.

2.4 Civil Work Design

- ✓ The outline of civil design was discussed taking into account topographical, geotechnical, cooling water and environmental baseline conditions (Attachment –13).
- ✓ In this regard, JICA Study Team needs to consider the following points to finalize its civil design;
  - ➢ The earth work of the 1-3m high embankment is required for land formation of the site.
  - ➢ The civil structures for the cooling system and the intake facility should be carefully designed in consideration of the river flow rate and water quality.
- ✓ As for the source of embankment earth materials, MOE Team will provide to JICA Study Team the information on soil quality and locations of soil source.

2.5 Cooling System design

2.5.1 JICA Study Team presented the approach how to select the most applicable steam turbine condenser cooling method in accordance with the water availability conditions as shown in Attachment-14. The approach presented is understood by MOE Team.

2.5.2 JICA Study Team presented conceptual overviews of two (2) air cooling options of steam turbine condenser cooling, Air Cooled Condenser and Heller. Information presented is understood by MOE Team.

2.5.3 JICA Study Team presented the conceptual evaluation of cooling water requirements for both of the circulating water and the cooling tower makeup as shown in Attachment-14. The evaluation presented is understood by MOE Team.

2.5.4 JICA Study Team presented the general guidelines of cooling tower makeup water as shown in Attachment-14 and pointed out the water qualities reported by the JICA Study Team are not suitable for the cooling tower makeup without pre-treatment. MOE Team understood the presentation and requested JICA Study Team to study further water treatment system using the information as mentioned in 2.5.5.

2.5.5 As for further necessary requirements, JICA Study Team will send official enquiry letter to MOE Team for information and readings regarding water quality, water quantity, water level and water flow rate of the Euphrates River. MOE will provide available data.

2.6 400kV Substation Design

2.6.1 Single Line Diagram

JICA Nasiryah II Power Station (NSRG 2) is connected to GE Nasiryah I Power Station (NSRG 1), and JICA Study Team presented a Single Line Diagram for discussion. The results are summarized as follows and a revised Single Line Diagram is attached as Attachment-15.

i) Connection from JICA NSRG 2 Generators is by 400kV cable in the underground cable trench.

ii) Independent bus-tie diameter is not required, and a 1-1/2 diameter will be used for connection between Bus A and Bus B.

iii) Interface with GE NSRG 1 is at the Busbar end of the sectionalizer breaker provided by GE NSRG 1.

iv) Busbar Shunt Reactors (SRB) shall be provided in NSRG 2 part of 400kV GIS. MOE Team confirmed the capacity of each SRB is 55MVar.

v) Based on the physical location of NSRG 1 and NSRG 2, NSRG 1 part of the Single Line Diagram should be shown at the right and JICA NSRG 2 should be at the left.

2.6.2 GE NSRG 1 Substation Layout

JICA Study Team reported that space for 400kV GIS Building for JICA NSRG 2 should be kept as 60m x 32m at the East of the NSRG 1 GIS Building which shall have breakable wall and rebars for easy extension at the NSRG 2 project execution.

Attachment-16 shows the proposed layout of NSRG 1 GIS Building and OHL Gantry area.

2.6.3 400kV Cable Route from JICA NSRG 2 to GE NSRG 1

The proposed 400kV Cable Route is underground concrete cable trench along the battery limit as shown on Attachment-17 and Attachment-18. MOE Team has no objection to this philosophy.

2.6.4 Communication between JICA NSRG 2 and NSRG 1

The philosophy using fiber optic is agreed as a general concept.

3. Project Implementation issues:

- ✓ Project Schedule is discussed thoroughly among MOE Team, JICA Study Team and JICA. MOE Team requested to shorten the project schedule and JICA Study Team and JICA replied to MOE Team that both Iraqi and Japanese governments would have to cooperate closely to do so. It was acknowledged that procurement strategy for consultant and EPC contractor would have a big impact on the schedule and it

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would be discussed during the discussion on project appraisal. MOE Team requested to indicate major event and activities under each stage of the project schedule (Attachment-19).

- ✓ Regarding Economic and Financial Analysis, JICA Study Team explained the following issues as per Attachment-20 and MOE Team consented all:
  - ➢ Project circumstances to calculate Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR) for the Project,
  - ➢ Methodology to calculate FIRR under the specific circumstances of the Project,
  - ➢ Understanding of EIRR and methodology to calculate EIRR,
  - ➢ Assumptions to calculate FIRR and EIRR

- ✓ Implementation organization during development and construction phase to be formed in MOE was confirmed by MOE Team and the one during operation phase would be presented in the report, considering the appropriate number of people as many as 200 or so for the Project. JICA Study Team presented to include the idea of a roadmap in the report for MOE to be able to manage operation and maintenance of large-scale CCGT power plant in the future with their own resources in cooperation of an international company in the industry for technology transfer to MOE.

- ✓ JICA Study Team suggests long term maintenance service contract. This is a worldwide current direction for operation and good maintenance of power plant.

This long term service contract will be declared in Feasibility Study. Furthermore and to explain future MOE reorganization Scheme, this information will be included in the final report.

4. Next Step

JICA Study Team will hold the 4th Mission for discussions on a proposed Draft Final Report from late January to early February 2012 inviting MOE Team and the Anbar University to Amman-Jordan.

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Attachment-1 (1/2)

Current Status and Pending Issues in Feasibility Study

November 2011

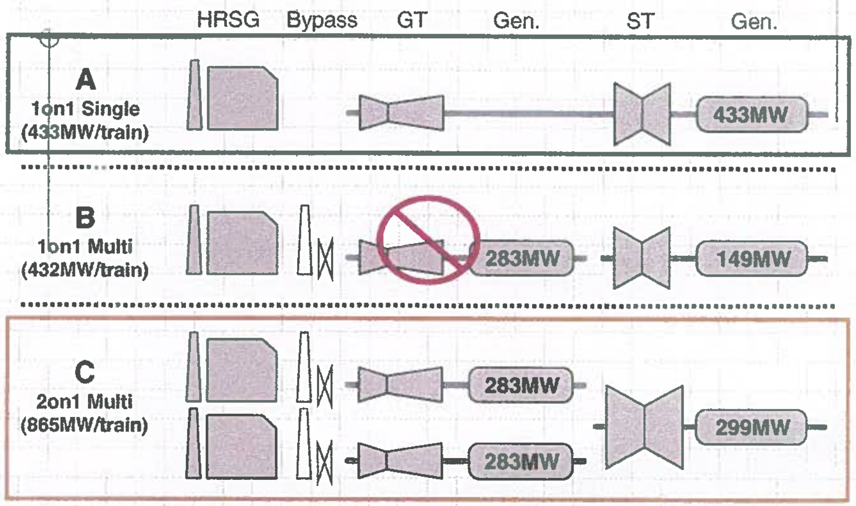
Tokyo Electric Power Services Co., Ltd.
Toyo Engineering Corporation
Mitsubishi Heavy Industries, Ltd.
UNICO International Corporation
Mitsui & Co., Ltd.

Current status of CCGT selection

- 2-on-1 multi-shaft CCGT and 1-on-1 single-shaft CCGT have been are still considered.
- 1-on-1 multi-shaft CCGT was declined due to its low efficiency and cost performance.
- 1-on-1 single shaft is unprecedented in operation in Iraq.

- JICA team has made a preliminary design work based on 2-on-1 multi configuration.

CCGT configuration per train



Note: The power outputs indicated are based on a **701F4 class GT** integrated CCGT unit.

Stepwise output of each CCGT

Plan/Type	Number of GT Unit			
	1 unit	2 Units	3 Units	4 Units
A (single)	433MW	866MW	1,299MW	1,732MW
B (1on1 multi)	432MW	864MW	1,296MW	1,728MW
C (2on1 multi)	N/A	865MW	N/A	1,730MW

Note: Power output specification of GT is configured by each GT maker as a default figure that can not be adjusted in line with user's demands.

Assuming the generating capacity of each CCGT should exceed 1,200MW as planned in the original MP.

- For Plan A, 1,300MW or 1,730MW are selectable.
- For Plan C, only 1,730MW is selectable in consideration of default specifications of GTs.

Pending issues

- What power output is feasible? Needs to consider from the standpoints of;
  - Economic efficiency in PDP,
  - Network capacity constraints,
  - Phasing approach,
  - Gas supply limitation, and
  - Cooling water supply limitation.
- What cooling system is feasible in consideration of;
  - River water volume requirement and,
  - River water quality requirement.

Agenda of the 3rd mission meetings

1. Follow-up of EIA study
2. Plant design issues
   ① Generating output (and plant configuration)
   ② Preliminary facility design
   ③ Civil work design
   ④ Cooling system design
   ⑤ 400kV substation design
3. Project implementation issues
   ① Project schedule including Governmental permissions and approvals
   ② Economic and financial evaluation

Thank you for your kind attention

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Attachment-2 (1/2)

3rd Mission Environmental and social considerations

November 2011

1. "A" category project under the JICA's Guidelines
2. Progress
3. Next step for the EIA Study

1. "A" category project

(1) The Project is categorized as "A" under JICA Guidelines.

(2) "A" project needs a comprehensive EIA Report for the JICA's environmental examination.

2. Progress

(1) Iraqi EIA Local Consultant has been selected.

(2) EIA Report (Preliminary Draft) has been prepared for the discussion among MOE, the EIA Local Consultant and the JICA Study Team.

3. Next step for the EIA Study

(1) Collaboration with the design group of the JICA Study Team

- EIA Study needs to be based on the plant specification.
- The environmental group of the Study Team will be responsible for the communication with MOE and the LC.

3. Next step for the EIA Study

(2) Collaboration with MOE, LC and Study Team

- Close collaboration is required to accomplish the EIA report in time.
- Tasks indicated in the TOR (EIA Study) need to be reviewed and re-allocated among LC and the Study Team.

3. Next step for the EIA Study

(3) Time frame for the EIA Study.

- The EIA report needs to be submitted to MOEN, Iraq, by the end of March 2012.
- Detailed schedule and task allocation should be agreed on at this mission.
- Based on the agreement, the detailed task list with deadlines of tasks and reportings is prepared at the mission.

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Attachment-3 (1/3)

Date			MOE	Anber Univ. (AU)	Study Team (ST)
December 2011	1	Thu	Start organizing the 1st stakeholders' meeting	1. Start organizing the 1st stakeholders' meeting 2. Start organizing social study in Nasiryah	
	2	Fri			
	3	Sat			
	4	Sun			
	5	Mon		Social study in Nasiryah	
	6	Tue		Social study in Nasiryah	
	7	Wed		Social study in Nasiryah	
	8	Thu		Social study in Nasiryah	1. Submit the answers of the questions from AU 2. Submit the revised Preliminary draft to MOE and AU
	9	Fri		Social study in Nasiryah	
	10	Sat		Social study in Nasiryah	
	11	Sun			
	12	Mon	1st stakeholders' meeting (tentative)	1st stakeholders' meeting (tentative)	
	13	Tue			
	14	Wed			
	15	Thu			
	16	Fri		Submit information on social conditions to MOE and ST	
	17	Sat			
	18	Sun			
	19	Mon			
	20	Tue			
	21	Wed			
	22	Thu		Submit the 1st draft of AU parts (Chapter 8 & 9) to MOE and ST	
	23	Fri			
	24	Sat			
	25	Sun			
	26	Mon			
	27	Tue			
	28	Wed			
	29	Thu			
	30	Fri			
	31	Sat			
	1	Sun			
	2	Mon			
	3	Tue			
	4	Wed			
	5	Thu			
	6	Fri			
	7	Sat			
	8	Sun			
	9	Mon			
	10	Tue			
	11	Wed			

Date			MOE	Anber Univ. (AU)	Study Team (ST)
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	3	Sat			
	4	Sun			
	5	Mon		Social study in Nasiryah	
	6	Tue		Social study in Nasiryah	
	7	Wed		Social study in Nasiryah	
	8	Thu		Social study in Nasiryah	1. Submit the answers of the questions from AU 2. Submit the revised Preliminary draft to MOE and AU
	9	Fri		Social study in Nasiryah	
	10	Sat		Social study in Nasiryah	
	11	Sun			
	12	Mon	1st stakeholders' meeting (tentative)	1st stakeholders' meeting (tentative)	
	13	Tue			
	14	Wed			
	15	Thu			
	16	Fri		Submit information on social conditions to MOE and ST	
	17	Sat			
	18	Sun			
	19	Mon			
	20	Tue			
	21	Wed			
	22	Thu		Submit the 1st draft of AU parts (Chapter 8 & 9) to MOE and ST	
	23	Fri			
	24	Sat			
	25	Sun			
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	27	Tue			
	28	Wed			
	29	Thu			
	30	Fri			
	31	Sat			
	1	Sun			
	2	Mon			
	3	Tue			
	4	Wed			
	5	Thu			
	6	Fri			
	7	Sat			
	8	Sun			
	9	Mon			
	10	Tue			
	11	Wed			

Date			MOE	Anber Univ. (AU)	Study Team (ST)
January 2012	12	Thu		Submit the Draft Report (DR) to MOE and ST	
	13	Fri			
	14	Sat			
	15	Sun			
	16	Mon	Start organizing the 2nd stakeholders meeting	Start organizing the 2nd stakeholders meeting	
	17	Tue			
	18	Wed			
	19	Thu	4th Mission (discussion and revision of the contents of DR (tentative)		
	20	Fri	4th Mission (discussion and revision of the contents of DR (tentative)		
	21	Sat	4th Mission (discussion and revision of the contents of DR (tentative)		
	22	Sun	4th Mission (discussion and revision of the contents of DR (tentative)		
	23	Mon	4th Mission (discussion and revision of the contents of DR (tentative)		
	24	Tue			
	25	Wed			
	26	Thu			
	27	Fri			
	28	Sat			
	29	Sun			
	30	Mon			
	31	Tue			
February 2012	1	Wed			Submit the revised DR to MOE and AU
	2	Thu			
	3	Fri			
	4	Sat			
	5	Sun			
	6	Mon	2nd stakeholders' meeting (tentative)	2nd stakeholders' meeting (tentative)	
	7	Tue			
	8	Wed			
	9	Thu			
	10	Fri			
	11	Sat			
	12	Sun			
	13	Mon			
	14	Tue			
	15	Wed			
	16	Thu		Submit Draft Final Report (DFR) to MOE and ST	
	17	Fri			
	18	Sat			
	19	Sun			
	20	Mon			
	21	Tue			
	22	Wed			
	23	Thu	Return its comments to AU		Return its comments to AU
	24	Fri			
	25	Sat			
	26	Sun			
	27	Mon			
	28	Tue			
	29	Wed			

Attachment-4 (1/3)

Supplemental Study on generating output and CCGT configuration

~ From the PDP standpoint ~

November 2011

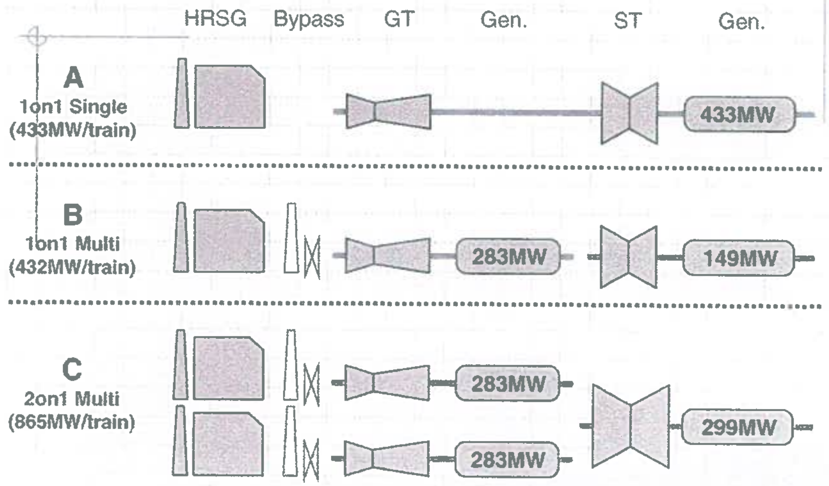
Tokyo Electric Power Services Co., Ltd.
Toyo Engineering Corporation
Mitsubishi Heavy Industries, Ltd.
UNICO International Corporation
Mitsui & Co., Ltd.

Assumption for comparative study

<Assumption>

- Three types of CCGT are compared such as 1-on-1 single shaft, 1-on-1 multi shaft, and 2-on-1 multi shaft.
- Generating capacity of each CCGT should exceed 1,200MW as planned in the original MP.
- 701F4 class GT at 283MW per unit is applied to all the cases, seeking higher efficiency and cost performance.

CCGT configuration per train



Note: The power outputs indicated are based on a **701F4 class GT** integrated CCGT unit.

Stepwise output of each CCGT

Plan/Type	Number of GT Unit			
	1 unit	2 Units	3 Units	4 Units
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C (2on1 multi)	N/A	865MW	N/A	1,730MW

Note: Power output specification of GT is configured by each GT maker as a default figure that can not be adjusted in line with user's demands.

- Comparisons are made in 1,300MW for Plan A, B and 1,730MW for Plan C in consideration of default specifications of GTs. (Yellow highlighted)
- As a reference, additional comparisons are also made by adjusting the number of GT units so as to uniform the total output of all Plans. (Orange framed)

Quantitative Features of Each Plan

		Plan A	Plan B	Plan C	Original (MP)
		Single shaft 1GT + 1ST	Multi shafts 1GT + 1ST	Multi shafts 2GT + 1ST	Multi shafts 2GT + 1ST
Output (Gross)		433MW x **3** 1,300MW	432MW x **3** 1,300MW	865MW x **2** 1,730MW	600MW x 2 1,200MW
Construction cost (USD/kW)		**744**	799	**742**	1,045
Construction periods (years)		3	3	3	2.5
O&M cost (USD)	Fixed (/kW/year)	14.6	14.6	14.6	20.4
	Variable (/MWh)	3.11	3.11	3.11	2.6
Life (years)		25	25	25	25
Efficiency (%)		**57.3**	57.1	**57.3**	50.1
Forced outage rate (%)		6	6	6	7
Scheduled outage (days/yr)		21	21	21	25

Note 1: All the costs were indicative that calculated on the basis of 701F4 class GT configuration and CCTPP industrial market in USA.
Note 2: In case of applying a smaller 701F3 class GT at 250MW per unit, thermal efficiency and construction cost for 2-on-1 multi shaft configuration are 56.7% and 771 USD/kW respectively.

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Economic Evaluation - 1

		Plan A	Plan B	Plan C	Original (MP)
		Single shaft 1GT + 1ST	Multi shafts 1GT + 1ST	Multi shafts 2GT + 1ST	Multi shafts 2GT + 1ST
Output (Gross)		433MW x **3** **1,300MW**	432MW x **3** **1,300MW**	865MW x **2** **1,730MW**	600MW x 2 1,200MW
Present value at 2020 (mil. USD)	Fixed cost	35,019	35,071	35,358	35,211
	Fuel cost	45,834	45,842	44,032	46,691
	Total	80,853	80,913	79,390	81,902
	Difference	- 1,049	- 989	**- 2,512**	±0 (Base)

Note : All the costs were indicative that calculated on the basis of 701F4 class GT configuration and CCTPP industrial market in USA.

The larger capacity is the more beneficial.

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Economic Evaluation – 2 (Adjusting to an uniform output)

		Plan A1	Plan B2	Plan C
		Single shaft 1GT + 1ST	Multi shafts 1GT + 1ST	Multi shafts 2GT + 1ST
Output		433MW x **4** **1,732MW**	432MW x **4** **1,728MW**	865MW x **2** **1,730MW**
Present value at 2020 (mil. USD)	Fixed cost	35,361	35,430	35,358
	Fuel cost	44,032	44,050	44,032
	Total	79,393	79,480	79,390
	Difference	**+ 3**	+ 90	**±0 (Base)**

Note : All the costs were indicative that calculated on the basis of 701F4 class GT configuration and CCTPP industrial market in USA.

Plan C and **Plan A** are almost identical in economic efficiency.

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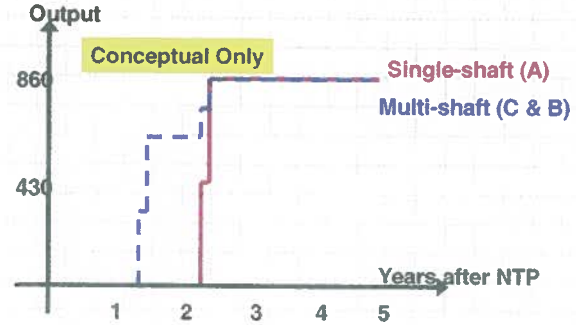
Additional benefit of Multi shaft CCGT by prior commissioning as simple cycle GT

- Benefit is generated by simple cycle operation of GT prior to CCGT full commissioning, substituting the existing lower efficient power plants in Iraqi power system.



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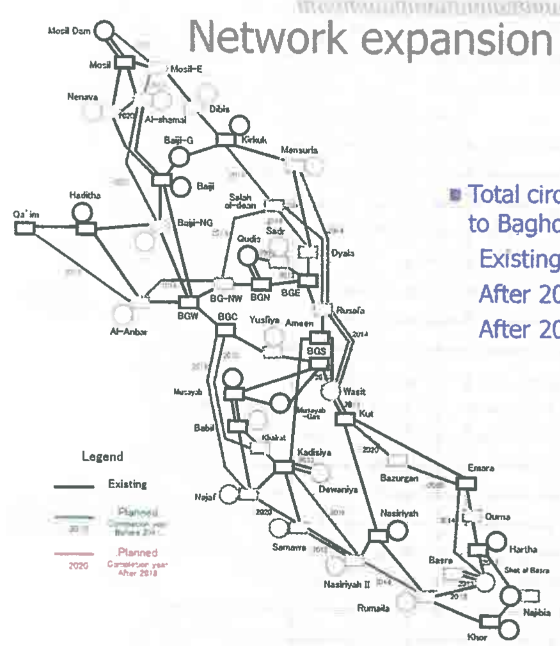
Preliminary result

- In consideration of the late CCGT model with higher thermal efficiency (almost 57%), larger scaled CCGT at 1,730MW is desirable but considerable in terms of the fund limitation.
- Multi-shaft Plan (Plan C) is very beneficial in prior commissioning of GT in simple cycle operation when the reserve margin is less than 5% meaning that a continuous power shortage occurs in Iraqi power system.
- Two-phased development is probably workable if budget issues occur. (Phase1:865MW, Phase2:865MW in 2-on-1 multi-shaft CCGT case)

Thank you for your kind attention

Transmission Network for Nasiryah II

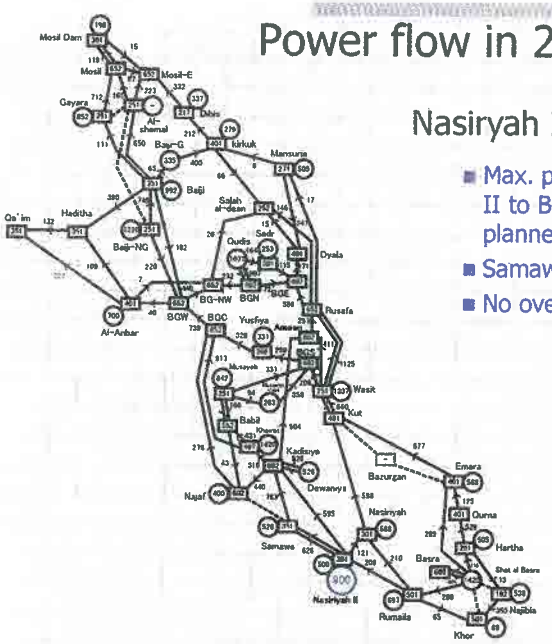
Network expansion plan of MOE



- Total circuits from Nasiryah II to Baghdad in west route:
  - Existing : 1
  - After 2016 : 2 or 3
  - After 2020 : 3

Power flow in 2017

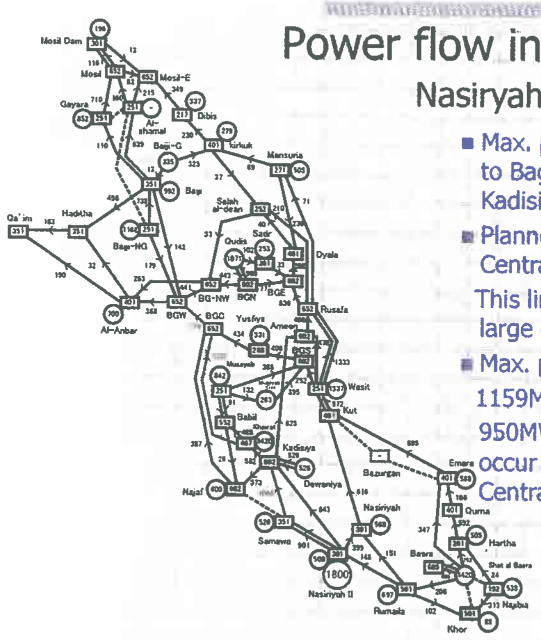
Nasiryah II : 900MW case



- Max. power flow from Nasiryah II to Baghdad : 813MW in planned Khairat-BGC line
- Samawa-Kadisiya : 763MW
- No overloaded lines

Power flow in 2017

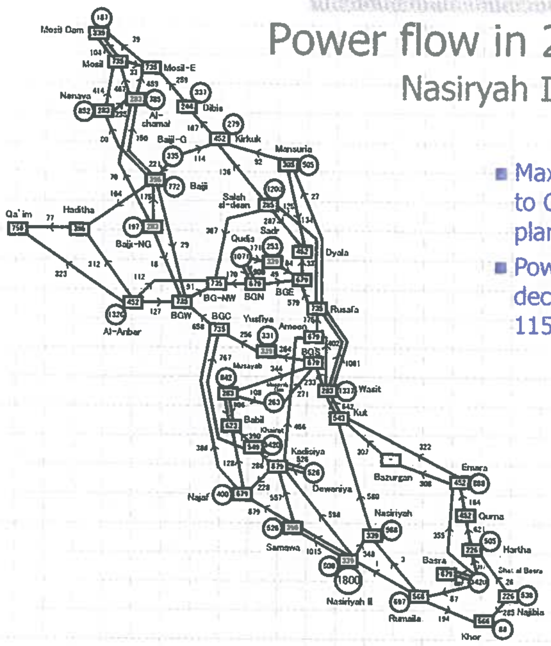
Nasiryah II : 1800MW case



- Max. power flow from Nasiryah II to Baghdad : 1068MW in Samawa-Kadisiya
- Planned line Khairat-Baghdad Central : 1023MW
  This line should be planned to have large capacity
- Max. power flow in whole network 1159MW in BGC-BGW with capacity 950MW, actually, overload will not occur by careful plant operation in Central and North regions

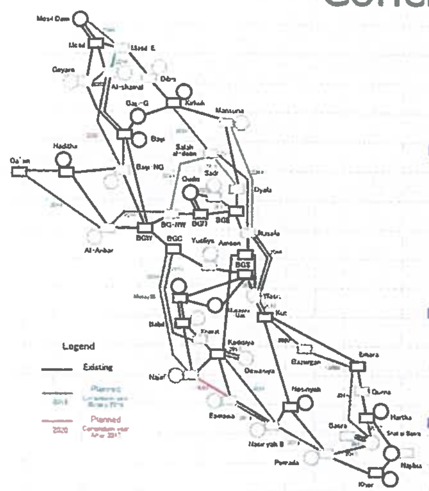
Power flow in 2020

Nasiryah II : 1800MW case



- Max. power flow from South to Central route 767MW in planned Khairat-BGC line
- Power flow in BGC-BGW will decrease to 658MW from 1159MW in 2017

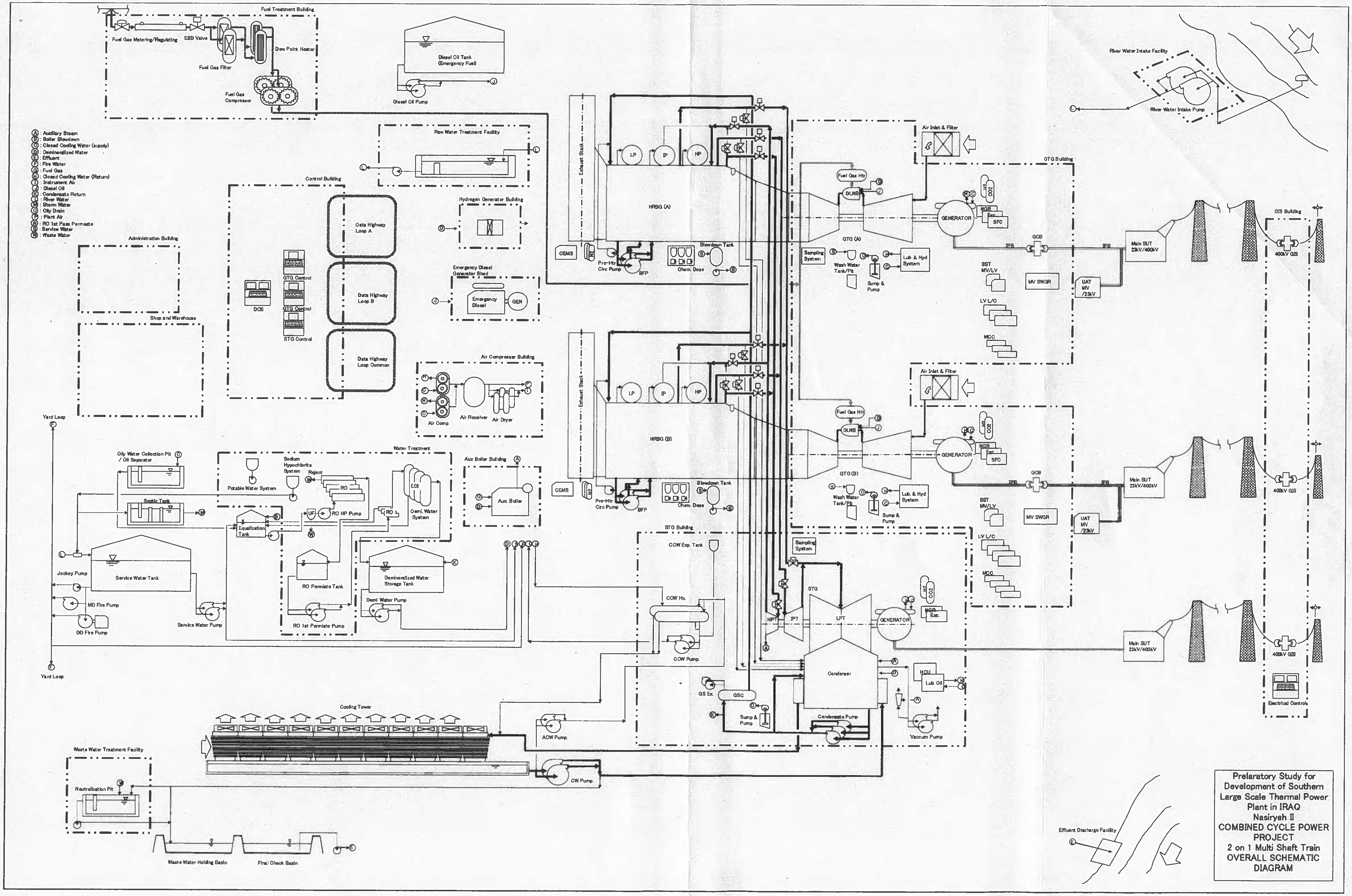
Conclusion



- Assuming a 900MW unit is commissioned in 2017 and the planned transmission lines are well completed, there is no overload problem
- In case of a 1800MW plant is completed in 2017, Samawa-Kadisiya line would be a bottleneck even if all the transmission lines are completed as planned. Therefore, earlier commissioning of Samawa-Najaf line is recommended
- Assuming a 1800MW plant is commissioned in 2020 and the planned transmission lines are well completed, there is no overload problem
- Reinforcement of the lines from Nasiryah II to Baghdad should be executed with the highest priority

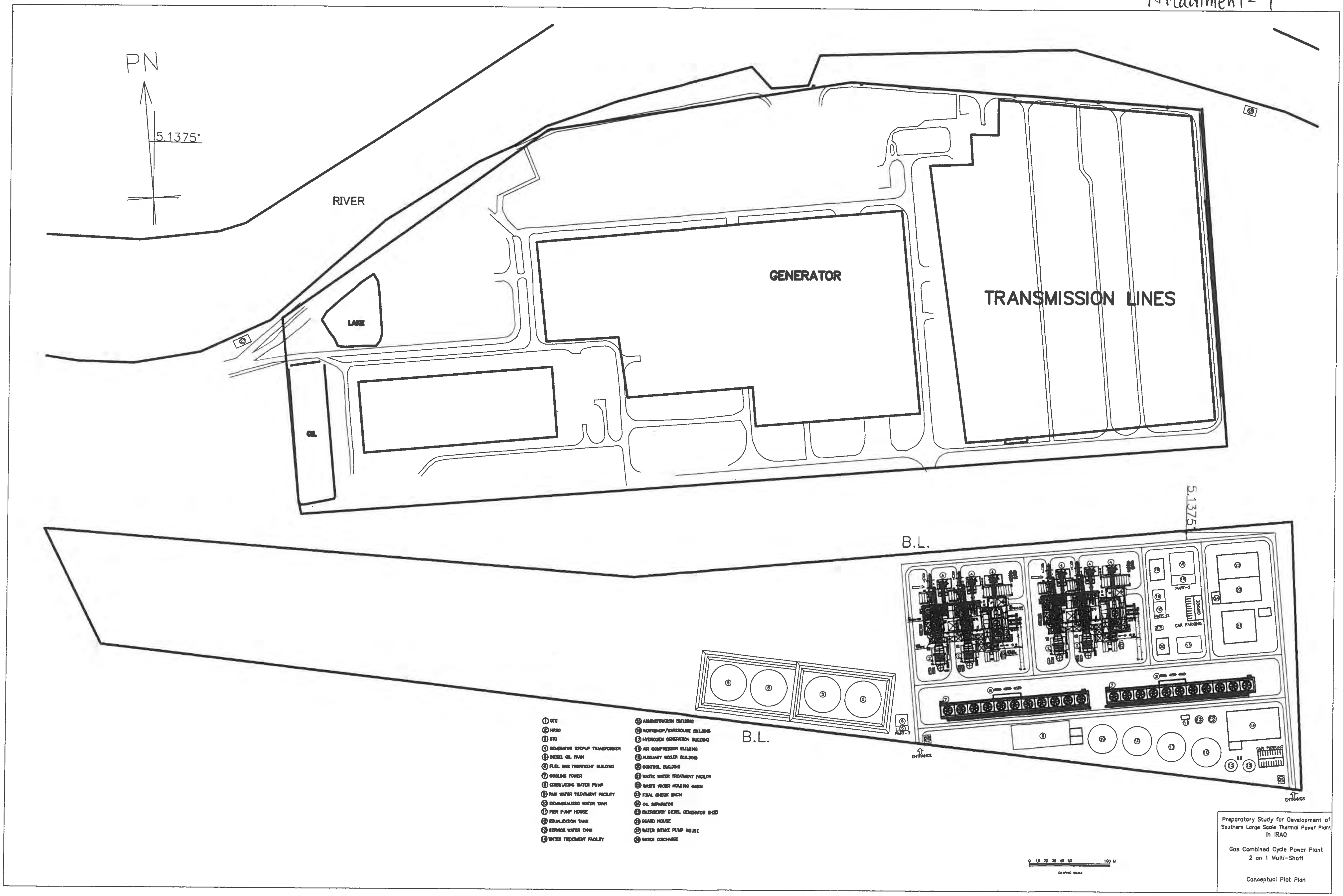
(2/2)

Attachment-6

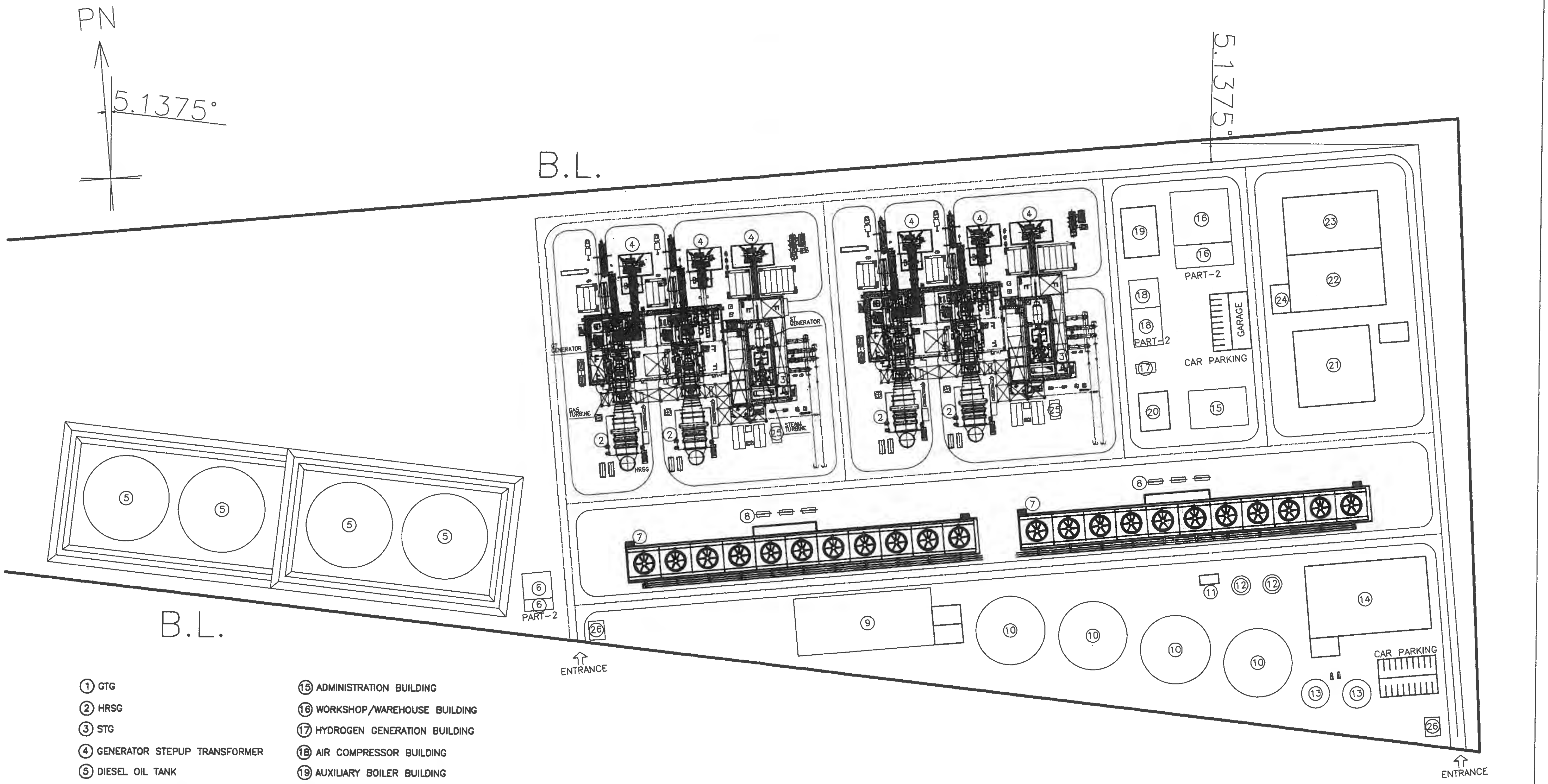


2011/11/20 Rev.0A

Attachment-7



Attachment-8



1. GTG
2. HRSG
3. STG
4. GENERATOR STEPUP TRANSFORMER
5. DIESEL OIL TANK
6. FUEL GAS TREATMENT BUILDING
7. COOLING TOWER
8. CIRCULATING WATER PUMP
9. RAW WATER TREATMENT FACILITY
10. DEMINERALIZED WATER TANK
11. FIER PUNP HOUSE
12. EQUALIZATION TANK
13. SERVICE WATER TANK
14. WATER TREATMENT FACILITY
15. ADMINISTRATION BUILDING
16. WORKSHOP/WAREHOUSE BUILDING
17. HYDROGEN GENERATION BUILDING
18. AIR COMPRESSOR BUILDING
19. AUXILIARY BOILER BUILDING
20. CONTROL BUILDING
21. WASTE WATER TREATMENT FACILITY
22. WASTE WATER HOLDING BASIN
23. FINAL CHECK BASIN
24. OIL SEPARATOR
25. EMERGENCY DIESEL GENERATOR SHED
26. GUARD HOUSE

0 10 20 30 40 50 100 M
GRAPHIC SCALE

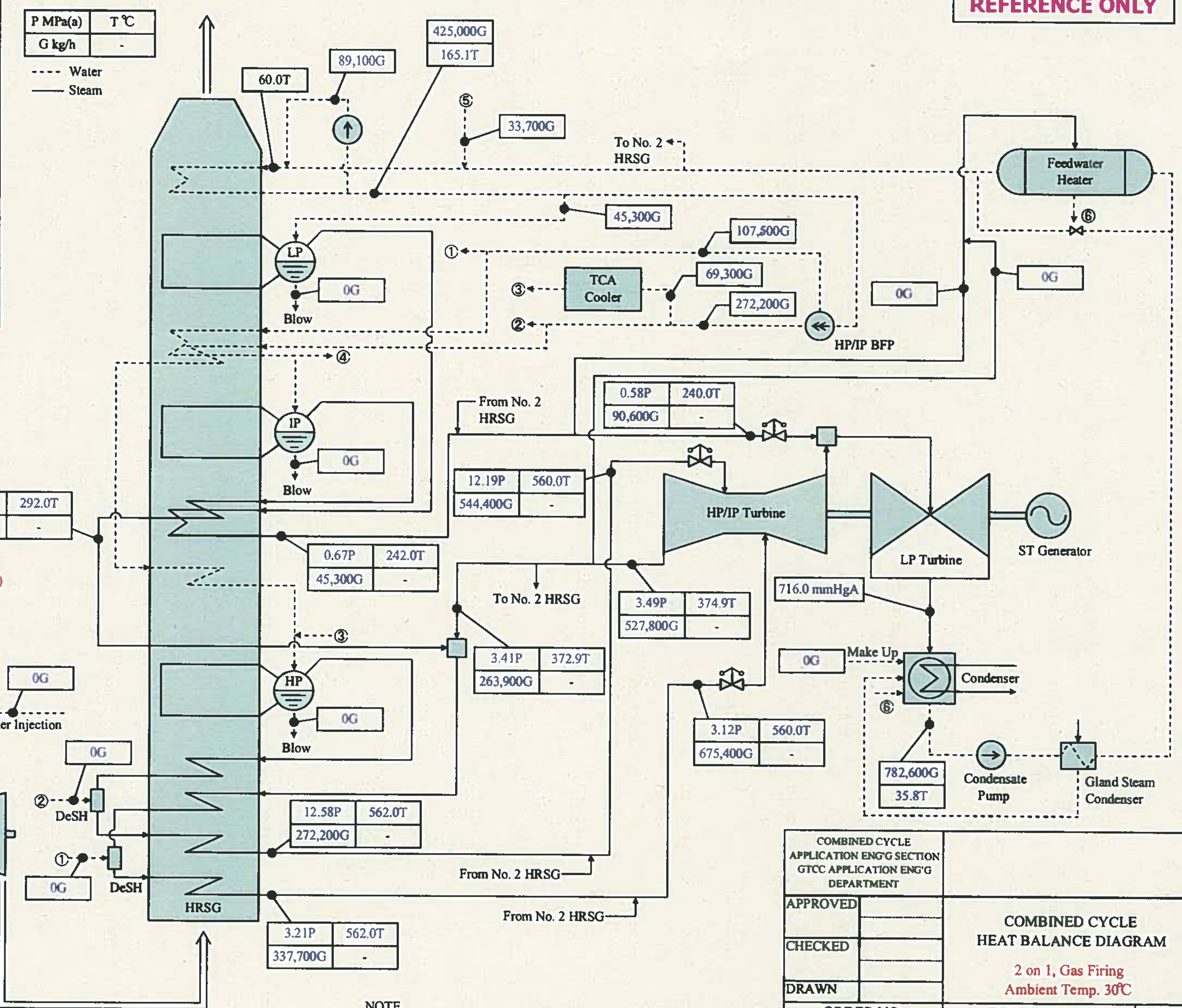
Preparatory Study for Development of Southern Large Scale Thermal Power Plant in IRAQ

Gas Combined Cycle Power Plant
2 on 1 Multi-Shaft

Conceptual Plot Plan

Attachment-9

PROJECT	
EXPECTED GROSS BLOCK OUTPUT :	847 MW
GROSS EFFICIENCY (LHV) :	58.4 %
OPERATING CONDITION	
Load	100%
Air Temp. (℃)	30
Air Press. (mbar)	1,013
R. Humidity (%)	17.1
Fuel	Natural Gas
Make Up (%)	0



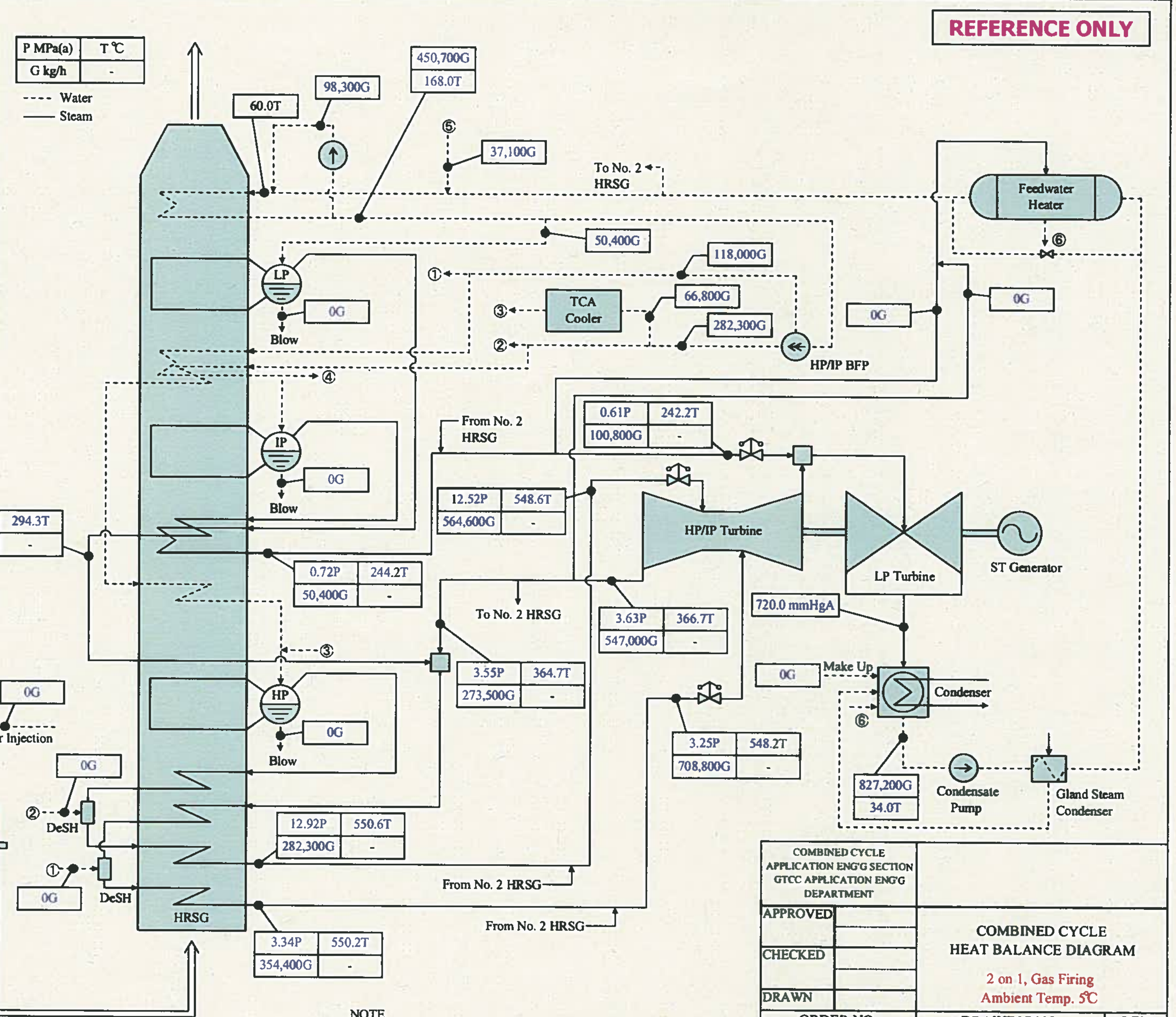
NOTE
1. All performance values indicated on this diagram are estimated.
2. All Performance values are based on new and clean condition.
3. Condenser vacuum is based on assumption. To be finalized later.

COMBINED CYCLE APPLICATION ENG'G SECTION GTCC APPLICATION ENG'G DEPARTMENT	
APPROVED	COMBINED CYCLE HEAT BALANCE DIAGRAM
CHECKED	2 on 1, Gas Firing
DRAWN	Ambient Temp. 30℃
ORDER NO.	DRAWING NO. 2G30-100 — REV NO.

MITSUBISHI HEAVY INDUSTRIES, LTD.

Attachment-10

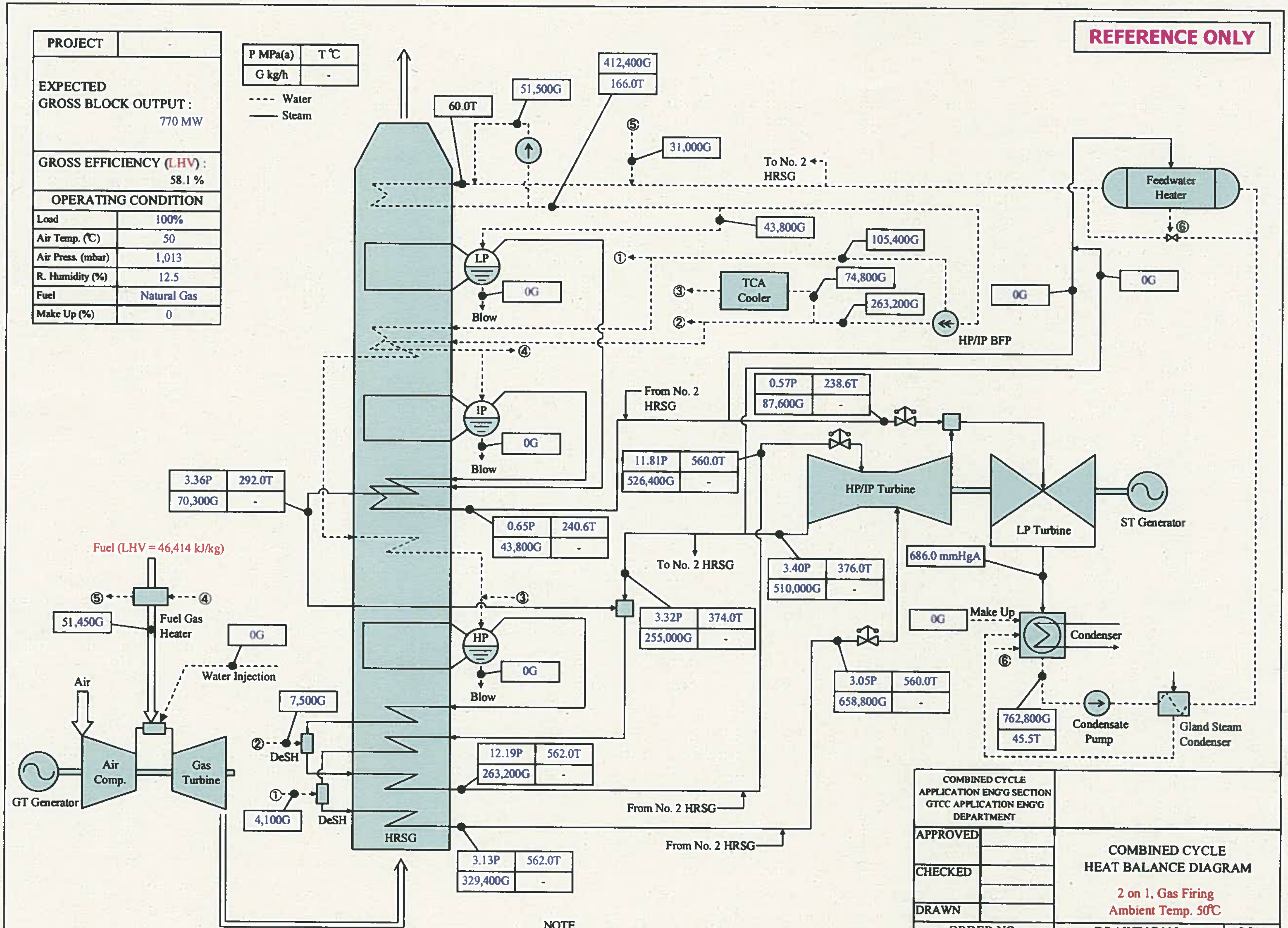
PROJECT	
EXPECTED GROSS BLOCK OUTPUT : 939 MW	
GROSS EFFICIENCY (LHV) : 58.0 %	
OPERATING CONDITION	
Load	100%
Air Temp. (℃)	5
Air Press. (mbar)	1,013
R. Humidity (%)	100
Fuel	Natural Gas
Make Up (%)	0



NOTE
1. All performance values indicated on this diagram are estimated.
2. All Performance values are based on new and clean condition.
3. Condenser vacuum is based on assumption. To be finalized later.

COMBINED CYCLE APPLICATION ENG'G SECTION GTCC APPLICATION ENG'G DEPARTMENT		
APPROVED	COMBINED CYCLE HEAT BALANCE DIAGRAM 2 on 1, Gas Firing Ambient Temp. 5℃	
CHECKED		
DRAWN		
ORDER NO.	DRAWING NO. 2G05-100	REV NO.
MITSUBISHI HEAVY INDUSTRIES, LTD.		

Attachment-11



PROJECT	-
EXPECTED GROSS BLOCK OUTPUT :	770 MW
GROSS EFFICIENCY (LHV) :	58.1 %
OPERATING CONDITION	
Load	100%
Air Temp. (℃)	50
Air Press. (mbar)	1,013
R. Humidity (%)	12.5
Fuel	Natural Gas
Make Up (%)	0

NOTE
1. All performance values indicated on this diagram are estimated.
2. All Performance values are based on new and clean condition.
3. Condenser vacuum is based on assumption. To be finalized later.

COMBINED CYCLE APPLICATION ENG'G SECTION GTCC APPLICATION ENG'G DEPARTMENT

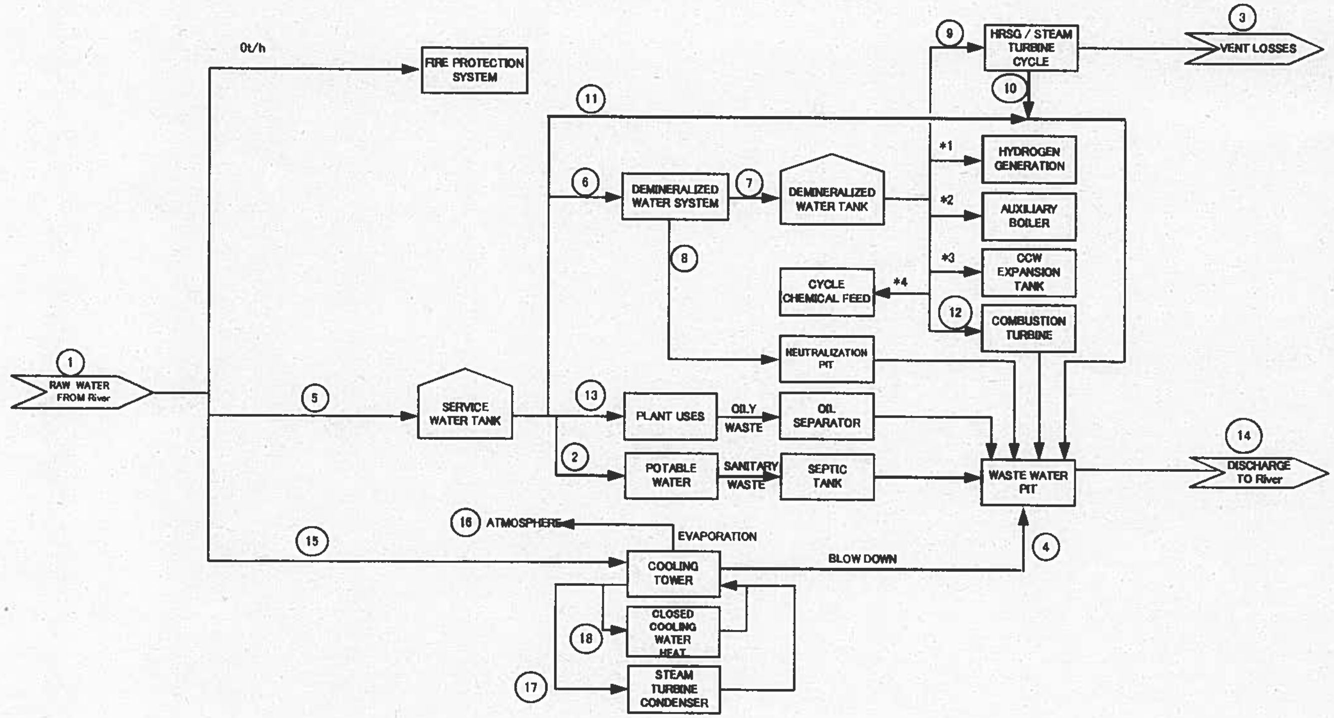
APPROVED
CHECKED
DRAWN

COMBINED CYCLE HEAT BALANCE DIAGRAM
2 on 1, Gas Firing
Ambient Temp. 50℃

ORDER NO.	DRAWING NO.	REV
	2G50-100	NO.

MITSUBISHI HEAVY INDUSTRIES, LTD.

Attachment-12



per 2 on 1 Muuti Shaft 900MW class CCPP one (1) Train

Number	Description	Unit	
1	Raw water from river	t/h	1,194
2	Potable water	t/h	4
3	Vent losses from HRSG/steam turbine cycle	t/h	8
4	Cooling tower blow down	t/h	220
5	Service water	t/h	74
6	Inlet to makeup demineralizer system	t/h	46
7	Demineralized water produced	t/h	40
8	Demineralizer system waste water	t/h	6
9	HRSG/steam turbine cycle makeup	t/h	40
10	HRSG blowdown	t/h	32
11	Quench water	t/h	20
12	Combustion turbine wash water	L/day	52
13	Miscellaneous service water uses	t/h	4
14	Discharge to river	t/h	66
15	Cooling tower makeup	t/h	1,120
16	Cooling tower loss to atmosphere	t/h	900
17	Condenser cooling water	t/h	45,800
18	Closed cooling water system cooling water	t/h	3,800

Notes:
1. All flows except combustion turbine wash water are average ton per hour
2. Combustion turbine wash water flow is average liters per day
3. HRSG blowdown is assumed to be 4% of total steam flow.
4. Vent losses are assumed to be 1% of total steam flow.
5. Demineralized water flow of *1, *2, *3 and *4 are included in ⑦.

Preparatory Study for Development of Southern Large Scale Thermal Power Plant in IRAQ
Nasiryah II
COMBINED CYCLE POWER PROJECT
2 on 1 Multi Shaft Train
WATER BALANCE DIAGRAM

2011.11.20 Rev. 0A

Attachment -13 (1/4)

Civil work design

November 2011

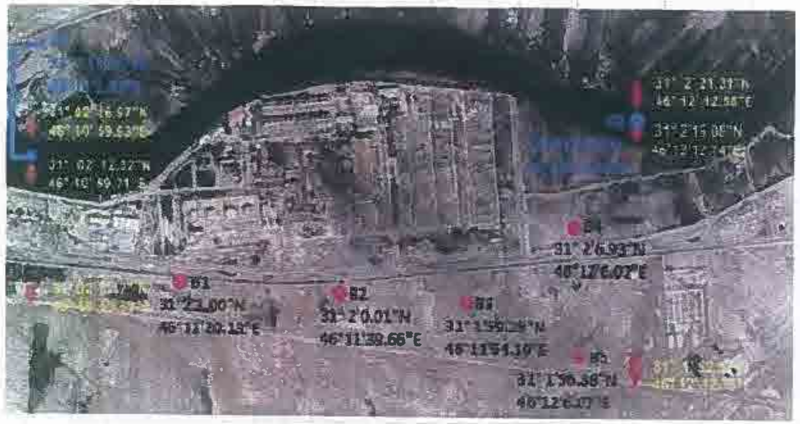
Tokyo Electric Power Services Co., Ltd.
Toyo Engineering Corporation
Mitsubishi Heavy Industries, Ltd.
UNICO International Corporation
Mitsui & Co., Ltd.

Civil design Outline (Nasiriyah II)

1. Location of Site survey
2. Topographical condition
3. Geotechnical condition
4. Cooling water resource condition
   River Bathymetric survey
   Hydrographic survey
5. Environmental Baseline condition

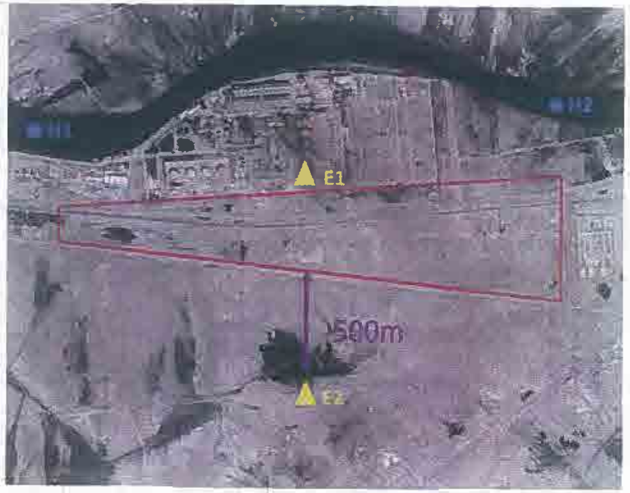
Topographical survey area

Geotechnical & Hydrographic survey points

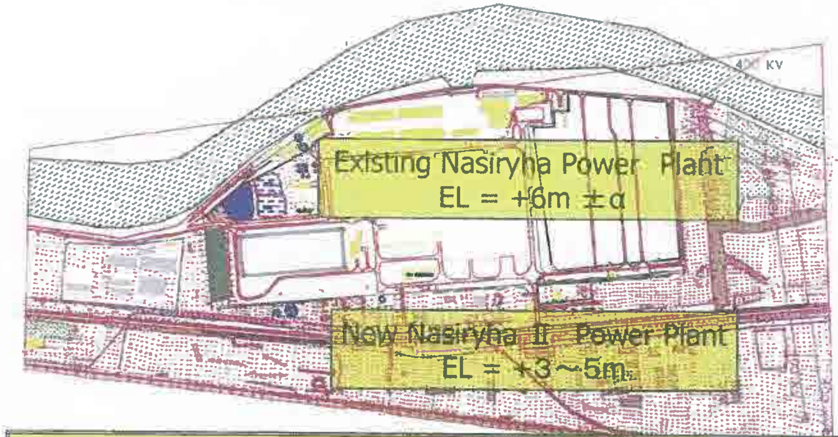


● : Geotechnical survey (Borehole Drilling) Points B1-5
● : Hydrographic survey Points H1-2

Environmental Baseline survey points

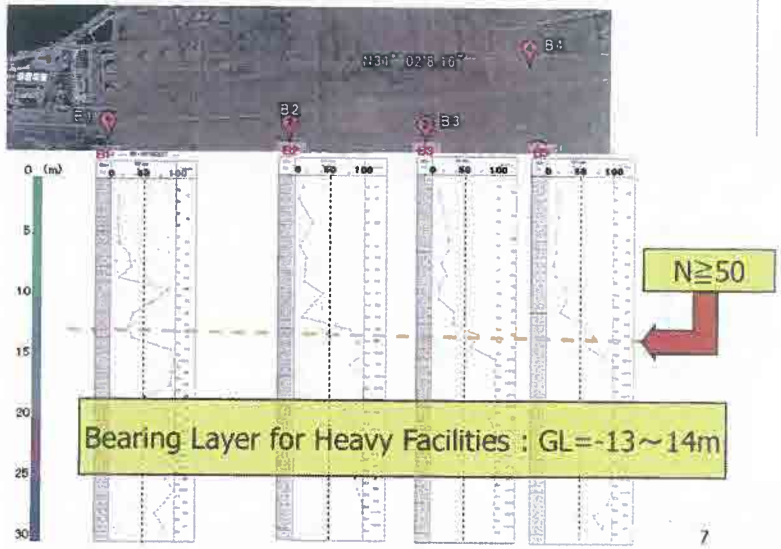


1.Topographical Condition

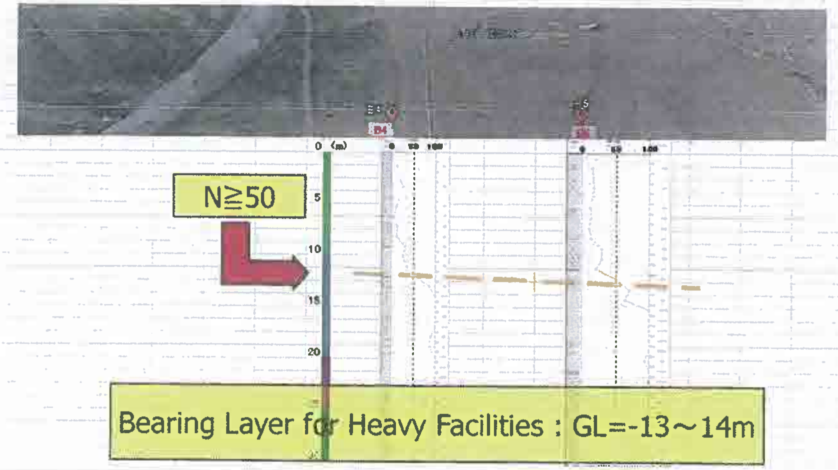


Embankment 1～3m (at least same EL of existing power plant)

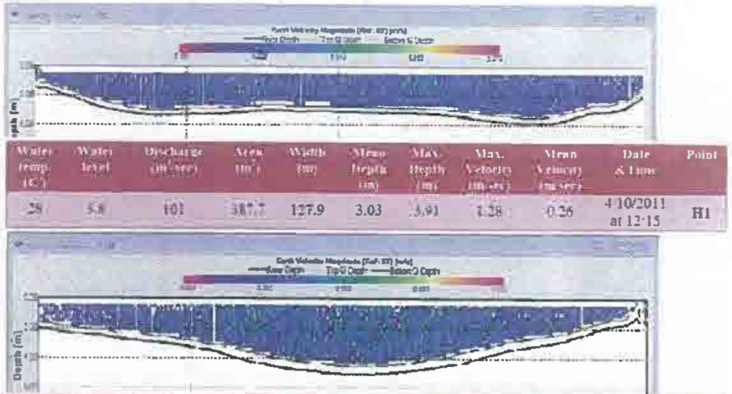
2.Geological Condition



2.Geological Condition

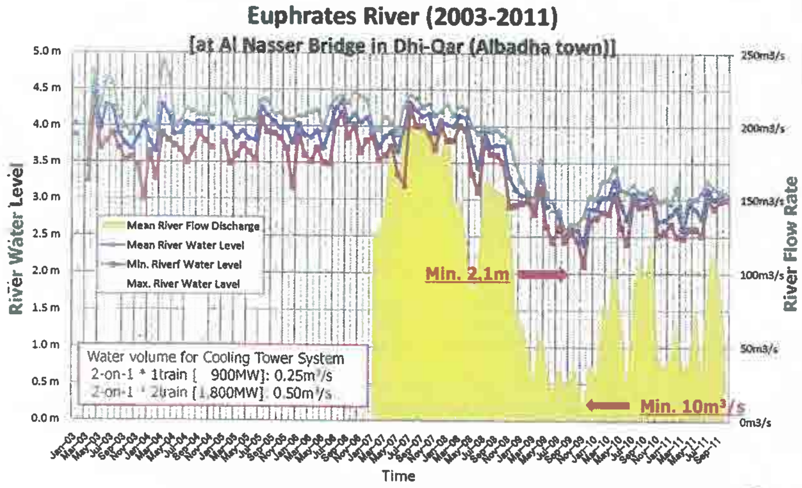


3.Cooling water resource (river) condition



Water temp (°C)	Water level	Discharge (m³/sec)	Area (m²)	Width (m)	Mean Depth (m)	Max. Depth (m)	Max. Velocity (m/sec)	Mean Velocity (m/sec)	Date & Time	Point
29	5.8	101	387.7	127.9	3.03	3.91	1.28	0.26	4/10/2011 at 12:15	H1
28.6	5.8	103	414.1	103.5	3.67	5.00	1.44	0.249	4/10/2011 at10:45 Am	H2

3.Cooling water resource (river) condition



4.Environmental Baseline Condition

Survey items

(1) Ambient air quality
(2) Ambient water quality
(3) Noise
(4) Vibration

4. Environmental Baseline condition

Results:

(1) Ambient air quality
SPM and CO are high.

(2) Ambient water quality
TDS, Cl, SO_4, NH_4 are high.
Need pretreatment facility for Cooling Water

(3/4)

4. Environmental Baseline condition

Parameter	Unit of measurement	Location H_1	Location H_2	Testing method	Iraqi Standard
Temp (°C)	Deg.centigrade	28.7	28.8	Electrometric	-
pH		8.05	8.14	Electrometric	6.5-8.5
EC	microsiem./cm	4474	4533	DIN EN 27888	-
TDS	mg/L	2860	2900	Calc. accord. to EC	-
TSS	mg/L	55	60	Standard method	-
DO	mg/L	9.1	9.4	Electrometric	< 5.0
BOD_5	mg/L	3.8	3.3	Azide Modific. at 20 C, 5 days.	> 5.0
COD	mg/L	42	31	Standard method	-
TOC	mg/L	3.1	3.3	DIN EN 1484	
Ca	mg/L	199	198	DIN EN ISO 10304-1	
Mg	mg/L	147	146	DIN EN ISO 10304-1	

Water Qualities of Euphrates River (1/3)

4. Environmental Baseline condition

Parameter	Unit of measurement	Location H_1	Location H_2	Testing method	Iraqi Standard
Na	mg/L	577	576	DIN EN ISO 10304-1	
K	mg/L	10.9	11.9	DIN EN ISO 10304-1	
Cl	mg/L	769	784	DIN EN ISO 10304-1	200
NO_3	mg/L	< 5.0	< 5.0	DIN EN ISO 10304-1	15
SO_4	mg/L	963	981	DIN EN ISO 10304-1	200
Free Cl_2	mg/L	0.1	0.02		
NH_4^+	Mg/L	3.0	3.5	EPA 350.3	
P	mg/L	< 0.10	< 0.10	DIN EN ISO 10304-1	0.4
Al	mg/L	< 0.10	< 0.10	DIN EN ISO 11885	0.1
Fe	mg/L	0.41	0.58	DIN EN ISO 11885	0.3
Cd	mg/L	< 0.002	< 0.002	DIN EN ISO 11885	0.05

Water Qualities of Euphrates River (2/3)

4. Environmental Baseline condition

Parameter	Unit of measurement	Location H_1	Location H_2	Testing method	Iraqi Standard
Cr	mg/L	< 0.010	< 0.010	DIN EN ISO 11885	0.05
Cu	mg/L	0.012	0.005	DIN EN ISO 11885	0.05
Mn	mg/L	< 0.010	< 0.010	DIN EN ISO 11885	0.1
Ni	mg/L	< 0.020	< 0.020	DIN EN ISO 11885	0.1
Pb	mg/L	< 0.02	< 0.02	DIN EN ISO 11885	0.05
Zn	mg/L	< 0.10	< 0.10	DIN EN ISO 11885	0.5
B	mg/L	0.68	0.68	DIN EN ISO 11885	1.0
Si	mg/L	5.39	5.34	DIN EN ISO 11885	
AS	mg/L	0.0024	0.0025	DIN EN ISO 11969	0.05
Hg	mg/L	< 0.00010	< 0.00010	DIN EN 1483	0.001
Oil & grease	mg/L	17.9	14.0	EPA 418.1	-

Water Qualities of Euphrates River (3/3)

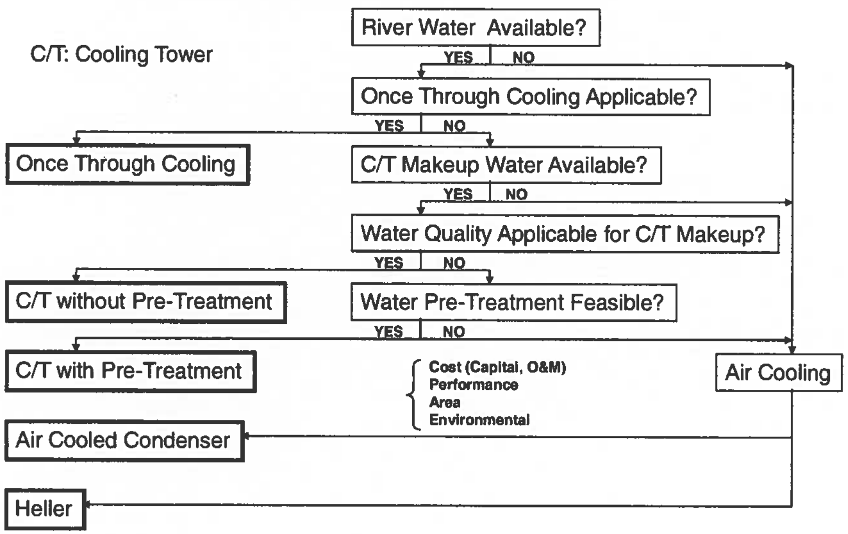
Necessary considerations

- Embankment for land formation is about 1～3m
- Piling length is about 13～14m
- Selection of Cooling system and Intake facility design in consideration of river flow rate and water quality

Attachment-14

Nov. 26, 2011

STG Condenser Cooling Options



Nov. 26, 2011

Conceptual Volumetric Evaluation of STG Cooling Water

(300MWe STG with 35% Efficiency as the evaluation basis)

Circulating Water

Thermal Loads to Condenser
300 / 0.35 - 300 = 560MWth = 560MJ/s

Specific Energy of Water
~ 4.2MJ/ton/degC

Circulating Water Required
560 / 4.2 = 130ton·degC/s

ΔT = 7degC
130 / 7 x 3600 = 67,000ton/h

ΔT = 10degC
130 / 10 x 3600 = 47,000ton/h

Cooling Tower Makeup Water

Thermal Loads to Condenser
300 / 0.35 - 300 = 560MWth = 560MJ/s

Thermal Energy for Water Evaporation
~ 2.4MJ/kg

Evaporation Required for Cooling
560 / 2.4 = 230kg/s = 840ton/h = E

M: makeup, B: blowdown, C: concentration
M = E + B, M = C x B
B = E / (C – 1)
M = E x C / (C – 1)
where C ~ 5
M = 840 x 5 / 4 = 1,050ton/h

Nov. 26, 2011

Cooling Tower Makeup Water Quality Guideline

ITEM	EFFECTs	Limits in Circ. Water
Calsium Hardness	Scaling	<120ppm as CaCO3
COD, BOD	Slime	<20ppm
TDS	Corrosion	<3,000ppm
SS	Fouling	<10ppm
Conductivity	Corrosion	<4,000μV/cm

Attachment-15

NOTES :

1) 400kV GIS : Rated Current : 4000A (Bus) / 2000A (Feeder Diameters)
Rated Short Time Withstand Current : 50kA, 1 sec.

2) NSRG 1 Tie-in : Busbar End at Sectionaliser Breaker (Expandable to the additional GIS for NARG 2 connections)

3) Overhead Lines from NSRG 1 400kV GIS : Total Nos 6 (4 OHL Cut-in, 1 OHL New, and 1 OHL Spare)
Cut-in : NSRP-RMLG, 4KAD-SAMAW. All are Facing to South.

4) Cable Connection to NSRG 1 400kV GIS from NSRG 2 Generators : , 6 Generator Feeders

5) Legend:

G : Generator [1G12 : NSRG 1, Block 1, No.2 Generator (GTG) / 2G23 : NSRG 2, Block 2, No.3 Generator (STG)]

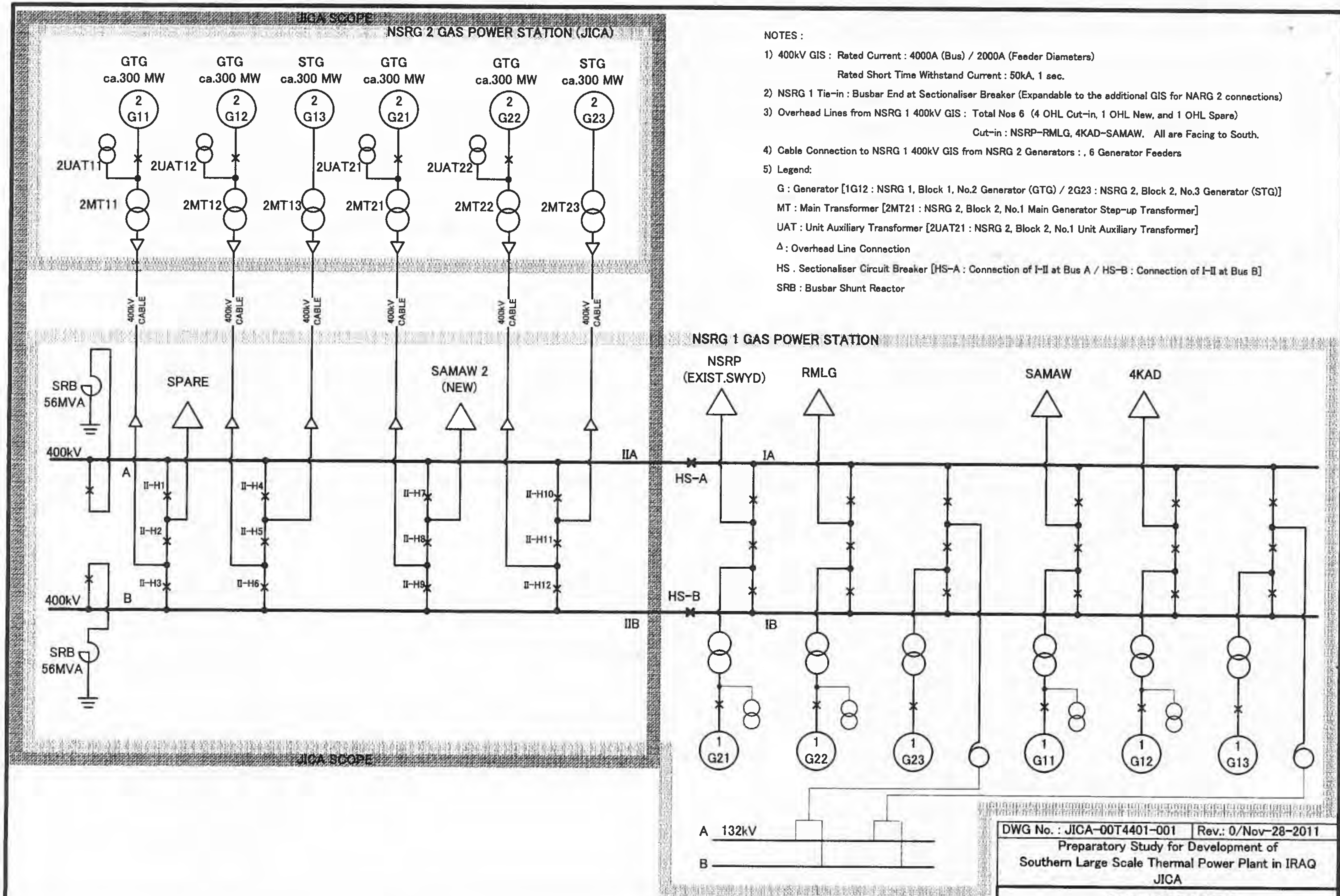
MT : Main Transformer [2MT21 : NSRG 2, Block 2, No.1 Main Generator Step-up Transformer]

UAT : Unit Auxiliary Transformer [2UAT21 : NSRG 2, Block 2, No.1 Unit Auxiliary Transformer]

Δ : Overhead Line Connection

HS . Sectionaliser Circuit Breaker [HS-A : Connection of I-II at Bus A / HS-B : Connection of I-II at Bus B]

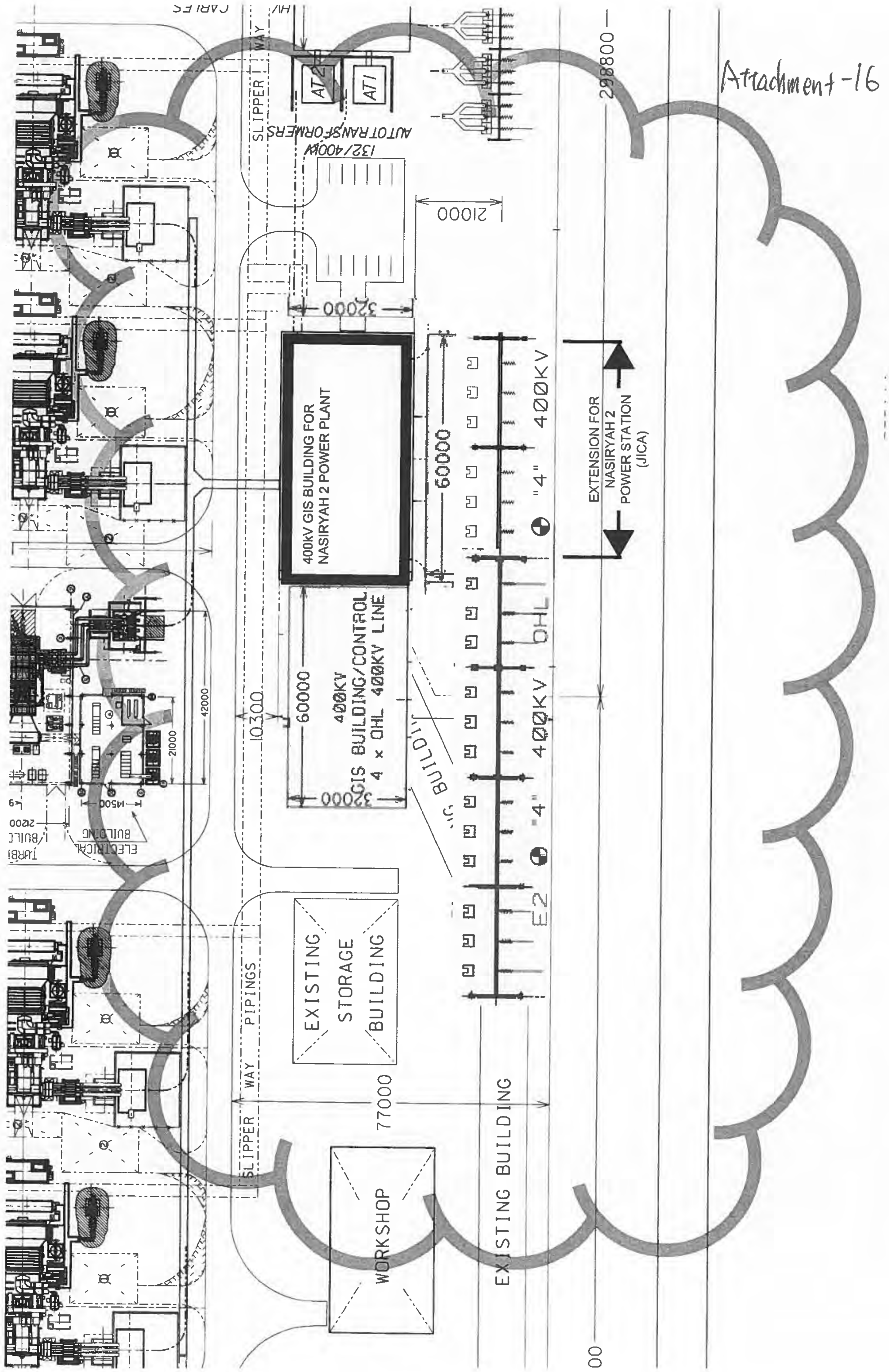
SRB : Busbar Shunt Reactor



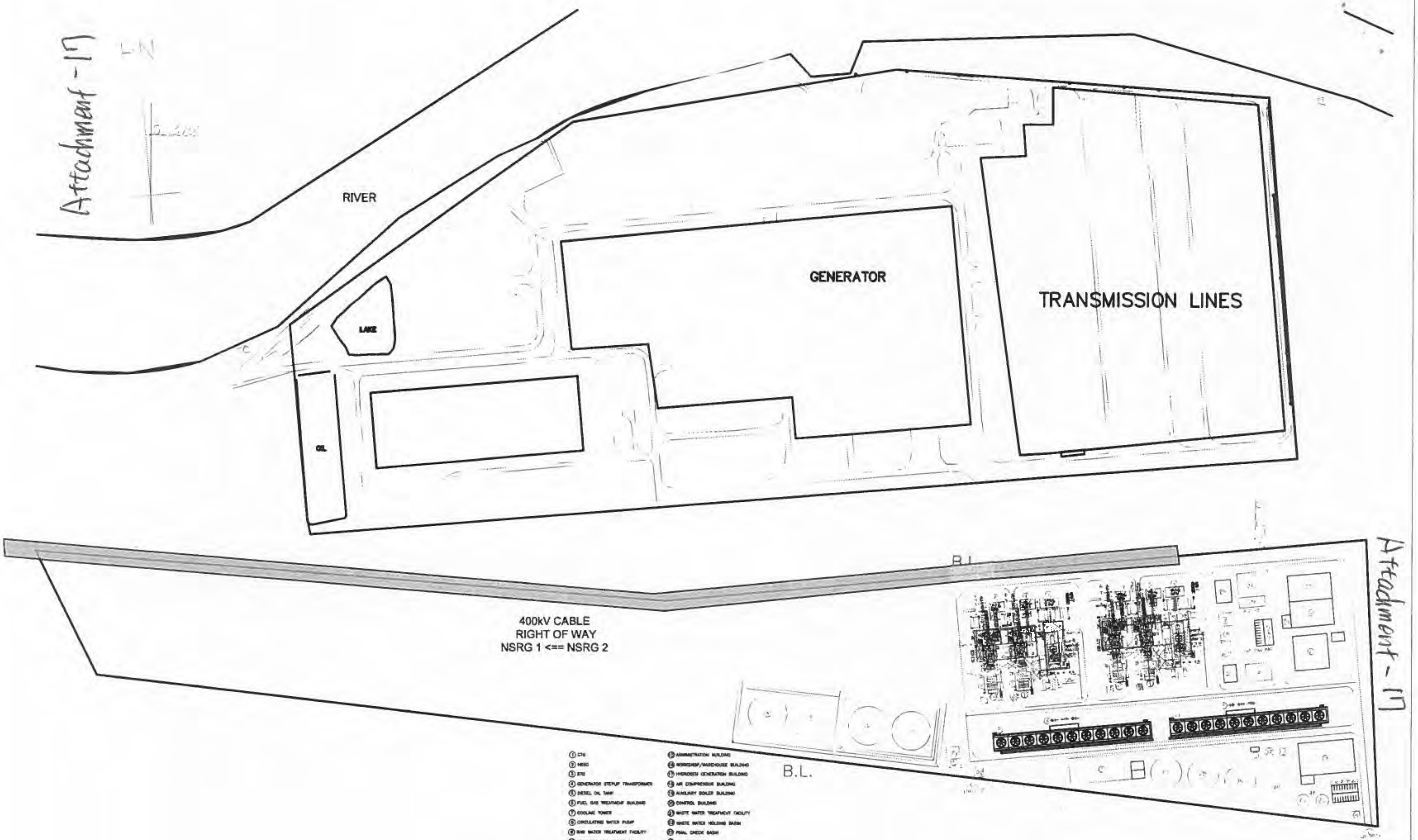
DWG No. : JICA-00T4401-001	Rev.: 0/Nov-28-2011
Preparatory Study for Development of Southern Large Scale Thermal Power Plant in IRAQ JICA	
SKELETON DIAGRAM NASIRYAH GAS POWER STATION 1 & 2	

NSRY2-SLD-R0D3.VSD

Attachment-16



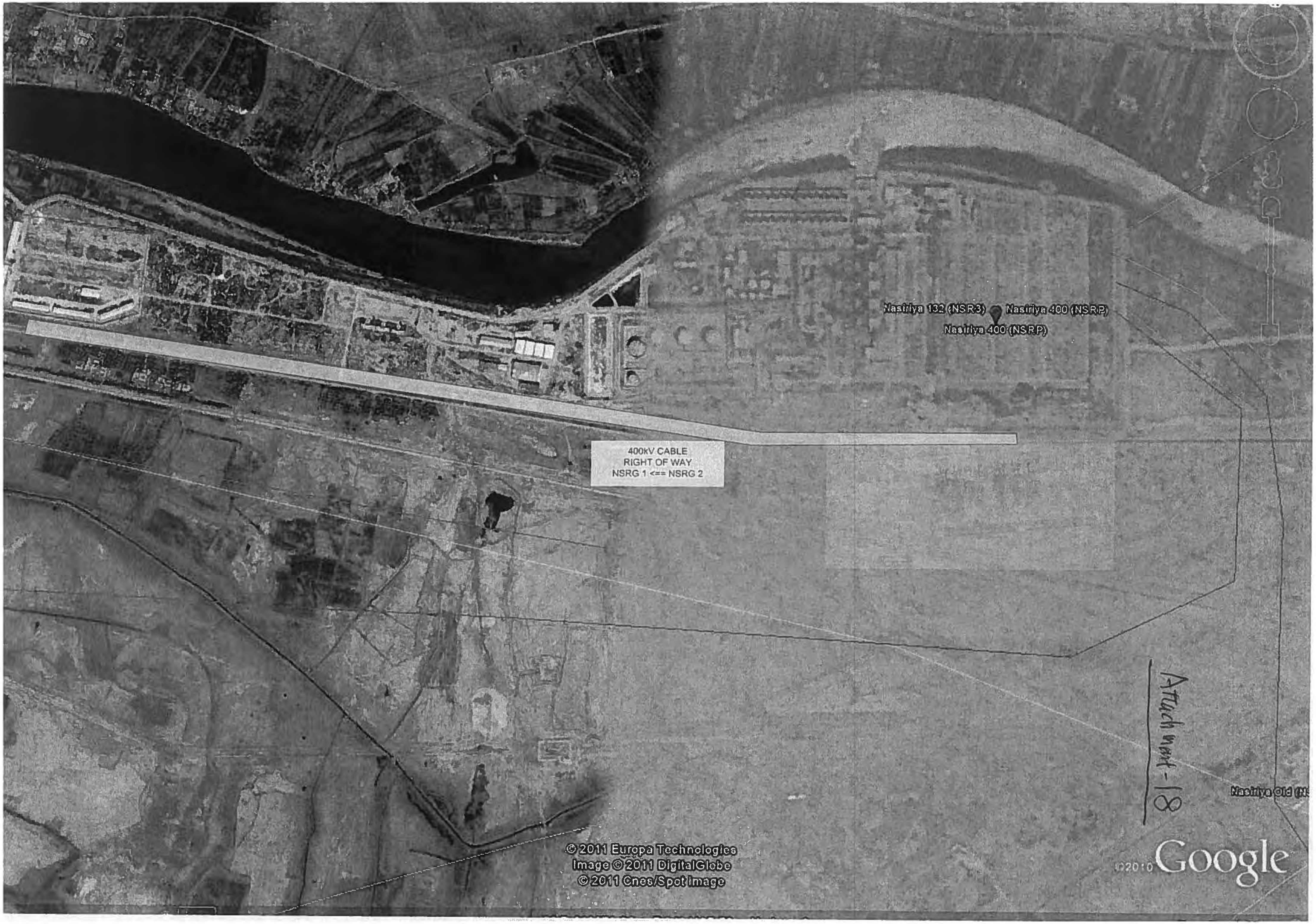
Attachment - 17



Attachment - 17

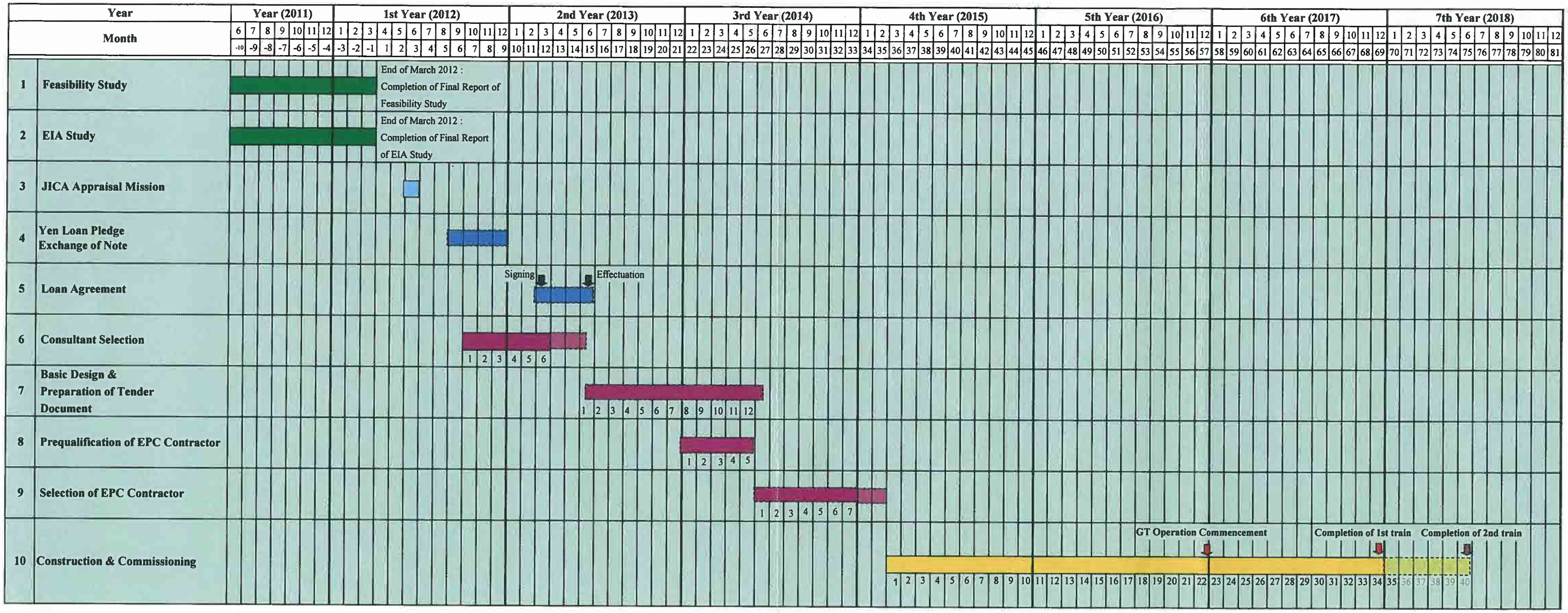
DWG No. JIC-00T4403-001, Rev.0 / Nov-28-2011

400kV CABLE ROUTE PLAN


Nasiriya 132 (NSR3)
Nasiriya 400 (NSRP)
Nasiriya 400 (NSRP)
400kV CABLE
RIGHT OF WAY
NSRG 1 <== NSRG 2
Attach ment-18
© 2011 Europa Technologies
Image © 2011 DigitalGlobe
© 2011 Cnes/Spot Image
Google

Attachment- 19

ENVISAGED PROJECT SCHEDULE / LARGE-SCALE THERMAL POWER PLANT IN THE SOURTH REGION



NOTE :

- Study (F/S, EIA)
- JICA Appraisal Mission
- Procurement of Consultant & EPC Contractor
- Construction

Attachment-20 (1/6)

3rd Mission

Project Implementation

November 2011

Project Implementation

1. Envisaged Project Schedule
2. Economic/Financial Analysis
3. Implementation Organization

1. Envisaged Project Schedule

(1) Envisaged Project Schedule (Attached)

(2) Necessary approvals and permissions within Iraqi Government

① Project Identification by MOE/Planning & Studies Office to be confirmed by the **Minister of Electricity**

② Permission from **Ministry of Environment** and **Ministry of Antiques and Tourism** for the selected **site** (Nasiryah) for a new power plant with project identification

③ **Budget** confirmation from **Ministry of Finance** and **Ministry of Planning**

④ EIA

⑤ Official project announcement by MOE

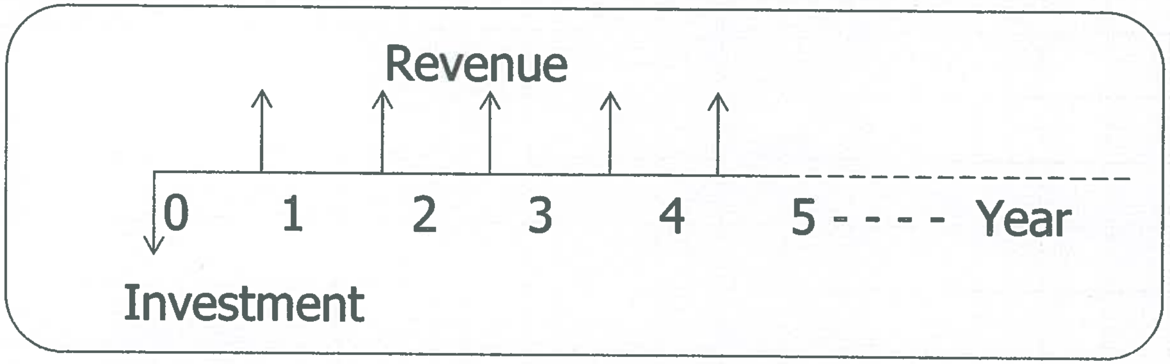
➔ **Bidding procedure will start**

2. Economic/Financial Analysis

(1) Project Circumstances

- Revenue received by the project owner (MoE) solely from the project

Project Battery Limit



- Direct revenue to MoE from the Project is not clearly measurable (tariff at the Project boundary not available)
- Cost for operation and maintenance for the Project is not calculated for each project by project but they are included in a total MoE budget

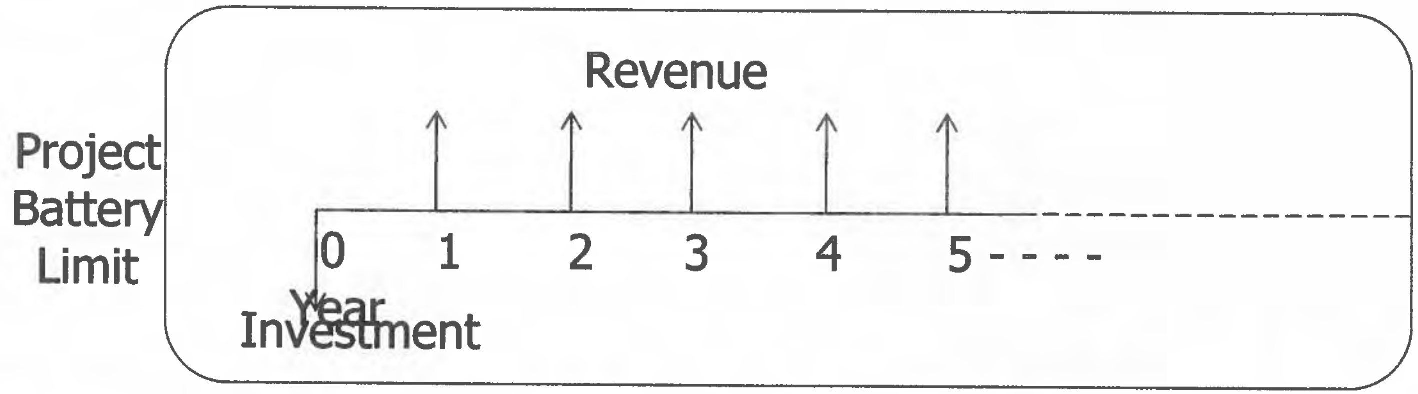
➔ FIRR as it is used in a project can not be applied

(4/10)

2. Economic/Financial Analysis

(1) FIRR / Methodology

- FIRR calculation as if it is an independent power plant project for reference



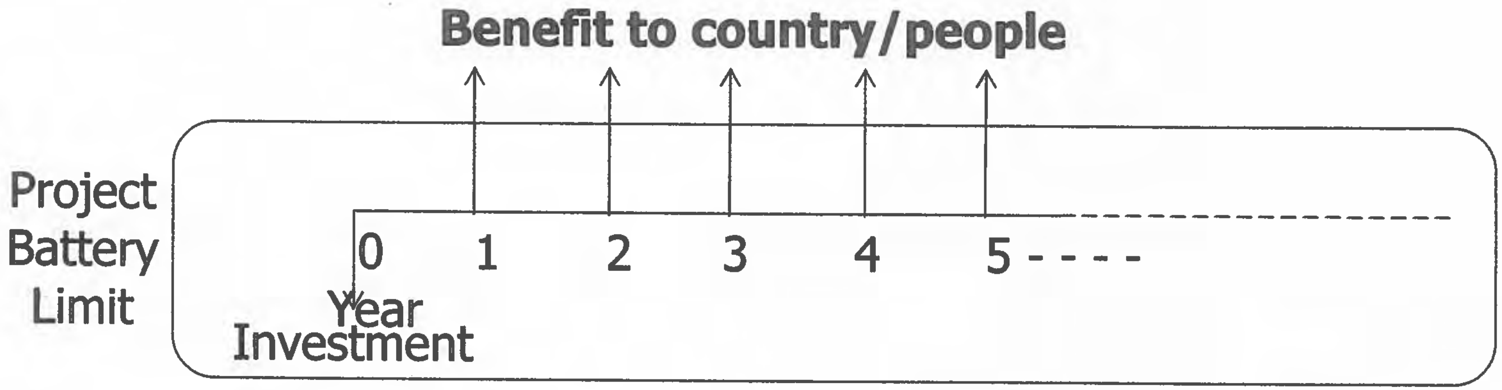
- Investment : Expected EPC cost of the Project
- Return : Stable return by tariff calculated and converted based on "Proposal Tariff in future (2013)" for industrial use

(5/10)

2. Economic/Financial Analysis

(2) EIRR (Economic Internal Rate of Return)

- Return is benefit to the country and people of Iraq with the Project (with project vs without project)



- An example of the benefit:

  - Some people in Iraq can receive electricity enough or longer hour
  - Reduction of fuel diesel oil
  - Increase in GDP

2. Economic/Financial Analysis

(2) EIRR (Economic Internal Rate of Return)

- ➢ Benefit quantification by willingness-to-pay and macro economic data
- ➢ Assumptions to calculate EIRR
- ✓ Power consumers (users): Household 60%, Others 40%

(Source: Public Policy on Subsidies, Iraq MoE, Executive Summary (USAID), July 2005)

- ✓ Others includes industrial, agricultural, commercial and governmental use
- ✓ 1/3 of Others own their generator for half day
- ✓ 1/3 of Others intend to purchase their own generators
- ✓ 1/3 of Others have no intention to generate own power
- ✓ Their own generator is small capacity and 40% of the consumed fuel is gasoline or diesel and its 20% is HFO

2. Economic/Financial Analysis

(3) Other assumptions for FIRR/EIRR

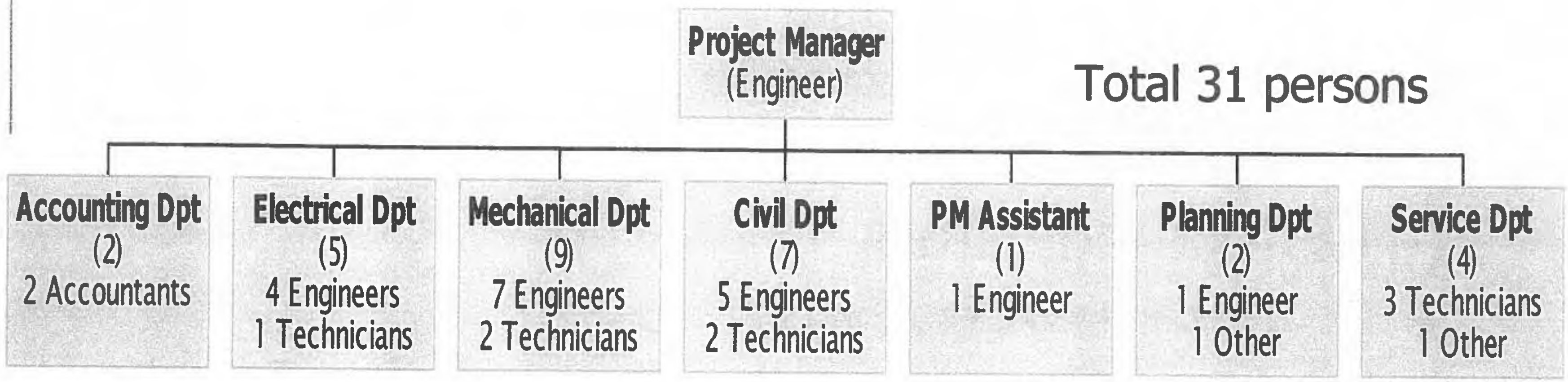
- Project term of 20 years for calculation (Yen loan repayment period: 30 years<)
- Fuel cost: Dry gas @ US$4/mmbtu, Diesel @ US$1,000/MT
- Manpower cost: Indicated as total (Not no of people x salary)
- Insurance cost for operation period: Not considered
- Inflation: Not considered
- Discount rate (hurdle rate): Rate applied by internal financial institute such as ADB, plus premium
- No resettlement cost
- No land related cost (land will be available by MoE)
- No cost for the right of way (power plant, transmission line, pipeline)

3. Implementation Organization

(1) Development & Construction Phase

MOE Project Team for Nasiryah II Project

Total 31 persons



(2) Operation Phase

- Considering an example of current organization at a steam turbine power plant (400 MW, 1200 people) and also TEPCO CCGT power plant case

(9/10)

3. Implementation Organization

(3) Operation indicators

- Maximum generation capacity
- Operating rate/Utilization rate
- Thermal Efficiency rate
- Scheduled and unscheduled shut-down period

(4) Effect indicators

- Maximum generation capacity
- Generation capacity at the battery limit of the Project

(10/10)