Republic of Malawi
Ministry of Energy
Department of Energy Affairs (DOE)
Electricity Supply Corporation of Malawi (ESCOM)

THE PREPARATORY SURVEY FOR EXTENSION OF TEDZANI HYDROPOWER STATION PROJECT IN REPUBLIC OF MALAWI

FINAL REPORT

MARCH 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ELECTRIC POWER SERVICES CO.,LTD

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[Preface]

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Tokyo Electric Power Services Co., LTD.

The Survey Team held a series of discussions with the officials concerned of the Government of the Republic of Malawi, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Malawi for their close cooperation extended to the Survey Team.

March 2014

Takumi UESHIMA
Director General
Industrial Development and Public Policy Department
Japan International Cooperation Agency

[Summary]

1 Background and Outline of the Project

1-1 Background

In 2011, the Malawi Government issued a mid-term economic development plan, “Malawi Growth and Development Strategy II” (MGDS II) for the period between 2011 and 2016.
The MGDS II is based on six broad thematic areas namely: Sustainable Economic Growth; Social Development; Social Support and Disaster Risk Management; Infrastructure Development; Improved Governance; and Cross Cutting Issues.

From these themes, the MGDS II identified nine key priority areas which were central to the achievement of sustainable economic growth and wealth creation. These key priority areas are: Agriculture and Food Security; Energy, Industrial Development, Mining and Tourism; Transportation Infrastructure and Nsanje World Inland Port; Public Health, Sanitation, Malaria and HIV and AIDS Management; Integrated Rural Development; Green Belt Irrigation and Water Development; Child Development, Youth Development and Empowerment; and Climate Change, Natural Resources and Environmental Management (in MGDS eight areas above are mentioned). Among these key areas, efficient energy systems are essential for development of industry, mining and tourism.

The Government focused on the exploitation of power sources and the extension of transmission line to ensure reliable power supply to satisfy growing power demand.

In 2009, the power generation capacity in Malawi was 288 MW, while the maximum power demand exceeded about 350 MW. Power supply and demand shows an imbalance. Insufficient generation capacity causes frequent blackouts and brownouts. Furthermore, Malawi faces steep rise in petrol and gas prices caused by increases in inland transportation costs.

Under these energy conditions, the extension of the Tedzani Hydropower Stations in Brantyre Province is to develop hydropower potential for supplying additional electricity to the national grid in order to reduce blackouts and brownouts and stabilize voltage and frequency of the power supply system, and thus the Tedzani Project will contribute to the overall goal of MGDS II.

1-2 Outline of the Project

In order to achieve the overall goal of the MGDS II that is based on six broad thematic areas; the extension of the Tedzani Hydropower Station envisages additional power of 21.8 MW with an annual generated power of 170 GWh to stabilize the power supply system.

The Project is composed of two components: installation of a new hydropower station and transmission line including substation.

The Project utilizes the existing Tedzani Dam and newly constructs an intake, headrace, head tank, penstock, and power station in the area of the Tedzani Hydropower Stations.

The generated power will be sent to Tedzani I and II substation where it will be supplied to the 66 kV national grid. The transmission line requires two towers with cable length of 260 m from Tedzani IV power station (a new power station) to the existing Tedzani I and II substation.

2 Basic Design of the Project

2-1 Civil Structures

Table 1 gives an outline of the civil works facilities in the Project.

Table 1 Feature of Civil works

Category	Facility	Contents	Remarks
Power generating particulars	Type of generation	Run of river type	
	Peak water usage	70.0m3/s	
	Effective head	37.0m	
	Maximum output	21,800kW	1unit
Civil structures	Intake	H13.8m, W32.2m	
	Headrace	H5.0m, W5.0m, L586.2m	Box culvert
	Head Tank	H17.2m, W39.7m, L87.5m	
	Penstock	D4.0m, L110.9m	Surface
	Power House	H40.7m, W32.0m, L27.0m	Surface
	Tailrace Channel	W11.2m, L18.8m	
	Access Road	W6.0m, L280.0m	

2-2 Generator, Transformation and Distribution Equipment

Table 2 and 3 shows the outline specifications of the turbine, generator and transmission line equipment respectively.

Table 2 Outline Specifications of Transmission Line

Items	Facilities	Specification
66kV Transmission Line	Tower	Angle type steel tower, 1 circuit
	Foundation	Inverse T type foundation
	Insulator	Single tension type insulator string 8 disc/string
	Conductor	Bare ACSR(LYNX)
	Shielding Wire	20SA 7/2.03 (BS EN 61232:1997)

Table 3 Outline Specifications of Turbine and Generator

Equipment	Specification	No.	Purpose
1.Water Turbine	Type: Francis turbine Effective Head: 37.0m Maximum Discharge: 70.00m^3/s/unit Maximum Output: 23MW Rated Speed: 167 min^{-1}	1 Unit	To convert potential energy of water to rotational energy
2.Inlet Valve	Type: Biplane Valve Operation Method: Oil pressure, with counter-weight Valve Diameter: 3,800mm	1 Unit	To stop water flow
3.Auxiliary Mechanical Equipment	High Pressure air system Cooling water supply/discharge system Drainage system	1 Set	For auxiliary equipment control, unit cooling, generator braking etc.
4.Generator	Type: Vertical type, three-phase synchronous generator Rated Output: 26.6MVA Rated Speed: 167min^{-1} Rated Voltage: 11kV Rated Frequency: 50Hz Insulation Class: F	1 Unit	To convert rotational energy to electric energy
5.Overhead travelling crane	Crane Span:16.4 m Length of Crane Rail:30m Main Hoist Capacity:1200KN Auxiliary Hoist Capacity:100kN	1 Unit	For turbine/generator installation, assembly, disassembly etc.
6.Control and Protection System	Unit Control Panel for Unit start and stop control, Local Control Panel for local auxiliary equipment , Plant Supervisory Panel for plant supervision of power, voltage, current etc. Mimic Panel for visual plant supervision, Protection Panel for detection of faults and the protection	1 Set	For unit start and stop control, plant supervision, detection of faults and the protection etc.
7.Main Circuit Equipment	Disconnecting Switch Voltage transformer Current transformer Neutral grounding equipment	1 Set	To connect generator to main transformer, and supervise the voltage and current
8.Station Auxiliary Power System	Station transformer Auxiliary AC power system Auxiliary DC power system	1 Set	To supply AC and DC power to electrical equipment in the power house
9.Main Transformer	Type: Oil transformer, natural air cooling Rated Capacity: 26MVA Rated Voltage: 66kV/11kV with on load taps Frequency:50Hz	1 Unit	To step up generator voltage from 11kV to 66kV of transmission line voltage
10. Outdoor Switchgear	Generator circuit breaker Disconnecting switch Arrester	1 Set	To connect main transformer to transmission line and close/open the circuit
11.Cable facilities	High voltage cable Low voltage cable Control cable	1 Set	To connect electrical equipment for power supply, operation, control, and protection
12.Earthing facilities	Earthing for powerhouse Earthing for outdoor switchgear Ground resistance :not more than 0.5Ω	1 Set	To suppress voltage rise of ground for safety to personnel when grounding fault occurs
13.Transmission Line	Angle type steel tower Single tension type insulator string Wind pressure:1400Pa	2 Units	To link Tedzani IV 66kV line with Tedzani I/II 66kV busbar

3 Project Implementation Schedule and Project Cost

3-1 Project Implementation Schedule

Table 4 shows the works period that will be required to implement the Project.

Table 4 Project Works Period

Implementation Contents	Implementation Period	Implementation Months
Detailed design	April 2014 ~ December 2014	9 months
Tender Process	January 2015 ~ May 2015	5 months
Facilities construction and equipment procurement period	June 2015 ~ September 2018	40 months

3-2 Project Cost

Table 5 shows the outline of Project cost.

Table 5 Outline of Project Cost

Total Project Cost	Non-disclosed up to Approval of the Execution and procurement Contractor Agreements
Burden of Japan	Ditto
Burden on the host country side	81.80 million MK

4 Project Evaluation

4-1 Relevance

In Malawi, the development of energy is valued as one of the nine most prioritized fields in economic strategy, and ranked as one of the most significant issues for infrastructure improvement and sustainable economic growth. The maximum power demand in 2012 is 347 MW, which largely exceeds the installed capacity of the power supply (288 MW). Because of the chronic nation-wide power shortage, there are frequent power failures. In particular, serious negative influence has reached the civic life and the economic activity in the capital city, Lilongwe (population of 2,204,000) and the commercial city of Blantyre (1,297,000).

In Malawi, about 98% of its electricity is generated by hydroelectric power stations. Among these stations, about 98% of the capacity is generated along the Shire River. The Project will contribute to the reduction of power shortage and economic development of the country with its additional power generation.

Since the Project will explore the capacity of electric power generation, the stable and high quality power distribution will be realized and the industrial potential and the living standards in Malawi will be raised.

4-2 Effectiveness

The anticipated outputs of Project implementation are as follows.

(1) Quantitative effects

The purpose of this Project:

With increasing electric power consumption in Lilongwe and Blantyre, which are the main consumption areas in this region, since the power supply is one of the most significant elements of industrial infrastructure, it is imperative to increase power supply, secure stable power supply and improve quality and safety of power distribution for reinforcement of the economic potential in these areas.

Due to the aforementioned reasons, and in consideration of the promotion of adopting the reusable energy source for the power, this Project will construct Tedzani IV hydroelectric power station and utilize the overflow discharge water from Tedzani Dam. Tedzani IV will demonstrate the determinate capabilities illustrated in the table bellow.

Table 6 Quantitative Effect Indicators

Indicator	Reference Value (as of 2012)	Target Value (as of 2018) [3 years after Project completion]
Installed capacity (kW)	92,700	114,500
Annual generated energy (GWh/year)	620.8	782.8
Plant Factor (%)	76	78

Note: Reference Value is the total of Tedzani I, II and III while Target Value is the total of Tedzani I, II, III and IV.

(2) Qualitative Effects

Since this Project will explore the capacity of electric power generation, the stable and high quality power distribution will be realized in Lilongwe and Blantyre. From the above, the industrial potential and the living standards in these areas will be raised.

Preparatory Survey

for

The Extension of Tedzani Hydropower Station

in the Republic of Malawi

Final Report

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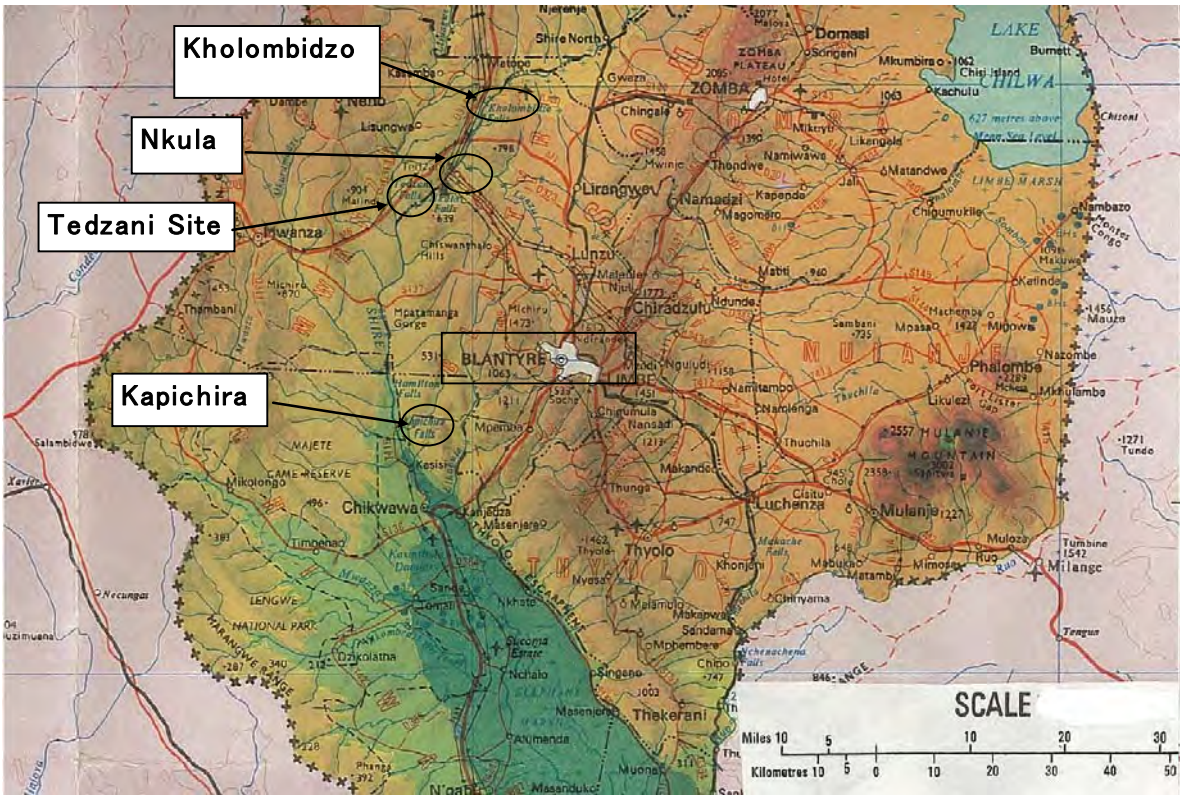

[Location Map]

[Perspective]

[Pictures of the Project Site]

Photo-1: Tedzani Dam

This picture shows the dam reservoir on the right side, the dam crest in the center and the spillway which had been discharging on the left.

Photo-2: Tedzani Reservoir

Upstream of the in-operation intake, a screen has been equipped to filter out the drift reed in Shire river.

Photo-3: Spillway

From this spillway of the Tedzani Dam, surplus water has been discharging permanently. The Project of Tedzani IV hydroelectric power plant with 21,800kW is planning to utilize this water.

Photo-4: New Intake Site

Hard bedrock crop out on the left side of the downstream of Tedzani Dam where there is the site for water-intake facilities. Blasting works will be needed in escavation work.

Photo-5: New Head Tank Site

The site for New Head Tank for Tedzani IV hydroelectric power plant, where there was the muck disposal yard.

Photo-6: New Powerhouse Site

The site for Tedzani IV hydroelectric power plant is planned on the left side of Shire river. The point for new powerhouse building which will house the water-wheel and turbine is planned at the place indicated in the picture.

Photo-7: Existing Tedzani I, II Substation

The generated output from Tedzani IV hydroelectric power plant will connect to the in-operation grid system (66kV) at Tedzani I & II substation.

Photo-8: Existing Tedzani III Substation

The generated output from Tedzani III hydroelectric power plant connected to the in-operation grid system (132kV) at Tedzani III substation.

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[Abbreviations]

ADCP	Acoustic Doppler Current Profiler
AfDB	African Development Bank
A/P	Authorization to Pay
AVR	Automatic Voltage Regulation
B/A	Banking Arrangements
BOD	Biological Oxgen Demand
DOE	Department of Energy Affairs
EAD	Environmental Affairs Department
EIA	Environmental Impact Assessment
EMA	Environment Management Act
EMP	Environmental Management Plan
EMMP	Environmental Management Monitoring Plan
ESCOM	Electricity Supply Corporation of Malawi
E/N	Exchange of Note
FS	Feasibility Study
G/A	Grant Agreement
GOJ	Government of Japan
GOM	Government of Malawi
GWh	Giga Watt hour, 10^6 x kWh
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
MP	Master Plan
M/D	Minutes of Discussion
MOECM	Ministry of Environment and Climate Change Management
NOx	Nitrogen Oxide
P/S	Power Station
SS	Suspended Solid
SOx	Sulfur Oxide
TEPSCO	Tokyo Electric Power Services Co., Ltd.
WB	World Bank

Chapter 1 Background of the Project

1-1 Background and Outline of the Grant Project

1-1-1 Background

In 2011, the Malawi Government issued a mid-term economic development plan, "Malawi Growth and Development Strategy II" (MGDS II) for the period between 2011 and 2016.
The MGDS II is based on six broad thematic areas namely: Sustainable Economic Growth; Social Development; Social Support and Disaster Risk Management; Infrastructure Development; Improved Governance; and Cross Cutting Issues.

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In 2009, the power generation capacity in Malawi was 288 MW, while the maximum power demand exceeded about 350 MW. Power supply and demand shows imbalance. Insufficient generation capacity causes frequent blackouts and brownouts. Furthermore, Malawi faces serious shortages of petrol and gas due to high cost of inland transportation of fuel.

Under these energy conditions, the extension of the Tedzani Hydropower Stations in Brantyre Province is to develop water resources for supplying additional electricity to the national grid to reduce blackouts and brownouts and stabilize voltage and frequency of the power supply system, and thus the Tedzani Project will contribute to the overall goal of MGDS II.

1-1-2 Outline of the Project

In order to achieve the overall goal of MGDS II, the extension of the Tedzani hydropower Station envisages additional power of 21.8 MW with an annual generated power of 170 GWh to stabilize the power supply system.

The Project is composed of two components: installation of a new hydropower station and transmission line including constructing of substation.

The project utilizes the existing Tedzani Dam and constructs and an intake, headrace, head tank, penstock, and power station in the area of the Tedzani Hydropower stations.

The generated power will be sent to Tedzani I and II substation where it will be supplied to the 66kV national grid. The transmission line requires two towers with cable length of 260 m from Tedzani IV power station, a new power station, to the existing Tedzani I and II substation.

1-1-3 Item Requested by the Malawian Side

Main item requested by the Government of Malawi to Government of Japan is extension of hydro power generation facility including transformer installation and transmission line to feed to existing grid.

1-2 Land and Natural Conditions

Malawi, an eastern African country, has land area of 118,484 km2, and the African Great Rift Valley runs north and south through the country. Lake Malawi (29,600 km2), a fault lake, occupies the majority of the country. The Shire River, Malawi's main river with catchment area of approximately 138,600km2, flows out of Lake Malawi and runs through the southern region of the country before it joins the Zambezi River in Mozambique.

1-3 Environmental and Social Considerations

1-3-1 Outline of Project Component from the View of Environmental and Social Consideration

(1) Hydropower Station

The type of the planned generation scheme is “Run-of-River” with no sizable reservoir which helps limit considerably both the environmental and social impacts.

Involuntary resettlement or land acquisition for implementation of the Project is not necessary as all of components will be installed within ESCOM's land.

(2) Transmission Line (including Substation)

Two towers with height of about 30m are planned to be built to transmit generated electricity from the power station to the existing transmission line for 260m.

These components need small scale logging, resettlement or leveling of ground for facilities entailing environmental and social impacts. (See Photo 1-1).

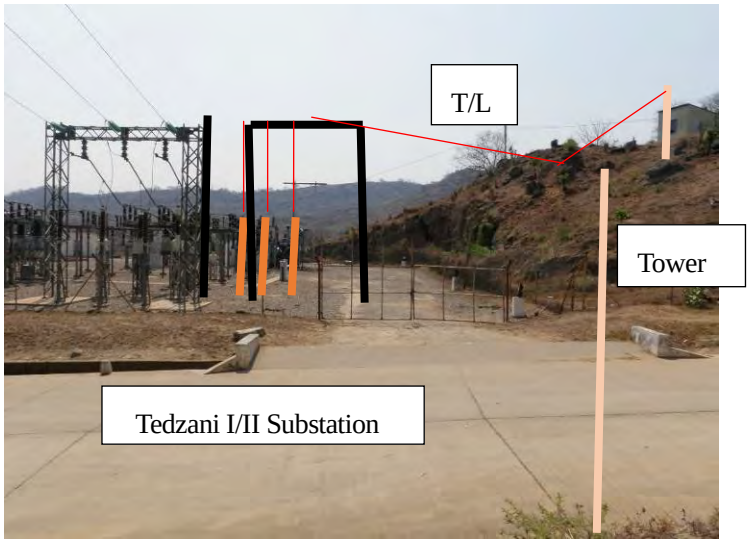


Photo 1-1 Layout of Transmission line and Towers

1-3-2 Environmental and Social Condition of the Project Site

(1) Hydropower Station

1) Natural Environment

The intake of the existing reservoir is planned in a small scale land excavation for construction of open channel. The vegetation around the intake is predominantly Miombo woodland of the escarpment types with Leguminosae and Bignoniaceous species planted after land clearances for Tedzani No.1 Hydropower station in the early 1970s.

But the whole area now shows secondary nature with tall grass savanna and other tree species such as Gramineae dominating the under growth (See Photo 1-2).

Photo 1-2 Miombo Woodland Near Existing Reservoir

The vegetation in the site for the power station with area of 1200m^2 (30mx40m) has same status as the intake mentioned above covered by few trees of Leguminosae and Bignoniacea species (See Photo 1-3).

Photo 1-3 Vegetation Near Planned Power-House

The vegetation around the power station is covered with lianous woody plant such as Leguminous or Euphorbia creeping between thin sandy residual rocks of escarpment areas.

The vegetation near the drainage gate is mainly covered with riverine plants such as Neptunia oleracea which is seen commonly along rivers in East Africa.

As for habitats for fauna, the number of species is limited and small, because this Project area is surrounded by tall fence that prevents animals from entering. In the Project to area.only monkeys *(Chlorocebus pygerythrus*) , Nile crocodiles (*Crocodylus niloticus*) ,lizards and snakes were confirmed through interviews with the local people.

The Nile crocodile (Crocodylus niloticus) has been designated as a protected-wildlife by the Malawi Act on National Parks and Wildlife-1992, but this species is categorized in the 2013 IUCN Red List of Threatened Species as Least Concern (LC) which has not been exposed to threatened species.

All of the species except Nile crocodiles (*Crocodylus niloticus*) that have been recorded on the Project site are commonly seen over broad area and are not designated as precious species in the IUCN Red List or as protected-wildlife by the Malawi Act on National Parks and Wildlife.

2) Social Environment

Six houses for ESCOM's employees are located near the headrace, but none of them need to relocate to other places, although there are some concerns about adverse impacts caused by scattered rocks during construction stage.

(2) Transmission Line (including Substation)

1) Natural Environment

Almost all of the sites are well-paved and no plants are observed except near the site for planned substation house adjoining river where there are riverine plants such as Neptunia oleracea.

2) Social Environment

There are no concerns about adverse impacts to social issues, as all of the sites are used exclusively for maintenance of the existing No.1and No.2 hydropower stations.

1-3-3 Institutional and Legal/Regulatory Framework and its Enforcement Structures for Environmental and Social Condition in Republic of Malawi

(1) Relevant Environmental Legislation in Malawi

Legislation, policies and instruments are available to support the environmental management and impact assessment process in Malawi.

The National Environmental Policy (2004) and the Environmental Management Act (1996) are the key instruments that cover environmental management in all the sectors of development.

The Environmental Impact Assessment Guideline (1997) prescribes the process and procedures to judge the Projects for which it is mandatory to implement Environmental Impact Assessment (EIA).

The following legislation and supporting regulations in Malawi are relevant to ensuring environmental and social issues;

- Republic of Malawi Constitution, 1995
- National Environmental Action Plan, 1994
- National Environmental Policy, 1996
- Environment Management Act No23, 1996
  - -EIA Guideline 1997
  - -Environmental Standards, 2002, 2004, 2005
  - -Environment Support Program 1998
  - -Waste control, management, treatment
- Water Resources Act 1969
  - -Water Resources Amendment Bill 1999
- Water Works Act 1995
- Draft Irrigation Act 1998
- National Forestry Policy 1996
  - -Forest Act 1997
- National Parks and Wildlife Act 1992
  - -National Parks and Wildlife (Amendment) Bill 1999
  - -National Parks and Wildlife Order 1994
- Land Act 1965
  - -Customary Land Development Act 1967
- Fisheries Conservation and Management Act 1997
- Electricity Act
- Monuments Act

(2) Environmental Impact Assessment (EIA) Procedural Framework in Malawi

The EIA process involves several stages or procedures (see Fig. 2-1).

It begins with a determination by the Environmental Affairs Department (EAD) as to whether a proposed Project is prescribed under Guideline 1997.

Under the Guideline, energy related Projects for which an Environmental Impact Assessment may be required are described as below.

Energy-related Project in Need(criterion)

1. *Construction or expansion of electrical generating facilities designated to operate at greater than 4 MW or, in the case of hydro-electric generating facilities, where the total head is greater than 20m or where there is a firm flow of 100 cubic meters per second.*
2. *Construction of electrical transmission facilities operating at a voltage of 132 kv or greater*

If not, no further action concerning EIA requirements need be undertaken.

If it is, then a Project Brief describing the outline of Project as below must be submitted to the Director of the Environmental Affairs Department (EAD).

Outline of Project should be described as the Project Brief

1. *The description of the Project*
2. *The activities that will be undertaken in the implementation of the Project*
3. *The likely impact of those activities on the environment*
4. *The number of people to be employed for purposes of implementing the Project*
5. *The segment or segments of the environment likely to be affected in the implementation of the Project*
6. *Such other matters as the Director may in writing require from the developer or any other person who the Director reasonably believes has information relating to the Project*

(3) Relevant Environmental Legislation in Malawi

The Director of the Environmental Affairs Department (EAD) indicated on 25th July 2013 that EIA implementation for the Project of "Extension of Tedzani Hydropower Station in the Republic of Malawi" is not required, and the Project is exempted from further compliance with the EIA requirements, and also issued a Certificate of EIA Exemption which advised the developer (DOE) to compile "a comprehensive Environmental Management Plan (EMP)" and "Environmental Monitoring Plan" and implement an Initial Environmental Examination (IEE).

(4) Other Relevant Act or Regulation

- Forest Act 1997

  Activities such as timber felling or leveling of forest ground in the designated special forest "Forest Reserves", National Parks, Wildlife Protection Area or Plant Protected Area are prohibited by Forest Act. The Project site is, however, not designated as special forest so there is no need to obtain any permission.
- National Parks and Wildlife Act 1992

  Nile crocodiles (*Crocodylus niloticus*) which are designated as protected-wildlife by Malawi Act, have been observed in the Project site, but permission is not necessary in accordance with National Parks and Wildlife Act unless capturing the crocodiles.

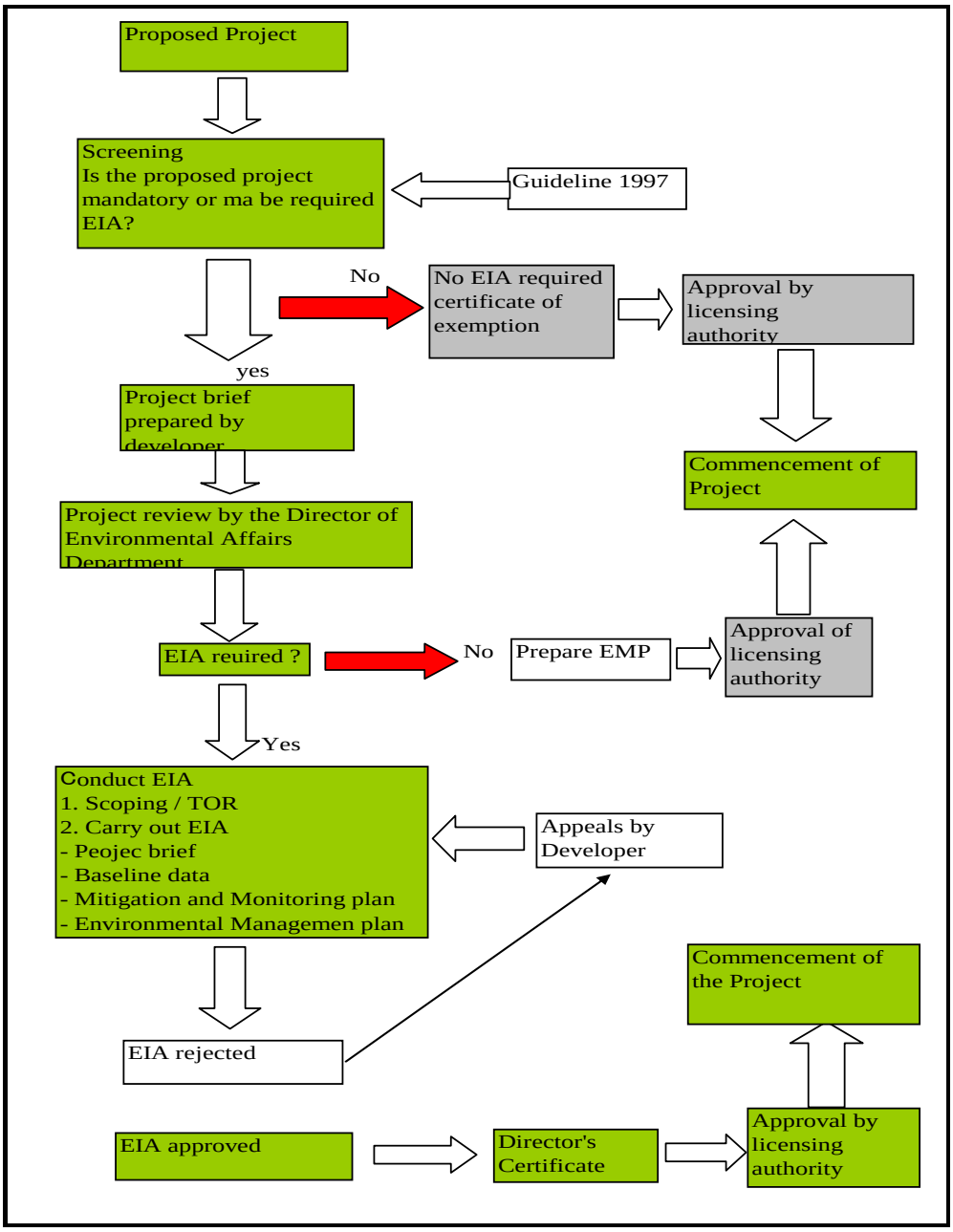


Figure 1-1 Flow Chart for EIA Procedure in MALAWI (Source: EIA Guideline EAD-1997)

1-3-4 Comparison of Alternatives

The characteristics of the alternatives from the view of Environmental and Social Conditions are summarized in Table 1-1. Three alternative plans were studied and a “C- Plan” was proposed as the best plan with little adverse impacts to natural resources and land.

Table 1-1 Characteristics of the Alternatives Studied

Alternatives	Outlines	Possible/Negative impacts
A (No-go option)	No construction and then discharging overflow water still continue without uses	-potential energy of 170GWh/year will be abandoned -unstable electrical energy supply and high frequency of power cut -No impacts to environment
B (Right bank of river)	Weir: No construction Headrace: 900m Capacity:21,800kw	-adverse impacts to nature caused by construction of new access and work road -adverse impacts to social matters by land-acquisition -raising of Project cost caused by land-acquisition
C (Left bank of river)	Weir: No construction Headrace: 586m Capacity:21,800kw	-reasonable construction cost caused by no construction of new access and work road -no resettlement or land-acquisition

1-3-5 Scoping on Natural and Social Environment

Table 1-2 shows the scoping result prepared based on the first field survey and the generally expected impacts by constructing hydropower stations.

Table 1-3 shows the result of scoping for the transmission line. This scoping result is prepared based on the results of the first survey and the generally expected impacts by constructing transmission line.

Table 1-2 Result of Scoping for Power Plant

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
Pollution mitigation measure	1	Air pollution	(-1)	C-	D	**Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area. **Operation phase:** air pollution is not expected by the plant operation.
	2	Water pollution	(-1)	A-	D	**Construction phase:** Water turbidity is anticipated by excavation work, but the impact will be temporary. The impact of concrete waste water and oil-containing wastewater is expected. **Operation phase: the impact of plant** Waste water, oil-containing wastewater, domestic wastewater, are not expected from the plant operation.
	3	Soil pollution	(-1)	C-	D	**Construction phase:** Possibility of soil pollution caused by leakage of lubricant and fuel oil from construction vehicles and machines. **Operation phase:** No Possibility of soil pollution caused by leakage of lubricant and fuel oil used for the unit operation.
	4	Sediment pollution	(-1)	B-	D	**Construction phase:** Possibility of sediment pollution in case construction wastewater flows into the river. **Operation phase:** No Possibility of sediment pollution caused by plant wastewater and domestic wastewater.
	5	Noise and Vibration	(-1)	C-	D	**Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area. **Operation phase:** Impact of noise and vibration is not predicted caused by plant operation.
	6	Odor	(-1)	C-	D	**Construction phase:** In case domestic waste from the workers' room was not appropriately treated, bad smell of rotten waste may occur. **Operation phase:** in case domestic waste from the room of workers in charge of repair work was not appropriately treated, bad smell of rotten waste may occur**.**
	7	Waste	(-1)	B-	D	**Construction phase:** general waste and hazardous waste is generated by the construction work. **Operation phase:** general waste and hazardous waste are not generated
	8	Ground subsidence				**N/A**
Natural environment	9	Natural reserve	-	D	D	**Construction phase and Operation phase:** There are no natural reserve areas near the proposed Project site.
	10	Ecosystem	(-1)	D	C-	**Construction phase:** The impact of construction on the precious species and ecosystem is not predicted. **Operation phase:** Impact to the fresh fish is predicted at water-decreased area during dry season.
Social environment	11	Resettlement				N/A
	12	Disturbance	(+1)	D	B+	**Design phase:** Impacts to households near the Project site

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
		to Poor People				are not anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	13	Disturbance to Ethnic Minority Groups and Indigenous People				N/A
	14	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	(+1)	B^+	C^+	**Design phase:** Employment of local people is not anticipated to be hired. **Construction phase:** Local people will be employed for construction works. **Operation phase:** Employment opportunities will be offered at the power station for the local people.
	15	Land Use and Utilization of Local Resources				N/A
	16	Disturbance to Water Usage, Water Rights etc.				**N/A**
	17	Disturbance to the Existing Social Infrastructure and Services	(-1)	B-	D	**Construction phase:** Traffic volume will increase during construction. **Operation phase:** Traffic volume will not increase after construction.
	18	Social Institutions such as Social Infrastructure and Local Decision-making Institutions				N/A
	19	Misdistribution of Benefits and Damages	(+1)	D	C^+	**Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	20	Local Conflicts of Interest				N/A
	21	Cultural Heritage	-	D	D	There is no historical, cultural and archaeological property and heritage existing on and around the site.

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
	22	Landscape	-	D	D	There is no such picturesque scenery existing on and around the site.
	23	Gender				N/A
	24	Children's Rights	(+1)	D	C^+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout the year if electricity conditions are improved.
	25	Infectious Diseases such as HIV/AIDS	(-1)	B^-	D	**Construction phase:** A temporary influx of migrant labor during construction period may increase the risk of sexual transmitted diseases and others.
	26	Working environment (including working safety)	(-1)	B^-	D	**Construction phase:** Risk of accident is predicted in construction work. **Operation phase:** Work accident of workers may not happen.
Others	27	Accidents	(-1)	B^-	D	**Construction phase:** Accident during construction work may happen caused by attacks of reptile. **Operation phase:** Traffic accidents due to increased traffic may not happen.
	28	Cross-boundary impact and climate change	(+1)	D	C^+	**Construction phase:** CO_2 will be generated by construction work, but no impact on climate change is predicted. **Operation phase:** CO_2 will not be generated by operation work and desirable impact on climate change is predicted.

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

(- 1): Minor impacts but not serious

(+1): Positive impact but not large

Table 1-3 Result of Scoping for Transmission Line

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
Pollution mitigation measure	1	Air pollution	(-1)	C^-	D	**Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area. **Operation phase:** No specific air pollution is anticipated.
	2	Water pollution	(-1)	C-	D	**Construction:** Water turbidity is anticipated by excavation work, but the impact will be temporary. **Operation phase** No specific Water pollution is predicted.
	3	Soil pollution	(-1)	C^-	D	**Construction phase:** Possibility of soil pollution caused by leakage of lubricant and fuel oil from construction

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
						vehicles and machines. **Operation phase:** No Possibility of soil pollution caused by leakage of lubricant and fuel oil used for the unit operation.
	4	Sediment pollution	(-1)	C-	D	**Construction phase:** Possibility of sediment pollution in case construction wastewater flows into the river. **Operation phase:** No Possibility of sediment pollution caused by plant wastewater and domestic wastewater.
	5	Noise and Vibration	(-1)	C-	D	**Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area. **Operation phase:** No specific noise and vibration is anticipated.
	6	Waste	(-1)	C-	D	**Construction phase:** general waste and hazardous waste is generated by the construction work. **Operation phase:** general waste and hazardous waste is not generated.
	7	Oder	-	-	-	**N/A**
	8	Ground subsidence	-	-	-	**N/A**
Natural environment	9	Natural reserve	-	D	D	**Construction phase and Operation phase:** There is no specific impact on the protected forest as no logging.
	10	Ecosystem	-	-	-	N/A
Social environment	11	Resettlement	-	-	-	N/A
	12	Disturbance to Poor People	(+1)	D	B+	**Design phase:** No impacts to surrounding people of Project are anticipated. **Operation phase:** They will have better lives and access to social services throughout the year if electricity conditions are improved.
	13	Disturbance to Ethnic Minority Groups and Indigenous People	-	-	-	N/A
	14	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	(+1)	B+	C+	**Design phase:** Employment of local people is not anticipated to be hired. **Construction phase:** Local people will be employed for construction works. **Operation phase:** Employment opportunities will be offered at the power station for the local people.
	15	Land Use and Utilization of Local Resources	-	-	-	N/A
	16	Disturbance to Water Usage,	-	-	-	N/A

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
		Water Rights etc.				
	17	Disturbance to the Existing Social Infrastructure and Services	-	C^-	D	**Construction phase:** Traffic volume will increase during construction. **Operation phase:** Traffic volume will not increase after construction.
	18	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	-	-	-	**N/A**
	19	Misdistribution of Benefits and Damages	(+1)	D	C+	**Construction phase and Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	20	Local Conflicts of Interest	-	-	-	N/A
	21	Cultural Heritage	-	-	-	N/A
	22	Landscape	-	-	-	N/A
	23	Gender	-	-	-	**N/A**
	24	Children's Rights	(+1)	D	C+	**Design phase and Construction phase:** There is no specific negative impact anticipated to Children's Rights. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	25	Infectious Diseases such as HIV/AIDS	(-1)	B^-	D	**Construction phase:** A temporary influx of migrant labor during construction period may increase the risk of sexually transmitted diseases and others.
	26	Working Conditions(including working safety)	(-1)	B^-	D	**Construction phase:** High risk of accident is predicted in construction work during rainy season. **Operation phase:** There is no risk of accident.
Others	27	Accidents	(-1)	B^-	D	**Construction phase:** Accident during construction work may happen caused by attacks of reptile.
	28	Cross-boundary impact and climate change	-	D	D	Cross boundary and CO_2 emission are not anticipated concerning the transmission line.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.
(- 1): Minor impacts but not serious
(+1): Positive impact but not large

1-3-6 TOR for Survey on Environmental and Social Conditions

Contents of Initial Environmental Examination (IEE) are as shown below:

Table 1-4 Contents of Survey and Methodology for Compilation of IEE

Category	NO	items	contents（plan）
Pollution Mitigation measure	1	（Air Pollution） -Environmental standard -State of Air Condition	-National ambient Air Quality Standards, Emission Standards -Meteorological record（Temperature, General weather condition）
	2	（Water Pollution） - Environmental standard - State of Water Condition	- National ambient Water Quality Standards, Discharge Standards -Data of river（Temperature, BOD, SS）
	3	（Noise, Vibration） - Environmental standard -State of Noise ,Vibration Condition	- National Standards on Noise, Vibration -Data of Noise, Vibration
	4	（Odor） - Environmental standard	Monitoring of Odor and countermeasures
	5	（Waste） - Environmental standard	Guideline for Waste Treatment
Natural environment	6	（Protected Ares） -State of habitat on Fauna, Flora	Distribution of Fauna and Flora
	7	（Ecosystem） -State of important habitat	Confirmation of distribution of rare species
Social environment	8	（Water usage） State of usage of river	-confirmation of irrigation - Interview to affected people
	9	（Cultural heritage） - State of Cultural heritage	-Concerned data
	10	（Landscape） -State of Landscape	-Concerned data
Others	11	Impacts to nature and mitigation	Describing it concretely in EMP
	12	Impacts to social and mitigation	Describing it concretely in EMP
	13	Compiling Environmental Monitoring Plan	Describing it concretely in EMP (including items, terms, cost, institution for implementation)

1-3-7 Results of Survey on Environmental and Social Considerations

(1) Natural Environment

There are no protection areas in and near the Project site which are designated by the country's laws or international treaties and conventions, and impacts to terrestrial ecosystems in and near the Project site are of a negligible level.

(2) Social Environment

There is neither involuntary resettlement nor issues about poverty groups, ethnic minorities and indigenous groups which should be paid particular attention before commencements of the Project.

Table 1-5 List of Plants Identified in and Near Project Site

No	Scientific Name	English Name	Local Name	IUCN	Law
1	*(eguminosae) Acacia nilotica*	Egyptian Mimosa	Chiwriri	No	No
2	*Brachystegia boelunii*	Prince of Wales Feathers	Mombo	No	No
3	*Combretum zeyheri*	African Bushwillow	Kalamafupa	No	No
4	*Terminalia stenostachya*	-	Mkunkhu	No	No
5	*(Bignoniacea) Kigelia africana*	Sausage tree	Mvunguti	No	No
6	*Caesalpinioideae Cassia abbreviata*	-	Mhalamira	No	No
7	*Rhizophoraceae Anisophyllea boehmii*	-	Mfungo	No	No
8	*Mimosoideae Acacia xanthophloea*	Fever tree	Nchezime	No	No
9	*Anacardiaceae Sclerocarya birrea*	Amalula	Mfula	No	No
10	*Papilionoideae Dalbergia melanoxylon*	Ebong	Mphingo	No	No
11	*Minosoideae Dichrostachys cinerea*	-	Kampangala	No	No

No	Scientific Name	English Name	Local Name	IUCN	Law
12	*Apocynaceae Diploxhynchus condylocarpon*		Thombozi	No	No
13	*Euphorbia ingens*	Naboom	Mokgoro	No	No
14	*Neptunia oleracea*	Water Mimosa	-	No	No
15	*Cordyla africana*	Bush mango	Mtondo	No	○
16	*Combretum molle*	Butterfly tree	Tsanya	No	○
17	*Dichrostachys cinerea*	Egyptian Mimosa	-	No	No

(Source: Results of hearing survey from local people by JICA Study Team)

Table 1-6 List of Animals Identified in and Near Project Site

class	No.	Scientific Name	English Name	Local Name	IUCN	Law
Mammal	1	*Chlorocebus aethiops*	Vervet Monkey	Nyani	No	No
	2	*Lupus saxatilis*	Scrub hare	Kalulu	No	No
Reptile	1	*Crocodylus niloticus*	Nile crocodile	Ng'ona	No	○
	2	*Hemidactylus mabouia*	Agama lizard	dududu	No	No
	3	*Gekkonidae*	Gecko	gulo	No	No
	4	*Bitis arietans*	Puff adder	mphiri	No	No
	5	*Dendroaspis polylepis*	Black mamba	-	No	No
Bird	1	*Rynchops flavirostris*	African Skimmer	-	N/T	No
	2	*Ploceus cucullatus*	Village Weaver	-	No	No
	3	*Bubulcus ibis*	Cattle Egret		No	No
	4	*Merops boehmi*	Boehm's Bee-eater	-	No	No
	5	*Estrilda astrild*	Common Waxbill	-	No	No
	6	*Actitis hypoleucos*	Common Sandpiper	-	No	No
	7	*Corvus albus*	Pied Crow	Khwangwala	No	No

class	No.	Scientific Name	English Name	Local Name	IUCN	Law
Fish	1	*Clarias gariepinus*	Catfish	Mlamba	No	No
	2	*Barbus ssp*	Barbel steed	Matemba	No	No
	3	*Oreochromis mossambicus*	Cichlid	Chambo	No	No

(Source: Results of hearing survey from local people by JICA Study Team)

1-3-8 Environmental Evaluation

An evaluation of adverse impacts predicted by the implementation of the Project and appropriate countermeasures to avoid or minimize such adverse impacts are listed in Table 1-7.

Table 1-7 Anticipated Impacts and Mitigation Measures (Hydropower Station and Transmission Line)

Category	Items	Ev.	Anticipated Impacts	Mitigation measures
Pollution Mitigation measure	Air pollution	(-1)	: **Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area	Control of dust by water sprinkling.
	Water pollution	(-1)	: **Construction phase:** Water turbidity is anticipated by excavation work, but the impact will be temporary. The impact of concrete waste water and oil-containing wastewater is anticipated.	Turbid water will be discharged into river after purification in pond.
	Soil pollution	(-1)	: **Construction phase:** Water turbidity is anticipated by excavation work, but the impact will be temporary. The impact of concrete waste water and oil-containing wastewater is anticipated.	Daily maintenance of trucks and heavy machines for prevention of oil leakage.
	Sediment pollution	(-1)	: **Construction phase:** Possibility of sediment pollution in case construction wastewater flows into the river.	Enforcement of discharge after purification in pond.
	Noise and Vibration	(-1)	: **Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area.	Adoption of Speed control of construction trucks for reducing Noise problem.
	Odor	(-1)	: **Construction phase:** In case domestic waste from the workers' room was not appropriately treated, bad smell of rotten waste may occur.	Giving advice to workers for appropriate treatment of waste.
	Waste	(-1)	: **Construction phase:** general waste and hazardous waste is generated by the construction work.	Enforcement of appropriate treatment based on local rule.

Category	Items	Ev.	Anticipated Impacts	Mitigation measures
Natural environment	Ecosystem	(-1)	**: Operation phase:** Impact to the fresh fish is predicted at water-decreased area during dry season.	Ensuring sufficient outflows at Gate to compensate for water loss on Dry season.
Social environment	Infectious Diseases such as HIV/AIDS	(-1)	**Construction phase:** A temporary influx of migrant labor during construction period may increase the risk of sexual transmitted diseases and others.	Giving educational program to workers
	Working environment (including working safety)	(-1)	**Construction phase:** High risk of accident is predicted in construction work.	Enforcement of secure works
	Disturbance to the Existing Social Infrastructure and Services	(-1)	**Construction Phase:** Traffic volume will increase during construction.	Enforcement of softly road condition by setting road sign or guidance by security guard.
Others	Accidents	(-1)	**Construction phase:** Accident during construction work may happen	Enforcement of secure works

Note: (-1): Minor impacts but not serious

1-3-9 Environmental Management Plan, Environmental Monitoring Plan and Implementation Budget

(1) Environmental Management and Monitoring Plan (EMP)

ESCOM as Project owner is required to prepare a Project Environmental Management Plan (EMP) and Environmental Management Monitoring Plan (EMMP) for construction of the Tedzani IV Hydropower station and transmission line with substation, which indicates how a contractor will implement mitigation measures and monitoring, as required under recommendations attached with "*Certificate of Exemption of EIA*" issued by the director of Environmental Affairs Department (EAD) of Ministry of Environment and Climate Change Management (MOECM) on 25th July,2013.

These plans of EMP and EMMP are to identify the work undertaken and documents for any environmental problems encountered during the reporting period on the environmental protection or mitigation measures adopted to resolve such problems, and any follow-up actions required to correct such problems.

Table 1-8 shows items to be managed, the duration of management and needed budget to carry out Environmental Management Plan.

Table 1-8 Environmental Management Plan (Hydropower Station and Transmission Line)

(Note: I=Pre-Construction Period, II=Construction Period, III=During Operation Period of Three Years)*

*(Note:**= Including Pre-construction Phase)*

Item	Potential Impact	Countermeasure to be taken	Responsibility	Duration*			Budget (Countermeasure Cost) (MWK)
				I	II	III	
Environmental							
Water Quality	Contamination to local waterways from construction sites	Not to discharge domestic waste water directly into waterways. Establishment of a sedimentation pond to lie down and purify turbid water. Install sediment traps on natural drainage paths. Heavy machinery should not be washed near waterways. Use well serviced heavy machinery and vehicles to minimize oils spills and leakages. Locate storage areas for fuels and lubricants away from natural drainage.	ESCOM/Contractor		○	○	250,000.00
Air Quality (Dust)	Increased Dust from construction vehicles	Use water trucks during dry season on access or public roads where construction vehicles will travel. Limit working period to daytime. Cover stockpiles of soil and sand.	ESCOM/Contractor		○		200,000.00

Air Quality (Noise)	Increased Noise from construction vehicles	Ensure loud vehicles or any earthmoving is conducted during the daytime at acceptable hours, e.g. 9am-5pm.	ESCOM/Contractor		○		Under-construction/operation cost
Aquatic Life**	Loss or deterioration of aquatic life	Ensure no contaminants or toxic waste is disposed of in or near waterways.	Contractor	○	○	○	Under-construction/operation cost
Wildlife**	Loss or deterioration of local wildlife	Ensure no hunting of wildlife by employing ranger and education programs. Education programs to workers on nature conservation.	Contractor	○	○	○	Under-construction/operation cost
Flora**	Loss or deterioration of local flora species	Avoid removal of any unnecessary vegetation. Education programs to workers on nature conservation. Re-vegetation of the cleared land with indigenous plants.	Contractor	○	○	○	100,000.00
Hazardous Waste	Disposal of hazardous waste into waterways or surrounding environment	Ensure hazardous waste is stored and disposed of by qualified contractors.	ESCOM /Contractor/ Blantyre District Council		○		Under-construction cost

Solid and Domestic Waste	Disposal of solid or domestic waste into waterways or surrounding environment	The use of septic tanks for toilets and bathrooms. Employ certified garbage persons and recycle paper and plastics. Solid waste should be taken to appropriate land fill sites and education programs for public sanitation would be held periodically.	ESCOM /Contractor/ Blantyre District Council		○		800,000.00
Soil Erosion	Erosion of riverbanks or road sides	Conduct Bank stability and re-vegetation and silt trap. Re-vegetation of the cleared land with indigenous plants.	Contractor		○	○	100,000.00 and Under-operation cost
Social							
Road Safety	Road accidents due to increased traffic	Correct signage including speed limits (40km/hr), warnings and humps on roads around Project site. Provide safety education to the employees on road safety.	ESCOM/Contractor		○		Under-construction/operation cost
River Hydrology	Changes in the river flow	Maintaining of minimum flow to downstream.	ESCOM/Contractor		○		Under-construction/operation cost

Worker Health and Safety (Public Health)	Risk of worker health and safety from poor sanitation and disease.	Regular health checks for all workers, and education programs. Provide appropriate personal Protective Equipment to all workers. Subject the site to occupational safety and health inspection by government of officials. Raise awareness among the workforce on the dangers of STIs and HIV & AIDS. Provide well stocked first aid kits. Clearly display an abstract of Occupational Health, Safety and Welfare Act on notice boards. Provide toilets and other welfare facilities such as showers.	ESCOM/Contractor		○	○	1,300,000.00
Village Health and Safety	Risk of village health & safety due to Project.	Ensure adequate education about the Project and construction of fencing around high risk areas	Contractor		○		Under-construction cost

National Economic Development	Increased employment opportunities	Ensure gender balance in the composition of employees at all levels. Employ people from the surrounding area. Offer realistic wages to employees. Give a fair chance of job opportunities to people from the area surrounding the Project site. Be transparent in the bidding process of any outsourced services. Ensure improved energy supply to industries and the people of Malawi.	ESCOM/Contractor		○	○	Under-construction/operation cost
Total							**2,750,000.00**

(2) Environmental Management Monitoring Plan (EMMP)

Project owner is also responsible for preparing a comprehensive monitoring plan which ensures the application and effectiveness of mitigation measures not only on natural environmental issues but also social environmental issues described in the Environmental Management Plan (EMP).

The monitoring plan, which should be implemented during the construction and operation phase by Project owner, is shown in Table 1-9, and the attached Monitoring Form (Table 1-12 and Table 1-13) is to be used to report results to JICA.

Table 1-9 Environmental Monitoring Plan (Hydropower Station and Transmission Line)

Item	Detailed	Area	Times (duration)	Authority in Charge	Budget
-Construction-					
Environment (Pollution, Natural)					
Air Quality	Noise/Dust	Near Project site Near Villages	1/0.5M	Contractor	600,000.00
Water Quality	pH,SS,DO	Project site	1/0.5M	Contractor	200,000.00
Aquatic	Fish/plant	Project site	1/1M	Contractor	100,000.00
Wildlife	Monkey Crocodile	Project site	1/3M	Contractor	100,000.00
Flora	Indigenous species	Project site	1/6M	Contractor	100,000.00
Hazardous Waste	Heavy metal	Project site	1/0.5M	Contractor	100,000.00
Domestic Waste	Domestic Waste	Project site	1/0.5M	Contractor	250,000.00
Erosion	Soil Erosion	Slope of nearby channel	1/0.5M	Contractor	200,000.00
Social					
Road Condition	Road facilities	Near Villages	1/0.5M	Contractor	100,000.00
Worker's Condition	Worker' working Condition	Project site	1/1D	Contractor	330,000.00
Public Health	Public Health	Near Villages	1/3M	Contractor	500,000.00

Item	Detailed	Area	Times (duration)	Authority in Charge	Budget
-Operation-					
Environment (Pollution, Natural)					
Water Quality	Ph,SS,DO	Downstream	1/0.5M 3-years	ESCOM	600,000.00
Aquatic	Fish/Plant	Project site	1/1M 3-years	ESCOM	300,000.00
Wildlife	Monkey Crocodile	Project site	1/3M 3-years	ESCOM	300,000.00
Flora	Indigenous species	Project site	1/6M 3-years	ESCOM	300,000.00
Erosion	Soil Erosion	Slope of nearby channel	1/0.5M 3-years	ESCOM	600,000.00
Social					
Public Health	Public Health	Project site	1/6M 3-years	ESCOM	300,000.00
Grievance	Grievance redress	Concerned people	As on demand 3-years	ESCOM	300,000.00

(3) Estimated Budget for implementation of Environmental Management Plan and Environmental Monitoring Plan

1) Environmental Management Plan Budget Estimate

The estimated cost to implement each item described in the Environmental Management Plan such as investigation cost and mitigation cost is shown below in Table 1-10.

Table 1-10 Environmental Management Plan Budget

Project Name / Budget (MWK)	Hydropower Station and Transmission line(including Sub-Station)
Implementation Cost for Environmental Management Plan (EMP)	2,750,000.00
Total	**2,750,000.00**

2) Monitoring Budget Estimate

Monitoring budgets are estimated based on the Project degree of complexity which intern determines the frequency of monitoring activities.

Number of sectors or authorities responsible for the monitoring is also related to such complexity of the Project.

Table 1-11 shows the total monitoring budget to implement such items shown in Table 1-12.

Table 1-11 Monitoring Budget estimated

Project Name / Budget (MWK)	Hydropower Station and Transmission line(including Sub-Station)	
	Construction phase	Operation phase
Implementation Cost for Environmental Monitoring Plan (EMMP)	2,580,000.00	2,700,000.00
Total	**5,280,000.00**	

Table 1-12 MONITORING FORM (Pre-construction phase, Construction phase)

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
ex.) Responses/Actions to Comments and Guidance from Government Authorities	

2. Mitigation Measures

- Water Quality（Effluent/Wastewater/Ambient Water Quality）

Item	Unit	**Measured Value（Mean）**	**Measured Value（Max.）**	**Country's Standards**	**Referred International Standards (WHO)**	**Remarks (Measurement Point, Frequency, Method, etc.)**
pH				6.00-9.5	6.5-8.5	
SS (Suspended Solid)	mg/l			0-20	No	
DO	mg/l			No	No	

- Waste

Monitoring Item	Monitoring Results during Report Period
Domestic Waste	
Industrial Waste	

- Noise / Vibration

Item	**Unit**	**Measured Value（Mean）**	**Measured Value（Max.）**	**Country's Standards**	**Referred International Standards (WHO)**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Noise level	dB				70dB	

3. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Impacts to Valuable Species (*Monkey, Crocodile)*	
Impacts to Indigenous Species Plants	
Impact to Fish & Aquatic Valuable Plants	

- Geology

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Slope Failures (Erosion) / Landslides	

4. Social Environment

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Road Condition	
Worker's Condition	
Infectious Diseases	

Table 1-13 MONITORING FORM (Operation phase)

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
ex.) Responses/Actions to Comments and Guidance from Government Authorities	

2. Mitigation Measures

- Water Quality（Effluent/Wastewater/Ambient Water Quality）

Item	Unit	**Measured Value（Mean）**	**Measured Value（Max.）**	**Country's Standards**	**Referred International Standards (WHO)**	**Remarks (Measurement Point, Frequency, Method, etc.)**
pH				6.00-9.5	6.5-8.5	
SS (Suspended Solid)	mg/l			0-20	No	
DO	mg/l			No	No	

3. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Impacts to Valuable Species (*Monkey, Crocodile)*	
Impacts to Indigenous Species Plants	
Impact to Fish & Aquatic Valuable Plants	

- Geology

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Slope Failures (Erosion) / Landslides	

4. Social Environment

- Public Health

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Worker's Condition	
Infectious Diseases	

Table 1-14 Environmental Checklist (Hydropower Station)

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) N (b) N (c) N (d) N	(a), (b), (c) This Project is exempted from compiling EIA report by the Environmental Law, but compiling both of Environmental Management Plan and Environmental Monitoring Plan is advised/recommended as an condition of exemption Project by the Ministry of Environment. Environmental Management Plan and Environmental Monitoring Plan are compiled as IEE Report carried out by JICA Study Team spontaneously. (d)Not required

	(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) N (b) N	(a) Holding SHM is not required on EIA Exemption Project by the Environmental Law (b) No Comments from local people as Project activities are limited within developer's asset.
	(3) Examination of Alternatives	(a) Have alternative plans of the Project been examined with social and environmental considerations?	(a) Y	(a)Three alternatives are discussed with No option
2 Pollution Control	(1) Water Quality	(a) Does the water quality of dam pond/reservoir comply with the country's ambient water quality standards? Is there a possibility that proliferation of phytoplankton and zooplankton will occur? (b) Does the quality of water discharged from the dam pond/reservoir comply with the country's ambient water quality standards? (c) Are adequate measures, such as clearance of woody vegetation from the inundation zone prior to flooding planned to prevent water quality degradation in the dam pond/reservoir? (d) Is there a possibility that reduced the river flow downstream will cause water quality degradation resulting in areas that do not comply with the country's ambient water quality standards? (e) Is the discharge of water from the lower portion of the dam pond/reservoir (the water temperature of the lower portion is generally lower than the water temperature of the upper portion) planned by considering the impacts to downstream areas?	(a) N (b) – (c) – (d) N (e) N	(a)No reservoir, No dam pond (b)No discharged water from dam (c)No reservoir, no dam pond (d)No change of water flow level (e)No reservoir, no dam pond
	(2) Wastes	(a) Are earth and sand generated by excavation properly treated and disposed of in accordance with the country's regulations?	(a) Y	(a)excavated earth is used for construction materials, rest of earth is carried to other and greened

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) N	(a) No
	(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) Is there a possibility that the Project will adversely affect downstream aquatic organisms, animals, plants, and ecosystems? Are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that installation of structures, such as dams will block the movement of the migratory fish species (such as salmon, trout and eel those move between rivers and sea for spawning)? Are adequate measures taken to reduce the impacts on these species?	(a) N (b) N (c) N (d) N	(a) No (b) No (c) No impacts to downstream as maintenance flow is being kept (d) No migratory fish.
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the installation of structures, such as weirs will adversely affect the surface and groundwater flows (especially in "run of the river generation" Projects)?	(a) N	(a) No impacts to hydrologic changes as weir is small and no large water diversion
	(4) Topography and Geology	(a) Is there a possibility that reductions in sediment loads downstream due to settling of suspended particles in the reservoir will cause impacts, such as scouring of the downstream riverbeds and soil erosion? Is there a possibility that sedimentation of the reservoir will cause loss of the storage capacity, water logging upstream, and formation of sediment deposits at the reservoir entrance? Are the possibilities of the impacts studied, and adequate prevention measures taken? (b) Is there a possibility that the Project will cause a large-scale alteration of the topographic features and geologic structures in the surrounding areas (especially in run of the river generation Projects and geothermal power generation Projects)?	(a) N (b) N	(a) No reservoir, No dam pond (b) No impacts as small weir and no large water diversion

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?	(a) N	(a) No Resettlement
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b) N	(b) No 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?	(c) N	(c) No Resettlement
		(d) Are the compensations going to be paid prior to the resettlement?	(d) N	(d) No Resettlement
		(e) Are the compensation policies prepared in document?	(e) N	(e) No Resettlement
		(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?	(f) N	(f) No Resettlement
		(g) Are agreements with the affected people obtained prior to resettlement?	(g) N	(g) No Resettlement
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) N	(h) No Resettlement
		(i) Are any plans developed to monitor the impacts of resettlement?	(i) N	(i) No Resettlement
		(j) Is the grievance redress mechanism established?	(j) N	(j) No Resettlement
	(2) Living and Livelihood	(a) Is there any possibility that the Project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) Y	(a) air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts
		(b) Is there any possibility that the Project causes the change of land uses in the neighboring areas to affect adversely livelihood of local people?	(b) N	(b) electricity supply will benefits to local people (c) No river use for

		(c) Is there any possibility that the Project facilities adversely affect the traffic systems? (d) Is there any 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 the minimum flow required for maintaining downstream water uses secured? (f) Is there any possibility that reductions in water flow downstream or seawater intrusion will have impacts on downstream water and land uses? (g) Is there any possibility that water-borne or water-related diseases (e.g., schistosomiasis, malaria, filariasis) will be introduced? (h) Is there any possibility that fishery rights, water usage rights, and common usage rights, etc. would be restricted?	(c)N (d) Y (e) Y (f) N (g) N (h) N	transportation, no causes of potential traffic jam (d) public health education will be given to construction workers. (e) maintenance water flow is planned (f) No change in the water flow level, Project area is far from sea (g) No possibility as Project has not created detention basin (h) No fishery rights, water usage rights at the river near Project site
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) N	(a) there are no places such as religious heritages
	(4) Landscape	(a) Is there a possibility that the Project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) there are no places such as landscapes designated by laws
	(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 to be respected?	(a) N (b) N	(a) No anticipated adverse impacts to ethnic minorities (b) No anticipated adverse impacts to ethnic minorities

	(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) Y (b) Y (c) Y (d) Y	(a) adequate measures are written in IEE and to be implemented (b) adequate measures are written in IEE and to be implemented (c) adequate measures are written in IEE and to be implemented (d) At local office level (ESCOM) , adequate measures is to be planned
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) Y (b) N (c) N	(a) air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts (b) No impacts to surrounding natures as Project does not need big civil works (c) No counter measures as no impacts to social environment
	(2) Accident Prevention Measures	(a) Is a warning system established to alert the inhabitants to water discharge from the dam?	(a) N	(a) No dam

	(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) Y (b)Y (c) Y (d) N	(a) Compiling monitoring plan and its implementation is mandatory, items having possibility of adverse impact will be monitored (b) adequate items are written in IEE and to be implemented (c) At local office level (ESCOM) , adequate measures is to be planned (d)these items are not being identified by Law and Guideline for the EIA Exception Project, but results of monitoring is supposed to submit regularly to DOE
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., Project in the mountains including large areas of deforestation). (b) In the case of dams and reservoirs, such as irrigation, water supply, and industrial water purposes, where necessary, pertinent items described in the Agriculture and Water Supply checklists should also be checked. (c) 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).	(a) N (b) N (c) Y	(a) No logging as there are no forest near Project site (b) No reservoir or dam pond (c) Checklist for T/L is being compiled

	Note on Using Environmental Checklist	(a) If necessary, the impacts to trans boundary or global issues should be confirmed (e.g., the Project includes factors that may cause problems, such as trans boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No impacts to global issues as a small Project with no impacts to environment

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 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 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.

Table 1-15 Environmental Checklist (Transmission Line)

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) N (b) N (c) N (d) N	(a), (b), (c) This Project is exempted from compiling EIA report by the Environmental Law, but compiling both of Environmental Management Plan and Environmental Monitoring Plan is advised/recommended as an condition of exemption Project by the Ministry of Environment. Environmental Management Plan and Environmental Monitoring Plan are compiled as IEE Report carried out by JICA Study Team spontaneously. (d)Not required
	(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?	(a) N	(a) Holding SHM is not required on EIA Exempted Project by the

		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b) N	Environmental Law (b) No Comments from local people as Project activities are limited within developer's asset.
	(3) Examination of Alternatives	(a) Have alternative plans of the Project been examined with social and environmental considerations?	(a) N	(a) No discussion as transmission line and substation is small scale size and not anticipated impacts to environment
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) N	(a) No cutting of earth and turbidity water will be discharged into the river after purification in pond.
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) N	(a) No

	(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) N (b) N (c) N (d) N (e) N (f) N	(a)surrounding of Project site is mainly man-made forest and shrubbery (b) Not included (c)No impacts to ecosystem (d) No obstruct to animals behavior, habitats (e) No anticipated adverse impact to ecosystem (f) Project site is being developed and no loss of natural resources
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 to prevent soil runoff?	(a) N (b) N (c) N	(a) No possibility of erosion as Project site of transmission line is flat and stable slope area (b) No large cutting or filling of earth (c) No large cutting or filling of earth, but re-vegetation will be carried out
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	(a) N	(a) No resettlement

		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?	(b) N (c) N (d) N (e) N (f) N (g) N (h) N (i) N (j) N	(b) No resettlement (c) No resettlement (d) No resettlement (e) No resettlement (f) No resettlement (g)No resettlement (h)No resettlement (i) No resettlement (j) No resettlement
	(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?	(a) N (b) N (c) N	(a) electricity supply not gives adverse impacts (b) safety and public health education will be done (c) No impacts as not so long power line and just 3 towers with height of 30m (d) No houses under

		(d) Are the compensations for transmission wires given in accordance with the domestic law?	(d) N	transmission lines
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) N	(a) there are no places such as religious heritages
	(4) Landscape	(a) Is there a possibility that the Project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) there are no places such as landscapes designated by laws
	(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) N (b) N	(a) Not anticipated adverse impacts to ethnic minorities (b) Not anticipated adverse impacts to ethnic minorities
	(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) Y (b) Y (c) Y (d) Y	(a) adequate measures are written in IEE and to be implemented (b) adequate measures are written in IEE and to be implemented (c) adequate measures are written in IEE and to be implemented (d) adequate measures are to be planned at local office level (ESCOM),

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)?	(a) Y	(a) air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b) N	(b) No impacts to surrounding natures as Project not needs big civil works
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(c) N	(c) No counter measures as no impacts to social environment
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	(a) Y	(a) Compiling monitoring plan and its implementation is mandatory, items having possibility of adverse impact will be monitored
		(b) What are the items, methods and frequencies of the monitoring program?	(b) Y	(b) adequate items are described in IEE
		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c) Y	(c) At local office level (ESCOM) , adequate measures are to be planned
		(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	(d) N	(d) these items are not being identified by Law and Guideline for the EIA

		regulatory authorities?		Exception Project, but results of monitoring is supposed to submit regularly to DOE
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) N	(a) impacts to existing road is not anticipated
	Note on Using Environmental Checklist	(a) If necessary, the impacts to trans-boundary or global issues should be confirmed, (e.g., the Project includes factors that may cause problems, such as trans-boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No impacts to global issues as a small Project with no impacts to environment

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.

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Project Site

The Project target site is an extension to the Tedzani Hydropower Station located in Blantyre District in Southern Region.

Figure 2-1 Project Site Map

2-1-2 Overall Goal and Project Goal

The objectives of the Project are as follows:

① Overall Goal: Stabilization and improvement in reliability of power supply in Malawi
② Project Goal: Extension of Tedzani Hydropower station

2-1-3 Project Implementation Setup

① Responsible government agencies: Department of Energy (DOE), Ministry of Energy and Mining
② Implementation agency: Electricity Supply Corporation of Malawi (ESCOM)

2-2 Outline of the Project

2-2-1 Policy of the Design

2-2-1-1 Basic Policy

In compiling the basic power generation plan for the Project, the optimum plan will be compiled based on comparative examination upon considering natural and environmental conditions, the relationship with existing power stations, and the relationship with existing power systems, etc.

In hydropower planning, the basic power generation plan forms the core of the Project, and it is thus important to compile the optimum plan upon comprehensively judging the river flow rate, power supply and demand situation, condition of existing systems, and beneficial effects, etc.

In the Project, in addition to the above points, it is necessary to consider the following kind of location conditions:

① The Project site is a basin sandwiched between existing power generating facilities and Shire River.
② The existing Tedzani hydropower station complex is a core power source in Malawi, so it will be necessary to avoid or minimize reductions in power from the existing power station and impacts on existing equipment during the works period and operating period.
③ The Project site constitutes complex and uneven terrain with lots of minor undulations.
④ Available water for the Project is the water that remains following intake for the existing power station. Because the useable head is smaller than the head used by the existing power station, it will be necessary to give priority to operation of the existing plant, however, so far only the residual flow has been determined and the actual flow used by the existing power station isn't clear.
⑤ Since the Project will entail integrated operation with an existing power station, restrictions will be imposed in terms of control method and transmission capacity, etc.

In compiling the basic power generation plan, since it will be difficult to unambiguously decide the optimum plan due to the large number of abovementioned factors that need to be considered, in this Preparatory Study, the following policy and procedure will be followed in arriving at the optimum power generation plan.

2-2-2 Basic Plan

2-2-2-1 Generation Plan

(1) Comparative Examination of Headrace Type and Route

In order to avoid impacting existing facilities in the Project (hereafter referred to as Tedzani IV), the water intake position will be placed downstream of the existing dam, and the outfall will be installed upstream of the existing I and II power stations.

The headrace over this interval can either be a pressure tunnel similar to that used for the existing TedzanI power station, or an open channel that conveys water in line with the terrain (See Figure 2-2).

The open channel option entails installing the open channel along contour lines with foundation elevation of EL308 m after the intake, and carrying water over a distance of 699 m to the head tank. Also, it is planned to install a penstock over inclined land over a distance of 109 m to the powerhouse.

The pressure tunnel option entails building a reservoir approximately 80 m from the intake, and directing water from here to the pressure tunnel by means of a bell-shaped intake and vertical shaft of approximately 15 m in the center of the reservoir. It is planned to install a pressure adjusting tank approximately 550 m downstream and from there convey water to the powerhouse via an underground penstock of approximately 87 m.

Table 2-1 shows the results of comparing both routes assuming provisionally maximum water usage of $70m^3/s$ and effective head of approximately 37 m. Power output is almost the same in both cases at around 21,700kW, however, construction cost is approximately 3.4 billion yen in the open channel plan compared to 4.4 billion yen in the pressure tunnel plan, clearly indicating that the open channel plan is more advantageous.

Accordingly, it was decided to adopt the open channel alternative for the power generation route.

Table 2-1 Headrace Type and Route

Specification	Open Channel	Pressure Tunnel
Length(m)	699	550
Water Flow(m^3/s)	70	70
Usable Head(m)	36.85	36.55
Output(kW)	21,700	21,600
Cost(¥)	34.2	43.6

(Note) The above-mentioned numerical value is provisional figure in comparatively investigate stage, be careful about differing from the final design.

Table 2-2 Project Plan

Works	Items	Features
Civil Works	Generation method	Run of river
	Gross head	40.760m
	Effective head	37.0m
	Maximum discharge	70 m^3/s
	Installed capacity	21,800 kW (1unit)
	Annual generated energy	170 GWh
Electro-mechanical and Transmission Line Works	Turbine	Vertical Francis turbine
	Generator	Synchronous generator
	66kV transmission line	260m
	11kV/66kV main transformer	1 unit

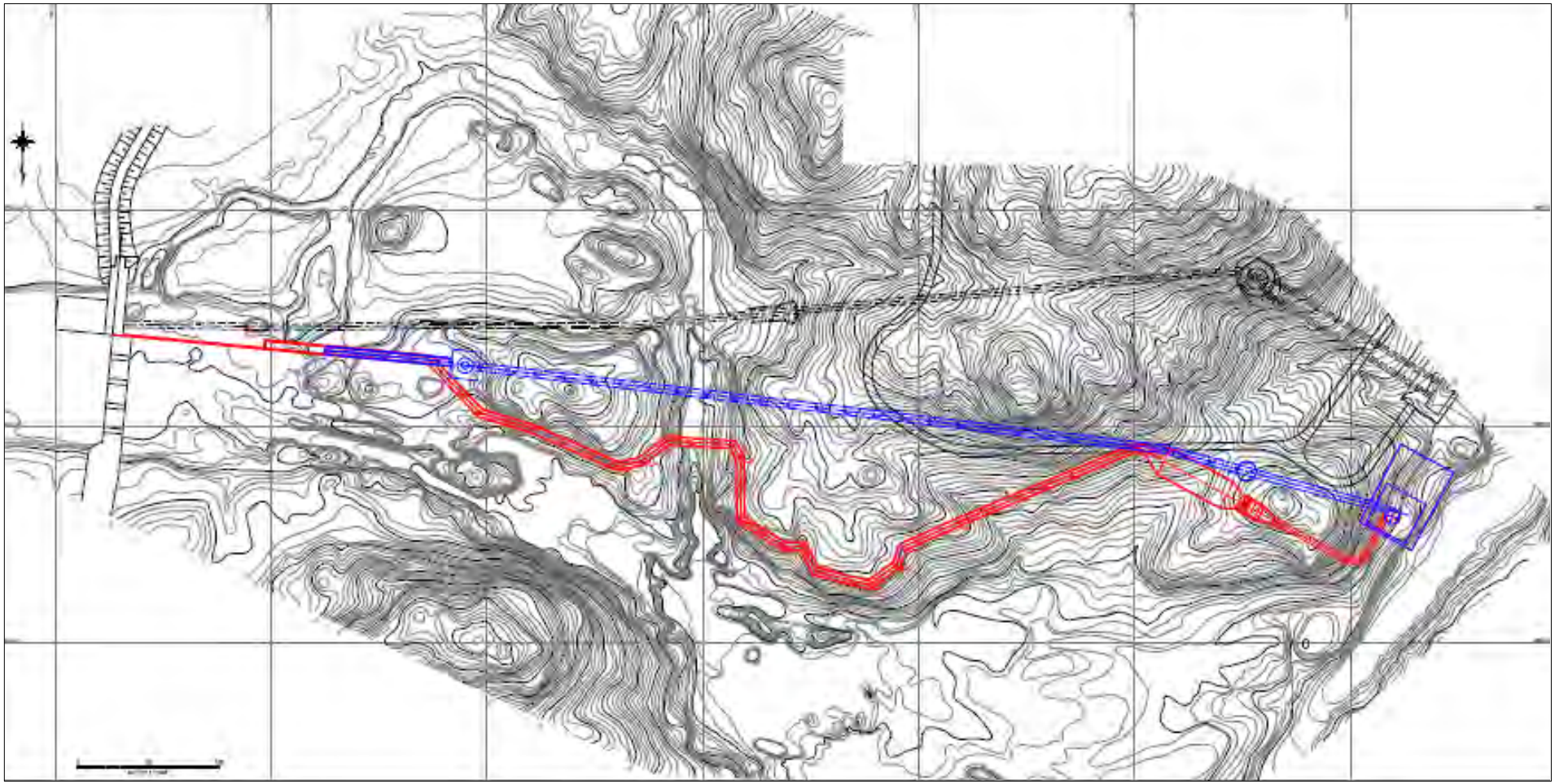


Figure 2-2 Headrace Route

(2) Available Water Flow for Power Generation

Figure 2-3 shows the flow diagram prepared from the spillway discharge flow between 2006 and 2012. The spillway discharge flow is basically the flow that isn't utilized by the existing power station, so this will be used to generate power in Tedzani IV.

Incidentally, the river maintenance flow is assumed to be $10m^3/s$ in consideration of Water Resources Board stipulations and intake for the public water supply and sewerage systems (See below).

(Maintenance flow $9m^3/s$＋Walker　Ferry intake $1m^3/s$: Total $10m^3/s$)

(3) Useable head

As a result of the first and second field surveys, the useable head of Tedzani IV power station (total head) was set as shown in Table 2-3.

Table 2-3 Usable Head

Specification	Designed Water Level& Head	Basis
Intake(EL.m)	313.76	Overflow Section Level
Tail Water(EL.m)	273.00	Tedzani III tail water level＋0.2m (370m upstream from Tedzani)
Total Head(m)	40.76	

(4) Scale of development

Table 2-4 shows the results of comparing power generation particulars and rough economy in the case where maximum water usage is varied between $60m^3/s$ and $80m^3/s$. Out of the three cases, Case-2 (maximum discharge $70m^3/s$) was selected.

Table 2-4 Alternative Plan Comparison

Specification		Case-1	Case-2	Case-3
Max. discharge	m^3/s	60	70	80
Gross head	m	40.401	40.401	40.401
Net head	m	37	37	37
Max. Generating Output	kW	18,700	21,800	24,900
Annual possible output	MWh	154.2	172.3	184.9
Annual active output (95%)	MWh	146.5	163.7	175.7
Utilization Factor	%	94	90	85
Total Cost	JPY(million)	3843.9	43.01.3	4776.6
Cost/kW	JPY(thousand)/kW	205,556	197,307	191,831
Cost/kWh	JPY(thousand)/kWh	26.2	26.3	27.2
Power Cost (12%)	JPY(thousand)/kWh	3.1	3.2	3.3

Annual possible power generation: This was calculated upon assuming the total of the river maintenance flow and intake for public water supply to be $10m^3/s$.

Active power: This was obtained by deducting 5% transmission line loss from the annual possible power generation.

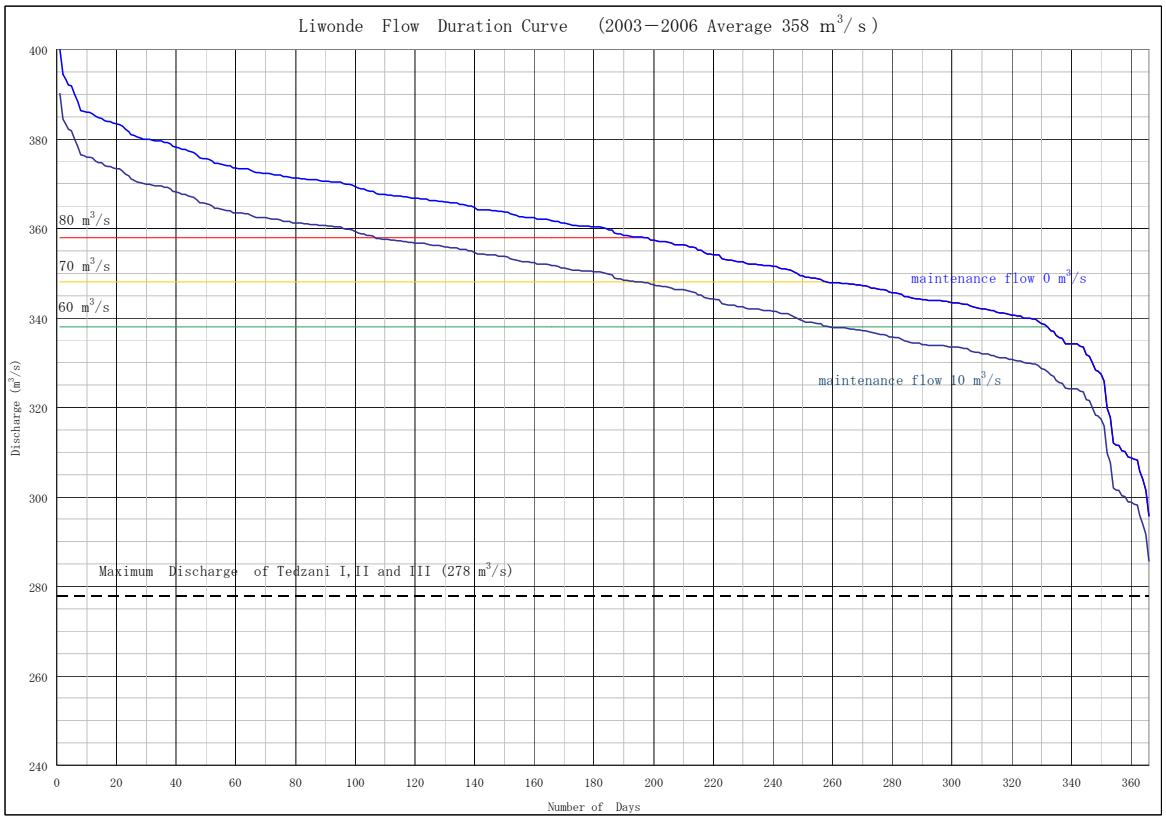


Figure 2-3 Duration Curves of Liwonde Barrage and Maximum Discharge of Tedzani Power Stations

July 2007 to June 2012

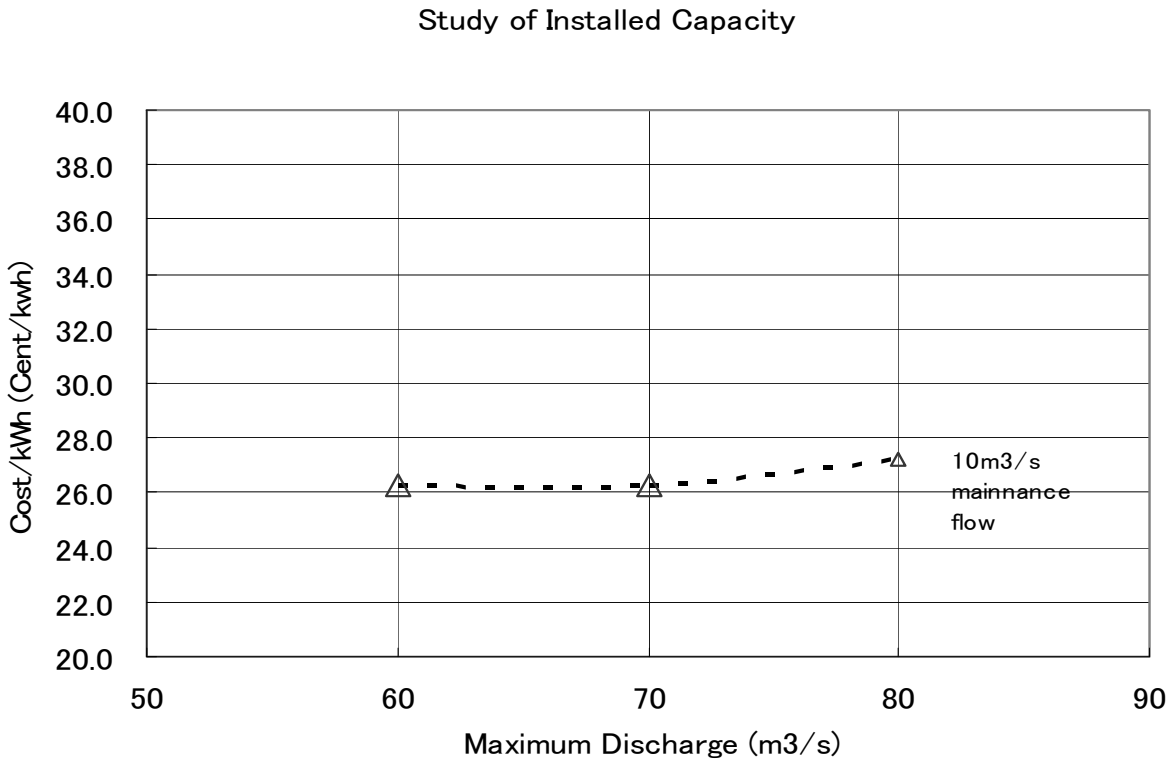


Figure 2-4 Installed Capacity Comparison

2-2-3 Outline Design of the Structure, Facilities and Equipment

(1) Basic Policy

Figure 2-5 shows the Project components. Moreover, because the powerhouse will be operated and maintained by ESCOM, which has sufficient experience regarding hydropower station management, soft component activities will not be implemented in the Project.

(2) Civil Engineering Structure

1) Intake channel and flushing channel

The water intake channel will be placed downstream of the furthest gate to the left of the existing dam so as to take water on the left bank. Because a screen for preventing inflow of driftwood and rubbish is installed upstream of the gate furthest to the left, sand removal facilities will not especially be installed, however, a scour gate and flushing channel for removing inflowing sediment will be installed.

2) Water intake

A weir will be installed over a 40 meter section downstream of the intake channel, and this will guide the designated amount of water for power generation into the forebay. A protective wall for preventing excessive inflow during flooding will be installed at the downstream end of the forebay, and a sluice gate will be installed on the downstream side of that.

It has been decided to install a screen to prevent the inflow of driftwood and garbage at the intake, however, assuming that garbage will to an extent be removed before the existing intake dam, an automatic sediment collector will not be installed. However, in cases where there is more garbage than expected, since it will be difficult to remove it manually, it will be necessary to reexamine the need for an automatic sediment collector upon investigating the garbage discharged from the existing dam in the detailed design.

3) Headrace flume

The headrace flume will be installed aboveground along contour lines on the left bank slope. The channel will basically be a box culvert structure, and maintenance manholes will be provided at intervals of around 45 m.

The channel cross section will comprise width of 5 m, height of 5 m, gradient of 1/500 and wet depth of 3.6 m. The stream located approximately 300 m from the start point will be crossed by an aqueduct bridge, and culvert will be installed over 586 m to the head tank.

As described later, the head tank spillway will be omitted, but rather a spillway will be installed between the 165 meter and 255 meter points from the start of the headrace flume, and this will directly discharge excess water from the headrace into the river.

4) Head Tank

The head tank, having width of 39.7 m, length of 87.5 m and height of 17.2 m, will be installed at the end of the headrace flume. Tank capacity of 12,720m^3, which is enough to hold the peak water usage of 70m^3/s for approximately 3 minutes, has been secured.

The head tank spillway is intended to safely discharge of excess water when the plant is not operating. Usually the spillway is installed on the head tank and the spillway channel runs parallel to the penstock, however, due to the large head, it would cost a lot of money to build both the channel and energy absorbing device.

Meanwhile, because the headrace flume in the Project is relatively short and runs close to the river, making it relatively easy to expel excess water midway along the headrace route, it has been decided to omit the head tank spillway and thus reduce costs.

5) Penstock

The penstock, having inner diameter of 4 m, will be installed over 110.9 m from the head tank to the inlet valve of the powerhouse. Moreover, it has been decided to coat the penstock pipe with concrete in order to prevent damage caused by falling sediment from the side cutting slopes and in consideration of the ease of maintenance.

6) Powerhouse Foundations

The powerhouse will be constructed aboveground, and the tube chamber will basically be constructed by digging the plant foundations into the ground rock. Revetment will be constructed around the powerhouse in order to avert inundation, etc. at times of flooding.

7) Outlet and Tailrace

The tailrace will be installed at the draft pipe outlet of the powerhouse, and the tailrace measuring 11.2 m across and 18.8 m long will be installed downstream of that in order to return discharge water from the powerhouse to Shire River.

It has been decided to omit the outfall gate for lower cost, but rather to install a stop log at the end of the tailrace as an alternative. In order to enable the stop log installation and removal work, an access road will be constructed from upstream of the powerhouse to the outfall.

8) Powerhouse Access Road

An access road measuring 7.0 m across and 218.7 m long will be constructed from the existing I and II power stations to enable the main machines and other heavy objects to be carried in. Moreover, when carrying in the main machinery to the powerhouse, since it will be necessary for trailers to reverse, turning space will be secured around the starting point of the access road. It has been decided to adopt Terre Armee retaining walls around the access road in view of the precipitous terrain and in order to reduce the quantity of concrete.

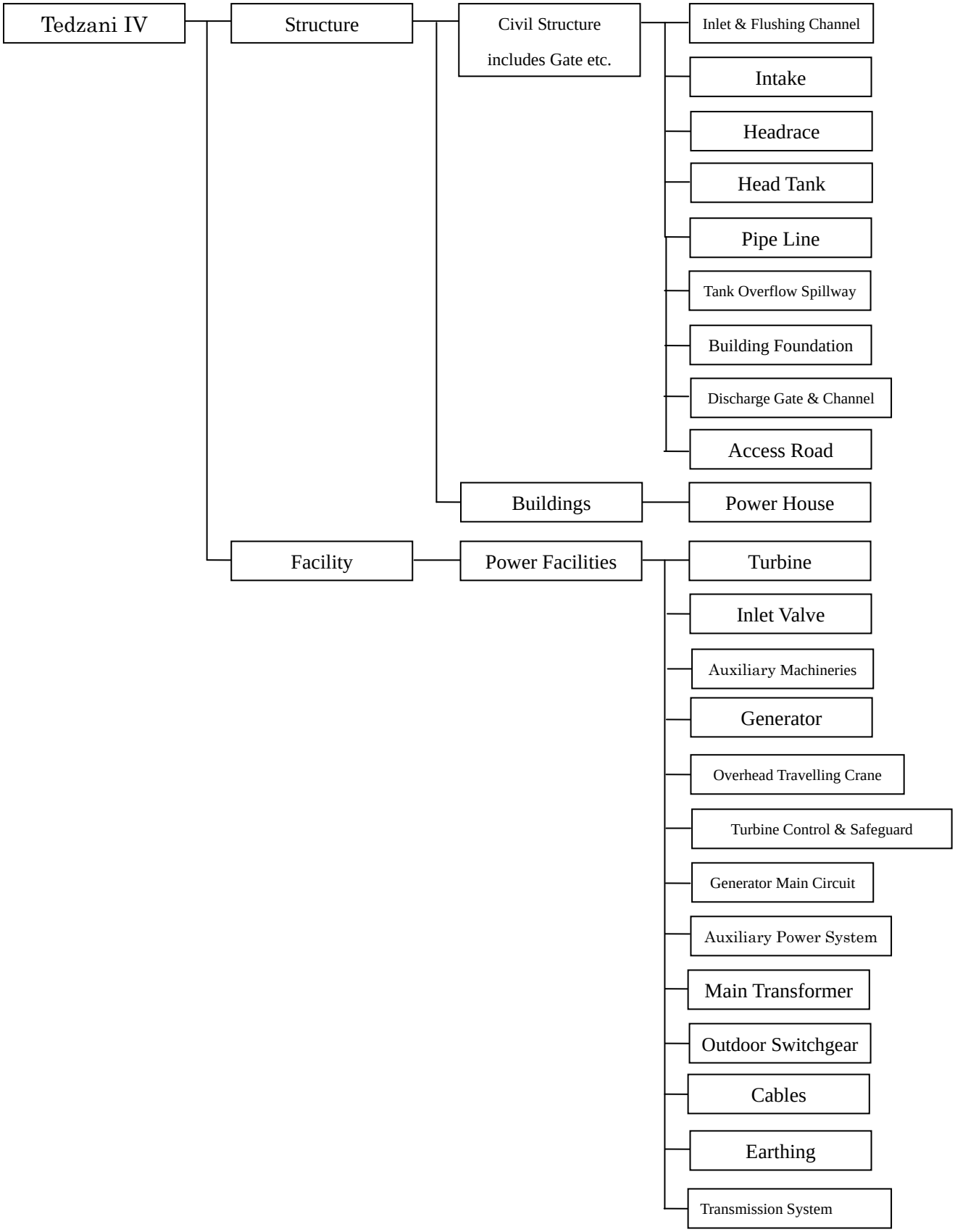


Figure 2-5 Tasks of the Project

(3) Building Facilities

The outline specifications of building Facilities have been determined as follows upon referring to the existing Tedzani III power station and Kapichira II power station. (Refer to Table 2-5)

Table 2-5 Outline Specification of Building Facilities in this Project

Item		Quantity	unit
1 Electrical Equipment			
1-1 Power Receive & Primary Power	Lighting Panel, SW Box, etc.	9	Panel
	Oblong switch box etc.	38	Unit
	FP-C, Insulated Cable, etc.	13,000	m
1-2 Lighting Equipment	Fluorescent & Guide Light etc.	269	Unit
	High Intensity Discharge Lamp	67	Unit
1-3 Light Electrical Equipment	Smoke & Fire detector	32	Unit
2 Plumbing & fire hydrant system	Stainless Steel Pipes	200	m
	PVC	100	m
	Gate Valve	36	Unit
	Lavatory	4	Unit
	Washstand	4	Unit
	Sink	2	Unit
	Conduit Pipe	100	m
	Septic Tank	1	Unit
3 Ventilating and Air Conditioning	Air Supply Unit	1	Unit
	Air Supply Control Console	1	Panel
	Exhaust fan	2	Unit
	Aeration & ventilation louver	9	Unit
	Ceiling & OA diffuser	63	Unit
	Ceiling suction port	4	Unit
	Exhaust louver	7	Unit
	Fir damper	12	Unit
	Air volume control damper	5	m^2
	Galvanized sheet iron	1,584	m^2
	Insulation work	317	m^2

1) Hydraulic turbine

In consideration of operation and ease of maintenance for the turbine, Francis type turbine, which are used for the existing Tedzani I, II & III power stations, will be applied and it will have structure to enable the runner removing from the bottom without disassembly of the generator.

(a) Type: Vertical Francis turbine
(b) Normal upper water level: 310.90 m
(c) Net head: 37.0 m
(d) Maximum turbine output: 23,000 kW
(e) Maximum turbine discharge: 70 m^3/s
(f) Rated speed: 167 min^{-1}
(g) Turbine specific speed: 277.5 m-kW

2) Turbine inlet valve

(a) Type: Biplane valve
(b) Diameter: 3,500 mm～3,800mm (to be finally decided according to the maker's recommendation)
(c) Operating method: Opening by oil pressure and closing by a counter-weight
(d) Maximum discharge: 70 m^3/s
(e) Design water pressure: 53 m

The oil pressure supply system will be commonly used for operation of the inlet valve servomotor and guide vane servomotors.

3) Mechanical auxiliary equipment

(a) Air compressor
(b) Cooling water supply system

① The cooling water supply system for the generating unit will consist of the primary water supply system and secondary water supply system. The primary system will supply water from the penstock to the secondary side cooler for cooling and discharge water to the draft tube. The secondary system will supply water through the cooler to the generating unit by using a circulating water pump.

② Clean water will be needed for the secondary side system, but this clean water supply system will be out of scope of the Project. (The system will be supplied and installed by ESCOM, and piping from the system will be connected to the secondary system inside the power house).

(c) Powerhouse dewatering and drainage system

① 2 drainage pumps for (submersible pumps)

Pump rating: Pumping head approximately 26m, drainage flow 3.9m^3/min/unit

② 2 dewatering pumps (submersible pumps)

Pump rating: Pumping head approximately 26m, drainage flow 7.8m3/min/unit

4) Generator

Based on the above turbine data, the generator ratings will be as follows:

(a) Type: Vertical type, three-phase synchronous generator, with closed air circuit with air cooler, semi-umbrella type

(b) No. of pole: 36

(c) Rated capacity: 26,600 kVA

(d) Rated speed: 167 min^{-1}

(e) Rated voltage: 11 kV

(f) Rated frequency: 50 Hz

(g) Type of excitation: Static excitation system

5) Powerhouse overhead travelling crane

(a) Crane span: Approximately 16.4 m

(b) Crane travel distance: Approximately 30 m

(c) Main hoist capacity: Approximately 1,200 kN

(d) Auxiliary hoist capacity: Approximately 100 kN

6) Unit control and protection equipment

(a) Plant supervision and control panel (control and monitoring of the overall power station)

(b) Unit control panel (start and stop control of the unit)

(c) Local control panel (control of auxiliary equipment locally installed)

(d) Protection panel (protection equipment for the unit and electrical equipment in the plant)

7) Generator main circuit equipment

(a) Generator disconnecting switch

(b) Generator neutral grounding equipment

(c) Voltage transformer and current transformer

(d) Surge absorber

8) Auxiliary power supply equipment

(a) AC power supply system (500kVA station transformer and AC distribution panel)

(b) DC power supply system (DC battery, battery charger, DC distribution panel)

(c) MCC (motor control center and auxiliary unit control)

(d) Emergency power supply will be out of the scope of supply. It has been confirmed that the existing emergency power system of Tedzani I is connected to the auxiliary power circuit of Tedzani IV

9) Main transformer

(a) Type: Three-phase, two-winding, oil- transformer, outdoor type, self-cooling type

(b) Rated capacity: 26 MVA

(c) Rated voltage: 66kV/11kV

(d) Winding connection: YNd1

(e) With on-load tap changer

10) Main transformer

(f) Type: Three-phase, two-winding, oil- transformer, outdoor type, self-cooling type

(g) Rated capacity: 26 MVA

(h) Rated voltage: 66kV/11kV

(i) Winding connection: YNd1

(j) With on-load tap changer

11) Outdoor switchgear

(a) Tedzani IV power station will be connected to Tedzani I power station via a newly installed 66kV transmission line. Accordingly, switchgear (disconnecting switch and bus line) will be installed inside Tedzani I power station, but it will be necessary to pay attention to the following points regarding design and execution:

① Because there are underground cables on the slope side of Tedzani I power station, and it is necessary to conduct large-scale civil engineering works, the switchgear will be installed on the side of the road inside the plant grounds.

② Therefore, it will be necessary to widen the site of Tedzani I power station by around 7 m in order to secure space for the plant road. Since the widening will need to be conducted over rock, blasting work will be required to ensure that no negative impacts are imparted on the existing switchgear.

③ Also, it will be necessary to move the power station entrance gate and guardroom.

(b) Outdoor switchgear to be installed in the outdoor switchyard of Tedzani IV power station

- Generator circuit breaker
- Disconnecting switch
- Earthing switch
- Lightning conductor
- Voltage transformer and current transformer

(c) Outdoor switchgear to be installed in the outdoor switchyard of Tedzani I power station

- Disconnecting switch
- Earthing switch

12) Cable equipment

(a) Power /control cables between electric devices inside Tedzani IV power station

(b) Power/control cables between electric devices installed in the outdoor switchyard of Tedzani IV power station

(c) Power/control cables between electric devices installed in the outdoor switchyard of Tedzani I power station

(d) Power/control cables between the powerhouse and outdoor switchyard of Tedzani IV power station

(e) Cables between water level gauges (head tank and tailrace) and powerhouse control equipment

13) Grounding equipment

(a) Powerhouse grounding equipment

(b) Grounding equipment for outdoor switchyard of Tedzani IV power station

14) Transmission (interconnection) equipment

As was mentioned above, as there is spare capacity on the transmitting side of Tedzani I power station, as a result of conducting adjusting with DOE and ESCOM in the second field survey, the transmission line from Tedzani IV power station will be connected to the bus line of Tedzani I power station.

Figure 2-6 shows the transmission system of Tedzani IV power station.

It was confirmed that ESCOM has implemented flow analysis on the existing transmission line in line with the additional installations in Tedzani IV power station. It was also confirmed that ESCOM will provide the results of the flow analysis.

It will be necessary to install two new steel towers to realize interconnection with Tedzani I power station.

Specifications of the Transmission Line facilities are shown in TableFigure 2-76.

Table 2-6 Specification of Transmission Line Facilities

Items	Facilities	Specification
66kV Transmission Line	Tower	Angle type steel tower, 1 circuit
	Foundation	Inverse T type foundation
	Insulator	Single tension type insulator string 8 disc/string
	Conductor	Bare ACSR(LYNX)
	Shielding Wire	20SA 7/2.03

Transmission Line System and Transmission Line Route are shown in Figure 2-6 and Figure 2-7 respectively.

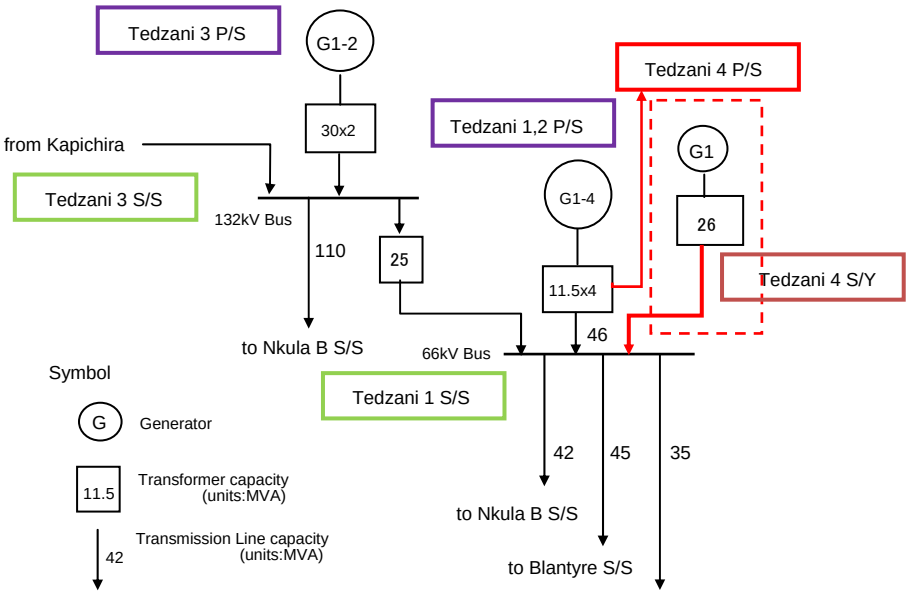


Figure 2-6 Transmission Line System for the TEDZANI IV P/S

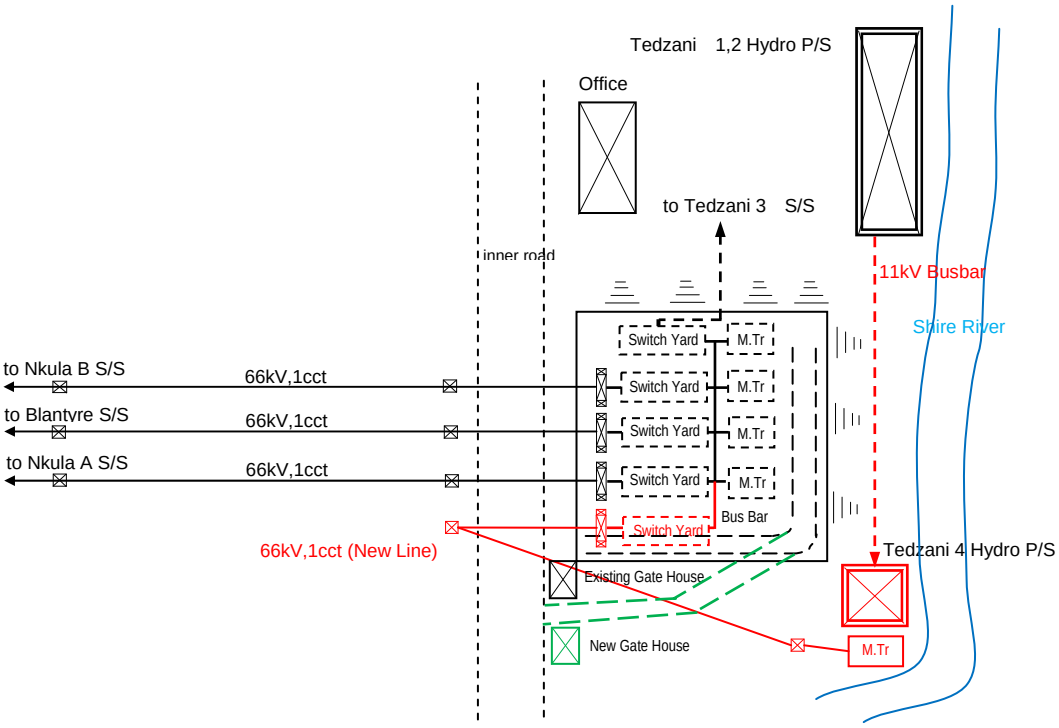


Figure 2-7 Transmission Line Route for the TEDZANI IV P/S

2-2-4 Outline Design Drawing

Below is the list of outline design drawings prepared based on the basic plan described in the preceding clause. The design drawings are indicated separately.

[General]	TD-G-GL-001:	General Plan
	TD-G-GL-002:	General Profile
[Civil Works]	TD-C-IT- 001:	Intake Plan and Profile
	TD-C-IT- 002:	Intake Sections (1/3)
	TD-C-IT- 003:	Intake Sections (2/3)
	TD-C-IT-004:	Intake Sections (3/3)
	TD-C-HR-005:	Headrace Typical Sections
	TD-C-HR-006:	Headrace Plan (1/4)
	TD-C-HR-007:	Headrace Plan (2/4)
	TD-C-HR-008:	Headrace Plan (3/4)
	TD-C-HR-009:	Headrace Plan (4/4)
	TD-C-HR-010:	Headrace Sections (1/4)
	TD-C-HR-011:	Headrace Sections (2/4)
	TD-C-HR-012:	Headrace Sections (3/4)
	TD-C-HR-013:	Headrace Sections (4/4)
	TD-C-HR-014:	Headrace Flume Plan and Profile
	TD-C-HR-015:	Headrace Flume Flume Sections
	TD-C-HT- 016:	Head Tank Plan and Profile
	TD-C-HT- 017:	Head Tank Typical Sections (1/2)
	TD-C-HT- 018:	Head Tank Typical Sections (2/2)
	TD-C-PS-019:	Penstock Plan and Profile
	TD-C-PS-020:	Penstock Typical Sections
	TD-C-PH-021:	Powerhouse Plan
	TD-C-PH-022:	Powerhouse Sections
	TD-C-PH-023:	Powerhouse Profile
	TD-C-PH-024:	Powerhouse GF Unloading Floor
	TD-C-PH-025:	Powerhouse B1F Machine Hall Floor
	TD-C-PH-026:	Powerhouse B2F Generator Floor
	TD-C-PH-028:	Powerhouse B4F Draft Tube Floor
	TD-C-PH-027:	Powerhouse B3F Turbine Floor
	TD-C-PH-029:	Powerhouse B5F Drainage Gallery Floor
	TD-C-PH-030:	Powerhouse Elevation View
	TD-C-PH-031:	Powerhouse Detail Sections
	TD-C-TR-032:	Tailrace Profile

	TD-C-TR-033:	Tailrace Sections
	TD-C-TR-034:	Stoplog Access Road
	TD-C-AR-035:	Access Road Plan and Profile
	TD-C-AR-036:	Access Road Sections(1/5)
	TD-C-AR-037:	Access Road Sections(2/5)
	TD-C-AR-038:	Access Road Sections(3/5)
	TD-C-AR-039:	Access Road Sections(4/5)
	TD-C-AR-040:	Access Road Sections(5/5)
	TD-C-GH-041:	Guard House (1/2)
	TD-C-GH-042:	Guard House (2/2)
[Electro-mechanical Works]	TD-E-GN-001:	Single Line Diagram
	TD-E-TL-002:	66kV Transmission Line Tower Type D1
	TD-E-TL-003:	66kV Transmission Line Tower Type D2
	TD-E-TL-004:	66kV Transmission Line Founfation for Tower Type D
	TD-E-TL-005:	66kV Transmission Line Gantry

2-2-5 Implementation Plan

2-2-5-1 Implementation Policy

Concerning the implementation and works methods, special techniques will basically be avoided and appropriate works methods will be selected upon grasping natural conditions of terrain, geology, climate, etc. in the Project area and fully considering the securing of safety including thirds parties, mitigation of impacts on existing structures (and averting structures), local technical standards, the procurable local materials and so on

2-2-5-2 Construction Plan

The temporary installation plan will be compiled upon grasping natural conditions of terrain, geology, climate, hydrology, etc., the surrounding environment, related legislation and other conditions, and taking the consistency with the scale, content, processes, etc. of works, and economy into consideration. The following paragraphs give outline descriptions of the temporary roads, temporary coffering, and temporary installations.

(1) Temporary Roads

The following temporary roads will be constructed. Roads will be 6 m wide and have an uphill gradient of no more than 20%.

- Access road to intake weir riverbed (temporary road 1): length 60 m

- Access road to powerhouse and tailrace riverbed (temporary road 4): length 205 m, newly constructed alongside the existing power station
- Access roads to headrace (temporary roads 2 and 3): 2 roads, length 100 m +200 m = 300 m

The temporary roads will be maintained as follows during the works period:

- Main roads (access roads to riverbed): surface course of 1.0 m cement improvement, length 265 m
- Other roads: replenishment and leveling of roadbed materials using excavation muck and riverbed sediment

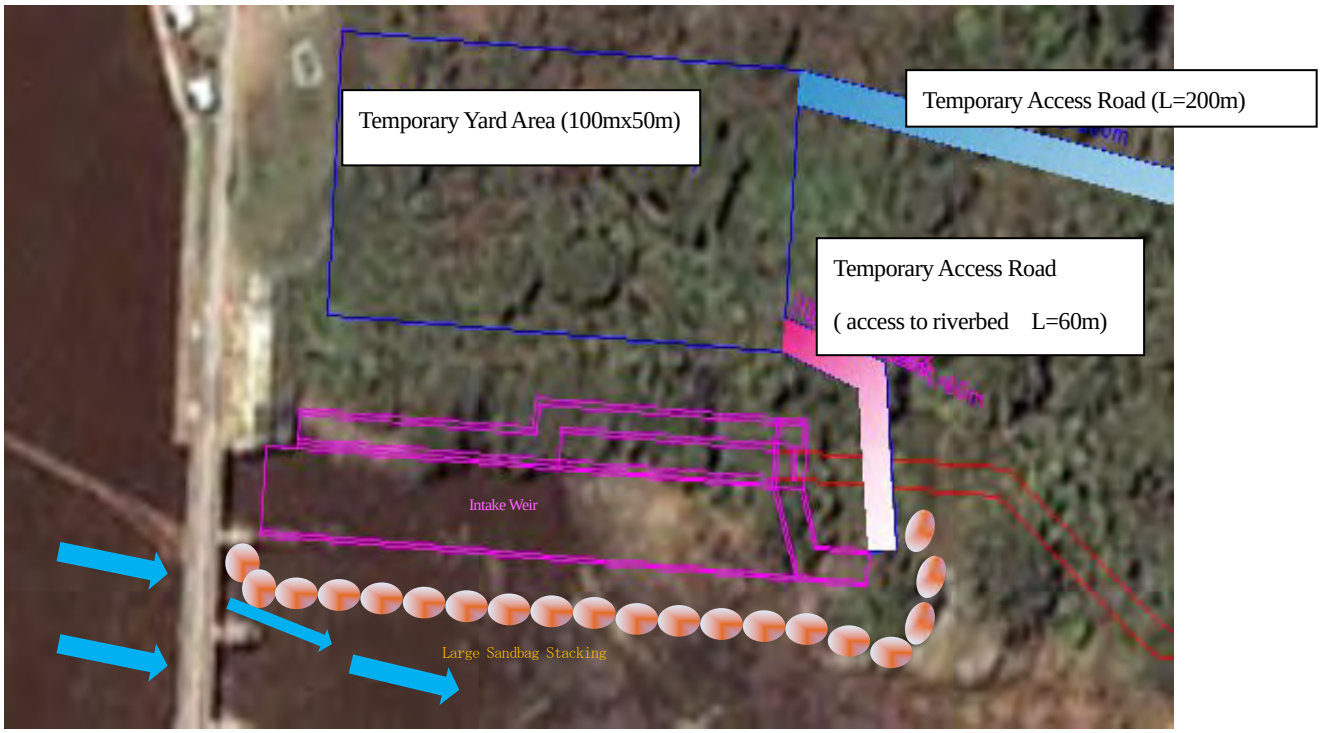


Figure 2-8 Outline of Temporary Facilities around the Intake

(2) Temporary Coffering

Temporary coffering will be installed around the intake weir, spillway, and tailrace. An earth-fill dam will be constructed on the left bank to transfer the water flow to the right bank. Slopes will be protected by large

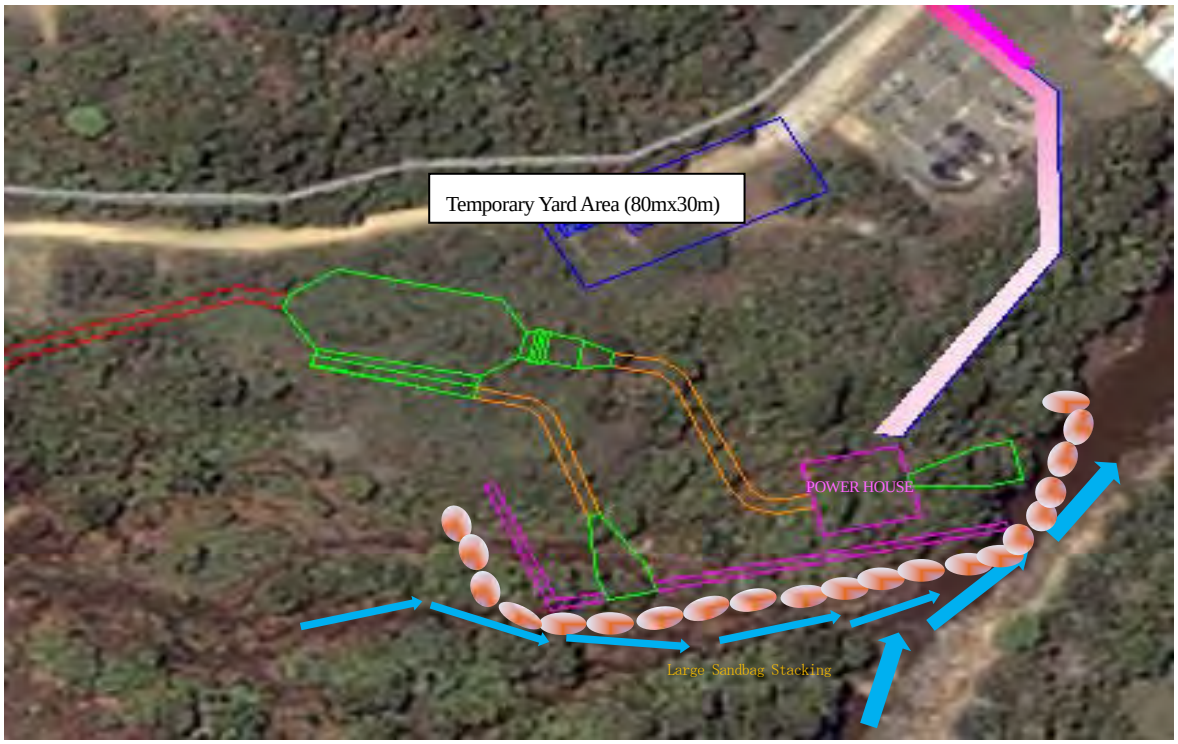


Figure 2-9 Outline of Temporary Facilities around the Powerhouse

(3) Temporary Installations

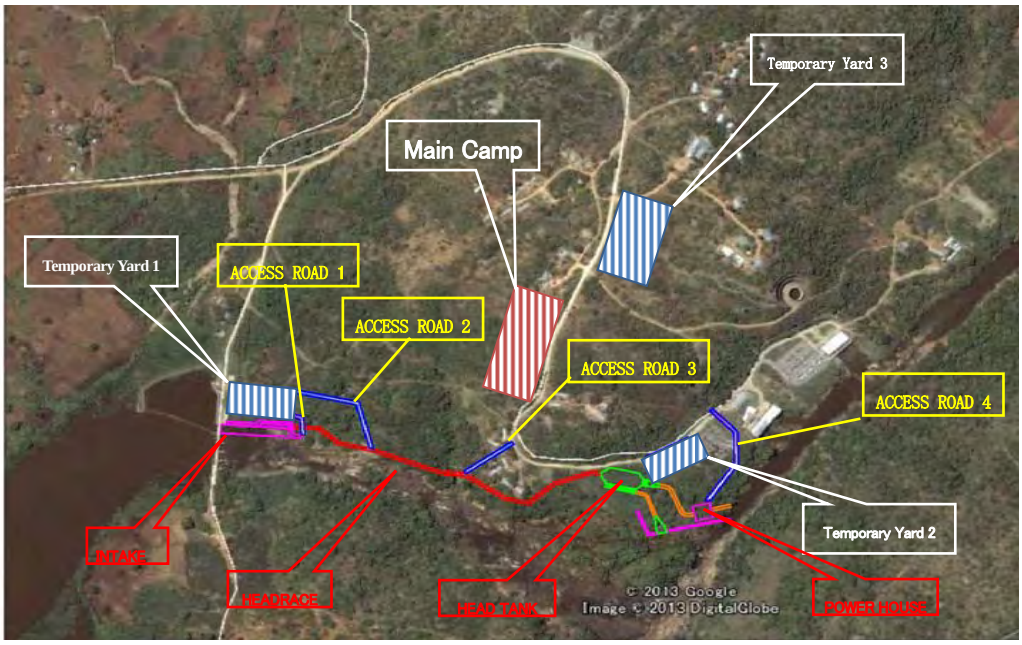


Figure 2-10 Outline of Temporary Yards

Table 2-7 Temporary Facilities

No.	yard	Distance from the Intake	Content	State
1	Main Camp	1.7 km	Office 150m x 80m Accommodations etc.	
2	Temporary Yard 1 Intake & Headrace	0.5 km	Stockyard 100m x 50m Resting facilities	
3	Temporary Yard 2 Head tank & Powerhouse	2.1 km	Stockyard 80m x 30m Resting facilities	
4	Temporary Yard 3	1.5 km	Plant yard 100m x 80m	
5	Quarry			
6	Fine aggregate pit			
7	Excavated soil bank			

Table 2-8 Outline of Main Camp

No.	Facility	Scale(m)	quantity
1	Consultant Office	5 x 6	1
2	Contractor Office	8 x 20	1
3	Sub-contractor Office	6 x 10	1
4	Accommodation for foreign stuffs	10 x 27	1
5	Dining area for foreign stuffs	5 x 7	1
6	Accommodation for domestic stuffs	10 x 27	1
7	Dining area for domestic stuffs	12 x 15	1
8	Workers accommodations	10 x 27	3
9	Restrooms & Bathrooms	5 x 7	4
10	Feed tank	3 x 5	1
11	Guard stations	2 x 2	2
12	Storehouse	8 x 10	1
13	Repair shop	8 x 10	1
14	Tool stocker	8 x 10	1

Table 2-9 Outline of Plant Yard

No.	Facility	Specification	Others
1	Batch plant (concrete)	$30m^3/h$	$1.0m^3$
2	Laboratory		$30m^2$
3	Explosives warehouse	12ton	$15m^2$
4	Explosive processing shop		$15m^2$

2-2-5-3 Consultant Supervision/Procurement Plan

(1) Basic Policy

The Japanese consultant will conduct supervision and guidance to ensure that the implementation and procurement are safely completed on time while securing the required quality. The important points to bear in mind regarding quality, schedule and safety are as follows.

1) Quality

- Concerning the main equipment, submission of shop drawings will be required and these will be checked to ensure compliance with the original design and specifications.
- Concerning works progress, confirmation will be conducted to ensure that works are finished according to

the design and shop drawings.

- Quality control tests and plant inspections will be attended to confirm quality where necessary.
- Finally, completion inspection will be implemented to confirm that the originally designed quality and functions are satisfied.

2) Schedule

- The progress of equipment works will be confirmed and compared with the original schedule.
- The situation regarding procurement of equipment and materials will be confirmed, and factors causing delay will be identified.
- Schedule adjustment meetings will be held regularly or as appropriate in order to adjust and secure the schedule.

3) Safety

- Since works on Tedzani IV power station will be implemented while operating the existing TedzanI power station, discussions will be held with the ESCOM Tedzani I power station personnel with a view to compiling an implementation plan that ensures the safety of existing ESCOM equipment, ESCOM employees and power station personnel, and this will be thoroughly informed to those concerned.
- When conducting blasting work, measures to prevent fly-off will be taken and restrictions will be placed on passage by pedestrians and vehicles.
- Safety patrols will be periodically conducted in order to confirm conditions on site and prevent accidents from happening.

4) Consultant supervision setup

In order to smoothly and appropriately implement consultant supervision work, a work supervisor who has ample experience of similar Projects and fully grasps the contents of the Project will be appointed.

Since the works contractor will basically be liable for quality, schedule and safety in the Project, it will assign the minimum necessary engineers to the site and also appoint a civil engineer as a permanently assigned manager. In line with the progress of works, civil design engineers, hardware engineers, electrical and mechanical engineers, and transmission engineers will be dispatched to the site to secure the functions of the hydropower equipment.

2-2-5-4 Quality Control Plan

(1) Civil Structures

In civil structures, quality control is required for concrete. Sample testing will be implemented to confirm that quality is secured as specified in contracts.

(2) Equipment and materials

Quality control of equipment will be implemented as follows:

- Equipment suppliers will be required to submit drawings and these will be checked to ensure compliance with the original design and specifications.
- Plant inspections for the main equipment will be attended to confirm that it is being manufactured according to approved drawings and contract specifications.
- When equipment and materials are carried into the site, they will be confirmed to make sure they comply with the procured specifications and haven't been damaged during transportation.

2-2-5-5 Procurement Plan

(1) Equipment and Materials Suppliers

The main equipment such as turbine, generator and control/protective equipment will basically be procured from Japan, however, in cases where items can be obtained at lower cost and with decent performance, parts will be secured from third countries such as mainly China, Southeast Asia, India and Europe, etc. Moreover, concerning, singular devices such as transformers, switches and distribution panels, etc., since these products are usually designed and manufactured according to international standards with performance levels that satisfy such standards, in cases where cheaper prices than for Japanese products can be obtained, products will mainly be procured from third countries such as China, Southeast Asia, India and Europe.

Out of construction materials, reinforcing bars, aggregate and cement will be procured in Malawi, however, other major equipment and materials will basically be procured from Japan, while parts that constitute no problems in terms of quality and performance will be procured from third countries such as China, Southeast Asia, India and Europe.

(2) Scope of Spare Parts

The necessary spare parts and maintenance and repair tools will be provided to ensure that the Project effects are maintained. Spare parts by nature are broadly divided into expendable parts and replacement parts. In the Project, expendable parts necessary for operation such as lamps and fuses, and replacement parts that are needed in emergencies will be supplied.

(3) Thinking on Warranty

The equipment procured in the Project will all require defect liability warranty. The defect liability period will be one year.

2-2-5-6 Operation Guidance Plan

Following the start of operation, Tedzani IV power station will be operated and maintained by ESCOM, the state power company of Malawi. However, since ESCOM possesses the required capability, it will not be necessary to provide special guidance.

① Since the equipment configuration, equipment specifications, operating methods and control methods at Tedzani IV power station are designed based on the equipment configuration and specifications of the existing Tedzani III hydropower station, it will not be necessary to provide additional guidance on operation and maintenance in particular.

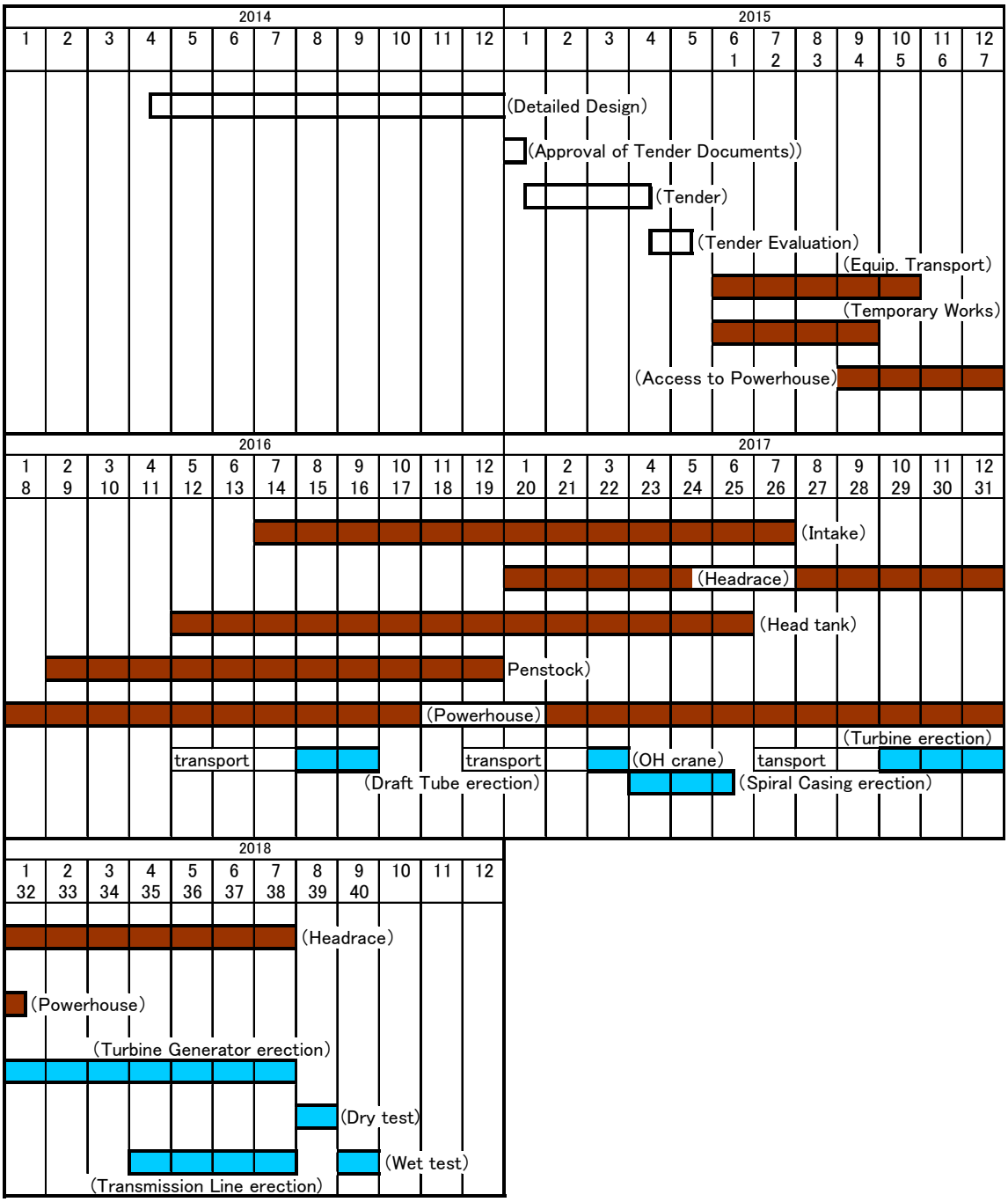
② The operation and maintenance manuals for equipment will be submitted by suppliers so that ESCOM and the consultant can implement review before the final manuals are presented.

③ During the equipment installation and test period, know-how concerning installation, testing and operation of equipment will be imparted via on-the-job training with equipment suppliers.

2-2-5-7 Implementation Schedule

The Project will be implemented over approximately five months as shown in Table 2-10.

Table 2-10 Implementation Schedule



2-3 Obligation of Recipient Country

The scope of works on the Malawi side during Project implementation will be as follows.

(1) Authorization procedures concerning hydropower development Projects

Authorization procedure concerning the additional installation of hydropower station will be conducted based on electric power-related legislation in Malawi (Energy Regulation Act 2004, Electricity Act 2004).

(2) Environmental and social consideration

In the event of Project implementation, the Department of Environment (DEA) has issued a notice to the Director of the Department of Energy (the Ministry of Energy and Mining) based on law (Environmental Management Law – EMA) indicating that implementation of the environmental impact assessment (EIA) will be exempted and that the following three items should be implemented. Moreover, the IEE has already been implemented in this study (see the appendices), and this report proposes implementation of the environmental management plan (EMP) and environmental monitoring plan (EMP).

① Initial Environmental Evaluation (IEE)

② Preparation of Environmental Management Plan (EMP)

③ Preparation of Environmental Monitoring Plan (EMP)

(3) Tariff exemption procedures

In the event of Project implementation, VAT exemption measures will be taken. Also, steps for exempting tariffs from imports to Malawi during construction will be conducted.

(4) Rebuilding of the operation and maintenance setup

Tedzani IV power station will be added to the existing Tedzani hydropower station, and operation and maintenance will be implemented by the existing ESCOM power station management organization. However, new operators and personnel will be secured and the setup will be reconstructed to ensure there is no impediment to power station operation and maintenance.

(5) Budgeting of operation and maintenance costs

The necessary budget for conducting operation and maintenance of the extended hydropower station will be planned and secured each year.

Moreover, in the long term, the necessary expenses to cover replacements and repairs of major electrical and mechanical equipment will be secured.

(6) Procedure for issuing bank agreement and authority to pay (DOE)

In the event of Project implementation, the banking agreement and authority to pay will be issued.

(7) Others

- Tax exemptions for foreign nationals including Japanese persons involved with the Project
- Adjustment, application and approval with related agencies
- Project operation and maintenance plan

(8) Organization

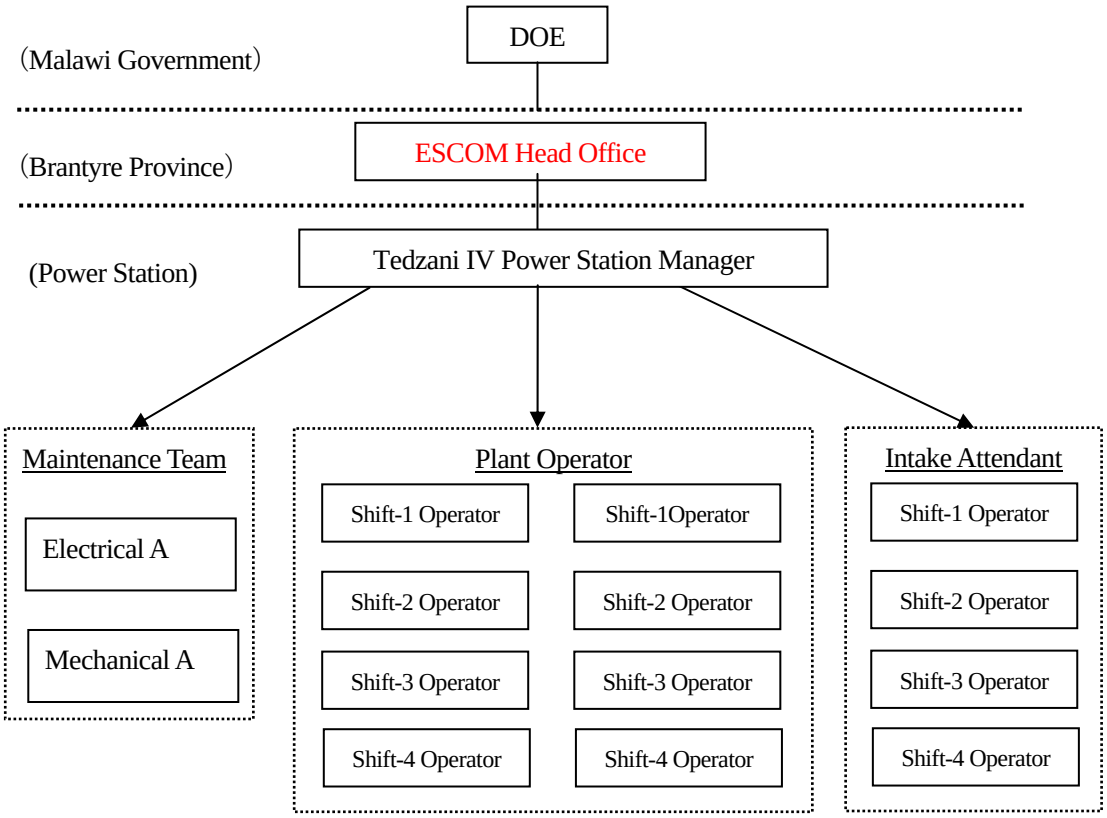


Figure 2-11 Proposed Organization Chart for O&M

Figure 2-11 shows the responsible government office and implementation agency of the Project.

Table 2-11 Responsible Government Office and Implementation Agency

Project Component	Responsible Government Office	Implementation Agency	
		Construction Phase	Operation and maintenance Phase
Hydropower Generation	DOE / ESCOM	ESCOM	ESCOM
Transmission Line			ESCOM

2-4 Project Cost Estimation

2-4-1 Initial Cost Estimation

In the case where the Project is implemented under the grant aid scheme, the portion of costs that will need to be borne on Malawi side will be as follows. However, this amount does not represent the grant limit stated in the E/N.

(1) Cost burden on Japan side

This cannot be disclosed until the construction and procurement contracts are certified.

(2) Cost burden on the Malawi side

Table 2-12 Cost Burden of the Host Country

Cost Item/Contents	Amount		Remarks
	(million MK)	(Approx. 1000 yen)	
Commission based on the bank agreement (A/P commission fee, B/A commission fee)	19.6	6,017.2	
Environmental monitoring	2.6	798.2	Construction period
Spare parts	59.6	18,297.2	
Total	81.8	25,112.6	

(3) Estimation conditions

① Estimation point: September, 2013

② Exchange rate (mean rate for the past 6 months at the estimation point):

1.00 MK = 0.00309US$

1.00 US$ = 99.38JPY

1.00 MK = 0.307JPY

③ Price fluctuation factor

The price fluctuation factor caused by the different estimation point, September 2013 and January 2015 (tender) was calculated based on the IMF inflation average consumer prices. As a result, the price fluctuation factor came to 13.7%.

④ Construction and procurement period

Table 2-10 shows the detailed design and the construction schedule.

⑤ Others

Estimation was implemented based on the Government of Japan's Grant Aid scheme.

2-4-2 Operation and Maintenance Cost

Plant operation and maintenance costs will amount to 133 million MK (40.8 million yen) per year, breaking down as 38.8 million MK (12 million yen) as personnel expenses, 91.5 million MK (28 million yen) as repair costs, and 2.7 million MK (830,000 yen) as environmental monitoring costs.

Table 2-13 Annual Operation and Maintenance Costs of Tedzani IV Hydropower Station

Item	Contents	Annual Cost (million MK)
Operation and maintenance personnel expenses	Operators: 8 Electric engineer: 1 Mechanical engineer: 1 Intake managers: 4	38.8
Repair costs	Power station maintenance	91.5
Environmental monitoring	Following start of plant operation	2.7
Total		133.0

(1) Operation and Maintenance Cost

Maintenance cost for the Project will be US$ 336,000 per year for operation and maintenance of the civil works and electro-mechanical works and transmission line works.

The turbine and generator should be replaced every 25 years, but Table 2-14 does not include costs for replacement.

Table 2-14 Operation and Maintenance Cost

Item	Annual Expense（US$）	Remarks
Maintenance	280,000	1％ of Civil Work cost
Other Cost (20% of maintenance)	56,000	
Total	336,000	

(2) Consumable Parts

Consumable parts, which will be necessary to be changed in short term due to wearing, replacing, and changing are listed in Table 2-15.

Table 2-15 List of Consumable Parts

Consumable Parts		Replaced Parts	
Parts Name	Quantities	Parts Name	Quantities
Filter element for governor	1 set	Maintenance seal for turbine	1set
Belt for air compressor	2 pieces	Packing and seal for turbine	1set
Generator carbon brush	1set	Packing and seal of water cooler for cooling system	2sets
Generator brake shoe	1 set	Packing for generator	1set
Crane brake shoe	1set		
DC battery and battery liquid	1set		

Chapter 3 Project Evaluation

3-1 Preconditions

The following procedures should be carried out by the Malawi side to facilitate the smooth implementation of this Project.

3-1-1 Approval Procedure about a Hydroelectric-Power-Development

Energy Regulation Act 2004:

Approval procedure of new hydroelectric power station extension based on the related laws and regulations in Malawi (Energy Regulation Act 2004 and Electricity Act 2004) will be performed by the recipient country.

Since ESCOM has ample experience in installation of power equipment, there are few assumed difficulties in the approval procedure; nevertheless, in order to carry out appropriately, verification by DOE will be indispensable.

3-1-2 Environmental and Social Safeguard Policies

Even though the expropriation of land for this Project is unnecessary, DEA will notify to DAE the prepare Initial Environmental Examination (IEE), Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMP), while; DOE /ESCOM will carry out the environmental monitoring appropriately.

3-2 Necessary Inputs by Recipient Country

The following indicates obligations of the recipient (Malawi) in this Project.

3-2-1-1 DOE

(1) Cooperation with JICA concerning this Project
(2) Support service for the legal proceedings which ESCOM performs
(3) Validation for the Project
(4) VAT exemption and import duty exemption procedure
(5) Opening of a bank account based on the bank agreements and coverage of handling fee

3-2-1-1 ESCOM

(1) Legal process
(2) Management system, operation and maintenance system and human resources planning
(3) The expense of the management system in operation and maintenance

3-3 External Conditions

3-3-1 Negative Influence on the Plant in Operation

This Project is extension of an established hydroelectric power plant, and construction works will restrict operation of the established plant.

In the period, such as temporary shutoff construction or coupling interconnection, it will be necessary to shut down the plant in operation temporary, therefore those stage of works must be finished as scheduled. Appropriate supervision on the construction works and schedule which takes the operation schedule of the plant in operation into account is indispensable for prevent the serious problems as like face to long delay in construction works.

3-3-2 Impact of Change in Foreign Exchange Rates

The exchange rate of the Malawi kwacha has changed greatly over a short period of time.

Labor, internal transport, fuel and the materials for civil works, for example, cement, aggregate and construction machines, will be domestically procured in Malawi in the cost estimation, among these Project expenses. Because of the long construction period which is over 4 years, there is a high possibility that the cost of these local contents will be influenced by the exchange fluctuation.

As mentioned above, it will become important to take measures to reduce influences of exchange fluctuation, as much as possible in construction, for example, basket purchase of main equipment..

3-4 Project Evaluation

3-4-1 Validity

In Malawi, the development of energy is valued as one of the nine top priority fields in economic strategy, and ranked as one of the most significant issues for infrastructure improvement and sustainable economic growth. However, the maximum power demand in 2012 is 347 MW, which largely overuses the capacity of the power supply (288 MW). Because of chronic nation-wide power shortage, there have been frequent power failures. In particular, serious negative influence has been exerted on civic life and economic activity in capital city Lilongwe (population of 2,204,000) and the commercial city of Blantyre (1,297,000).

In Malawi, about 98% of the electric power generation is hydroelectric. Among these stations, about 98% of the capacity is generated along on the Shire River. Since this Project will explore the capacity of electric power generation, stable and high quality power distribution will be realized and the industrial potential and the living standards in Malawi will be raised.

3-4-2 Effectiveness

The anticipated outputs of Project implementation are as follows.

(1) Quantitative Evaluation

The purpose of this Project:

In line with increasing electric power consumption in Lilongwe and Blantyre which are the main consumption areas in this region, since the power supply is one of the most significant elements of industrial infrastructure, it will be imperative that to increase power supply, secure of stable power supply and improve in quality and safety of power distribution for reinforcement of the economic potential in these areas.

Due to the aforementioned reasons, and in consideration of the promotion of adopting the reusable energy source for the power, this Project will construct Tedzani IV hydroelectric power station and utilize the overflow discharge water from Tedzani Dam. Tedzani IV will demonstrate the determinate capabilities illustrated in the table below

Table 3-1 Quantitative Effect Indicators

Indicator	Reference Value (as of 2012)	Target Value (as of 2018) [3 years after Project completion]
Installed capacity (kW)	92,700	114,500
Annual generated energy (GWh/year)	620.8	782.8
Plant Factor (%)	76	78

Note: Reference Value is the total of Tedzani I, II and III while Target Value is the total of Tedzani I, II, III and IV.

(2) Qualitative Evaluation

Since this Project will explore the capacity of electric power generation, the stable and high quality power distribution will be realized in the capital city Lilongwe (population of 2,204,000) and the commercial city of Blantyre (1,297,000). From the above, the industrial potential and the living standards in these areas will be raised.

[Appendices]

1. Member of List of the Study Team
2. Study Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussions
5. Minutes of Meetings
6. Presentation Materials
7. IEE：Initial Environmental Examination

1. Member of List of the Study Team

Name	Task	Company
Kazunari Oshima	Project Leader	JICA
Gaku Saito	Project Management	JICA
Keita Izumi	Project Management	JICA
Mitsuru Shimizu	Consultant Team Leader	TEPSCO
Hiroshi Kobayashi	Consultant Team Vice Leader	TEPSCO
Itsuro Miyata	Turbine Engineer	TEPSCO
Kenji Kudo	Generator Engineer	TEPSCO
Tetsuo Tejima	Civil Engineer	TEPSCO
Keiji Wakamatsu	Transmission, Control and Protection Engineer	TEPSCO
Tomoki Irei	Procurement Engineer	TCC
Shigeki Wada	Environment Expert	Wada Engineering
Seiichi Suzuki	Economist	TEPSCO
Shin Watanabe	Surveyor	TCC
Kiminori Nakamata	Geologist	TCC
Yuichiro Hirohashi	Hydrologist	TCC

2. Study Schedule

(1) The 1st Mission Schedule

Tedzani Hydropower Station Extension Project Field Study(1st stage) Schedule July.7-Aug.5

	DATE		STAFF(JICA)			STAFF(Consultant)								
			Administrator/ General Manager	Planning and Coordination		Project Manager	Assistant Project Manager	Plan of the Hydropower Station	Environmental and Social Safeguard	Procurement/Cost Estimate (Material / Machinery)	Control, T/L	Survey on the Natural Environment (Geology)	Survey on the Natural Environment (Topography)	Survey on the Natural Environment (Hydrometry)
			Ooshima	Saito	Izumi	Shimizu	Kobayashi	Tejima	Wada	Irei	Wakamatsu	Nakamata	Watanabe	Hirohashi
1	7-Jul-13	Sun	Mobilization (From Tokyo to Malawi)											
2	8-Jul-13	Mon	Mobilization to Lilongwe											
3	9-Jul-13	Tue	AM: Kickoff Meeting (DOE)- Information Session about Grant Aid Project Scheme PM:Mobilization to Blantyre											
4	10-Jul-13	Wed	AM:Meeting with ESCOM PM:Project Site Inspection											
5	11-Jul-13	Thu	AM:M/D Signing Ceremony(ESCOM) PM:Mobilization to Lilongwe											
6	12-Jul-13	Fri	AM:M/D Signing Ceremony(DOE) PM:Visit Japanese Embassy and JICA											
7	13-Jul-13	Sat	Classify and Analyze Collected Information			Classify and Analyze Collected Information	Mobilization to Lilongwe			Mobilization (From Malawi to Tokyo)				
8	14-Jul-13	Sun	Mobilization to Lilongwe			Team Meeting								
9	15-Jul-13	Mon	Mobilization (From Malawi to Tokyo)			Reconsignment Agreement/ Mobilization to Blantyre		Ministry of Water Development and Irrigation/ Mobilization to Blantyre	Reconsignment Agreement/Mobilization to Blantyre	Resource acquisition / Specimen collection/ Mobilization to Blantyre	Mobilization to Blantyre	Reconsignment Agreement/ Mobilization to Blantyre		Resource acquisition / Specimen collection/ Mobilization to Blantyre
10	16-Jul-13	Tue				Field Study Tedzani/Matope		Meeting(ESCOM) Field Study(Tedzani)	Field Study(Tedzani)	Field Study Tedzani/Matope	Field Study(Tedzani)	Field Study Tedzani/Matope		
11	17-Jul-13	Wed				Field Study (possible site for a new waterway)		Hydrometric Survey/ Matope	Meeting(ESCOM)	Hydrometric Survey/ Matope	Resource acquisition / Specimen collection(ESCOM)	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	Hydrometric Survey/ Matope
12	18-Jul-13	Thu				Field Study (possible site for a new waterway)		Meteorological Agency Procurement conditions Survey	Meeting(ESCOM)	Procurement conditions Survey	Field Study(Tedzani)	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	Resource acquisition / Specimen collection
13	19-Jul-13	Fri				Mobilization to Lilongwe		Tedzani Hydropower StationIII on site survey	Mobilization to Lilongwe	Field Study(Tedzani)		Geological Survey / Tedzani	Actual Location Survey/ Tedzani	
14	20-Jul-13	Sat				Classify and Analyze Collected Information								
15	21-Jul-13	Sun				Mobilization to Lilongwe		Classify and Analyze Collected Information						
16	22-Jul-13	Mon				Mobilization (From Malawi to Tokyo)		Nkura Hydropower Station(A/B) on site survey	Meeting with DOE/EAD	Field Study((Nkura) Procurement conditions Survey	Field Study((Nkura)	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	
17	23-Jul-13	Tue						Field Study (possible site for a new waterway at Tedzani)	Meeting with DOE/EAD	Procurement conditions Survey	Resource acquisition / Specimen collection(Tedzani)	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	
18	24-Jul-13	Wed						Classify and Analyze Collected Information	Meeting with Department of National Parks and Wildlife	Classify and Analyze Collected Information	Classify and Analyze Collected Information	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	
19	25-Jul-13	Thu						Resource acquisition / Specimen collection/ Zomba Geological Survey Office	Meeting with DOE/EAD	Mobilization to Lilongwe	Mobilization to Lilongwe	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	
20	26-Jul-13	Fri						Resource acquisition / Specimen collection(ESCOM)	Mobilization to Lilongwe	Procurement conditions Survey	Procurement conditions Survey	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	
21	27-Jul-13	Sat						Classify and Analyze Collected Information	Mobilization (From Malawi to Tokyo)	Procurement conditions Survey	Procurement conditions Survey	Field Study(Kapichira)		
22	28-Jul-13	Sun						Classify and Analyze Collected Information		Classify and Analyze Collected Information				
23	29-Jul-13	Mon						Resource acquisition / Specimen collection(ESCOM)		Procurement conditions Survey	Procurement conditions Survey	Geological Survey / Tedzani	Actual Location Survey/ Tedzani	
24	30-Jul-13	Tue						Meeting and Pre departure briefing session(ESCOM)		Classify and Analyze Collected Information	Classify and Analyze Collected Information	Meeting(ESCOM)	Actual Location Survey/ Tedzani	
25	31-Jul-13	Wed						Mobilization to Lilongwe		Classify and Analyze Collected Information	Classify and Analyze Collected Information	Mobilization to Lilongwe		
26	1-Aug-13	Thu						Pre departure briefing session (DOE/Japanese Embassy		Mobilization to Lilongwe				
27	2-Aug-13	Fri						Pre departure briefing session (ICA)		Mobilization (From Malawi to Tokyo)				
28	3-Aug-13	Sat						Classify and Analyze Collected Information						
29	4-Aug-13	Sun						Mobilization to Lilongwe						
30	5-Aug-13	Mon						Mobilization (From Malawi to Tokyo)						
	total		9	9	9	16	16	30	21	21	21	21	21	21

(2) The 2nd Mission Schedule

Vesion 2 9-Sep-13

Tedzani Hydropower Station Extension Project Field Study(2nd stage) Schedule Sep.14-28

			1	2	3	4	5	6	7
DATE			T.Tejima	Y.Hirohashi	A.Irei	K.Wakamatu	S.Wada	K.Nakamata	S.Watanabe
			Settle on the Construction Plan (Civil Engineering) Hydropower Station	Survey on the Natural Environment (Hydrometry)	Procurement/Cost Estimate (Material / Machinery)	Control, T/L	Environmental and Social Safeguard	Survey on the Natural Environment (Geology)	Survey on the Natural Environment (Topography)
1	14-Sep-13	Sat		Mobilization to Malawi	Mobilization to Malawi	Mobilization to Malawi	Mobilization to Malawi		
2	15-Sep-13	Sun	Mobilization to Malawi	Mobilization to Lilongwe	Mobilization to Lilongwe	Mobilization to Lilongwe	Mobilization to Lilongwe	Mobilization to Malawi	Mobilization to Malawi
3	16-Sep-13	Mon	Mobilization to Lilongwe	Meeting with Ministry of Water Development and Irrigation	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Meeting with local consultants about IEEA	Mobilization to Lilongwe	Mobilization to Lilongwe
4	17-Sep-13	Tue	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre
5	18-Sep-13	Wed	1st. Meeting with DOE, ESCOM	1st. Meeting with DOE, ESCOM	1st. Meeting with DOE, ESCOM	1st. Meeting with DOE, ESCOM	1st. Meeting with DOE, ESCOM	1st. Meeting with DOE, ESCOM	1st. Meeting with DOE, ESCOM
6	19-Sep-13	Thu	Resource acquisition / Specimen collection	Hydrometric Survey	Hydrometric Survey	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Geological Survey	Topography Survey
7	20-Sep-13	Fri	Resource acquisition / Specimen collection	Site Survey	Site Survey	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Geological Survey	Topography Survey
8	21-Sep-13	Sat	Classify and Analyze Collected Information						
9	22-Sep-13	Sun							
10	23-Sep-13	Mon	2nd. Meeting with DOE, ESCOM	2nd. Meeting with DOE, ESCOM	2nd. Meeting with DOE, ESCOM	2nd. Meeting with DOE, ESCOM	2nd. Meeting with DOE, ESCOM	Geological Survey	Topography Survey
11	24-Sep-13	Tue	Mobilization to Lilongwe Visit DOE	Mobilization to Lilongwe Visit DOE	Mobilization to Lilongwe Visit DOE	Mobilization to Lilongwe Visit DOE	Mobilization to Lilongwe Visit DOE	Mobilization to Lilongwe Visit DOE	Mobilization to Lilongwe Visit DOE
12	25-Sep-13	Wed	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection	Resource acquisition / Specimen collection
13	26-Sep-13	Thu	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre	Visit DOE, Japanese Embassy and JICA Mobilization to Blantyre
14	27-Sep-13	Fri	Depart from Malawi	Depart from Malawi	Depart from Malawi	Depart from Malawi	Depart from Malawi	Depart from Malawi	Depart from Malawi
15	28-Sep-13	Sat	Arrive in Japan	Arrive in Japan	Arrive in Japan	Arrive in Japan	Arrive in Japan	Arrive in Japan	Arrive in Japan

(3) The 3rd Mission Schedule

Tedzani Hydropower Station Extension Project Field Study(3rd stage) Schedule Dec.7-Dec. 17

DATE			STAFF(JICA)		STAFF(Consultant)	
			Administrator/ General Manager	Planning and Coordination	Project Manager	Assistant Project Manager
			Ooshima	Saito	Shimizu	Kobayashi
1	7-Dec-13	Sat	Mobilization (From Tokyo to Malawi)			
2	8-Dec-13	Sun	Mobilization to Lilongwe			
3	9-Dec-13	Mon	Meeting DOE, ESCOM, JICA			
4	10-Dec-13	Tue	Meeting DOE、ESCOM			
5	11-Dec-13	Wed	Mobilization(Lilongwe-Blantyre-Lilongwe) *A meeting with ESCOM at Blantyre had been cancelled			
6	12-Dec-13	Thu	M/D Signing Ceremony(Ministry of Energy、ESCOM) Meeting (JICA)/Visit Japanese Embassy			
7	13-Dec-13	Fri	Depart from Lilongwe		Classify and Analyze Collected Information	Mobilization to Lilongwe
8	14-Dec-13	Sat	Mobilization (From Malawi to Tokyo)		Field Study Lilongwe	
9	15-Dec-13	Sun			Depart from Lilongwe	
10	16-Dec-13	Mon			Mobilization	
11	17-Dec-13	Tue			Mobilization (From Malawi to Tokyo)	

3. List of Parties Concerned in the Recipient Country

Organization	Title/Role	Name
Department of Energy Affairs, Ministry of Energy	Director	Mr. Gideon NYIRONGO
	Principal Energy Officer	Mr. Patrick SILNGWE
	Power Development Advisor (JICA)	Mr. Keiichi TERAO
Ministry of Environment and Climate Change Management	Assistant Director of EAD	Ms.Tawonga Mbale
	Chief of the EIA & Pollution Control Division of EAD	Mr. Patridc Nyirenda
Ministry of Forestry	Assistant Director Forestry Officer in Blantyre	Mr. Peter M.H. Mkwapatira
Department of Parks and Wildlife	Chief of the Wildlife Management Division	Mr. Samuel Nyanyale
ESCOM	Chief Executive Officer	Mr. John KANDULU
	Senior Project Mgr.	Michael GONDWE
	Senior Electrical Eng.	Mr. Blessing PHARIWA
	Senior Project Eng.(Civil)	Mr. Alex KAITANE
	Senior Project Eng.(Environment)	Mr.Daud
	Senior Project Eng.P/S (Environment)	Mr.Areles
	Chief System Planning Eng.	Mr. Andrew SENZANI
	Assistant Land Surveyor	Mr. Justice A. MALEMA
	Design Engineer	Mr. Charles CHIBAMBO
	Transmission Planning Eng.	Ms. Julia NCHILAMUELA
	Generation Division, Tedzani P/S, Senior Mechanical-Maintenance Eng.	Mr. Resten MURIYA
	Generation Division, Tedzani P/S, Senior Operation Eng.	Mr. Edman Kamoto
	Generation Division, Tedzani P/S, Electrical-Maintenance Eng.	Mr. Wadson ZIMBAMBO

4. Minutes of Discussions

(1) M/D (Minutes of Discussions) in the 1st mission

Minutes of Discussions
of the Preparatory Survey on the Project for
The Extension of Tedzani Hydropower Station in the Republic of Malawi

In response to the request from the Government of the Republic of Malawi (hereinafter referred to as "Malawi"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for The Extension of Tedzani Hydropower Station in the Republic of Malawi (hereinafter referred to as "the Project").

JICA sent to Malawi the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Kazunari Oshima, JICA Visiting Senior Advisor. The Team is scheduled to stay in Malawi from July 8th to July 13th 2013.

The Team held discussions with the officials of Malawian authorities concerned (hereinafter referred to as "the Malawian side"). In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Lilongwe, Malawi
July 12th, 2013

Mr. Kazunari Oshima
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Gideon Nyirongo
Director,
Department of Energy Affairs,
Ministry of Energy

PP Mr. John Kandulu
Chief Executive Officer,
Electricity Supply Corporation of Malawi

ATTACHMENT

1. Objective of the Project

The objective of the Project is extension of Tedzani Hydropower Station.

2. Project Site

The Project site based on the request from the Malawian side is located in southern region of Malawi as shown in Annex-1.

3. Responsible and Implementing Organizations

(1) The responsible organization is Department of Energy Affairs (DOE).
(2) The implementing organization is Electricity Supply Corporation of Malawi (ESCOM).
(3) The organization structures of DOE and ESCOM are shown in Annex-2 and Annex-3.

4. Item Requested by the Malawian side

Main item requested by the Government of Malawi (hereinafter referred to as "GOM") to Government of Japan (hereinafter referred to as "GOJ") is extension of hydro power generation facility including transformer installation and transmission line to feed to existing grid.

5. Japan's Grant Aid Scheme

(1) The Malawian side understood Japan's Grant Aid Scheme explained by the Team as described in Annex-4 and Annex-5.
(2) The Malawian side will take the necessary measures, as described in Annex-6, for smooth implementation of the Project.

6. Schedule of the Preparatory Survey

The Team will continue carrying out the Survey in Malawi until 4th August 2013. Based on the results of this survey and additional survey which will be sent around September, JICA will prepare a Draft Final Report in English and send a mission around December 2013 to explain the Draft Final Report to Malawian side.

7. Environmental and Social Considerations

(1) The Malawian side agreed to ensure access to the project site and undertake necessary countermeasures.

(2) The Malawian side agreed to conduct the required environmental works, and obtain approval of related organization (Department of Environment Affairs, Ministry of Environment and Climate Change Management) for implementation of the Project.

(3)The Malawian side agreed to comply with the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "JICA Guidelines") as well as laws and regulations in Malawi, and was requested to prepare Environmental Checklist and Monitoring Form which are designated by JICA Guidelines for an outline design.

(4) The Malawian side agreed to make necessary arrangements with concerned governmental organizations in order to secure funding for and execution of the above environmental matters in a schedule as required for smooth execution of the Project.

8. Other Relevant Issues

(1) Status of the Survey

i) The Team explained that the purpose of the Survey is to collect necessary

information and data, verify appropriateness and urgency of the Project.

2) The Malawian side agreed to share all necessary information and data with the Team.

(2) Coordination among relevant donors and agencies

The Team requested the Malawian side to ensure coordination among relevant donors and agencies for smooth implementation of the Project and the Malawian side agreed to it.

(3) Counterpart Personnel

The Team requested the Malawian side that necessary number of counterpart personnel shall be assigned to the Team and necessary arrangements with related organizations to be made during the Survey in Malawi, and the Malawian side agreed to it.

(4) Major Undertakings to be taken by the Malawi side

The Malawian side confirmed that major undertakings as shown in Annex-6 should be taken by the Malawi side at its expense. The Malawian side shall specify organizations which will secure enough budget and execute each item listed in the column, "To be covered by Recipient Side" as shown in Annex-6.

(End)

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Annex-1	Location of the Requested Project Site
Annex-2	Organization Structure of Department of Energy Affairs
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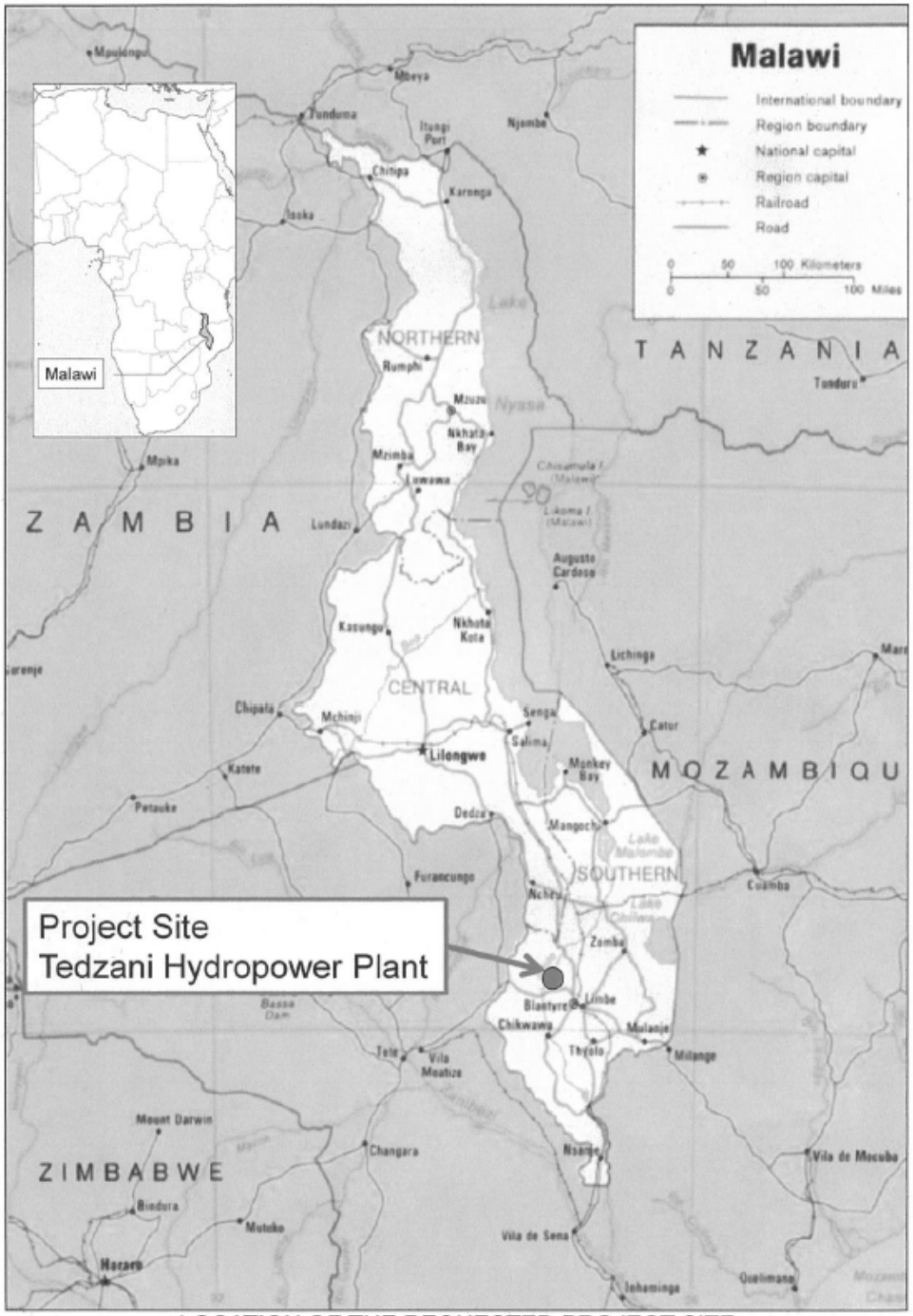
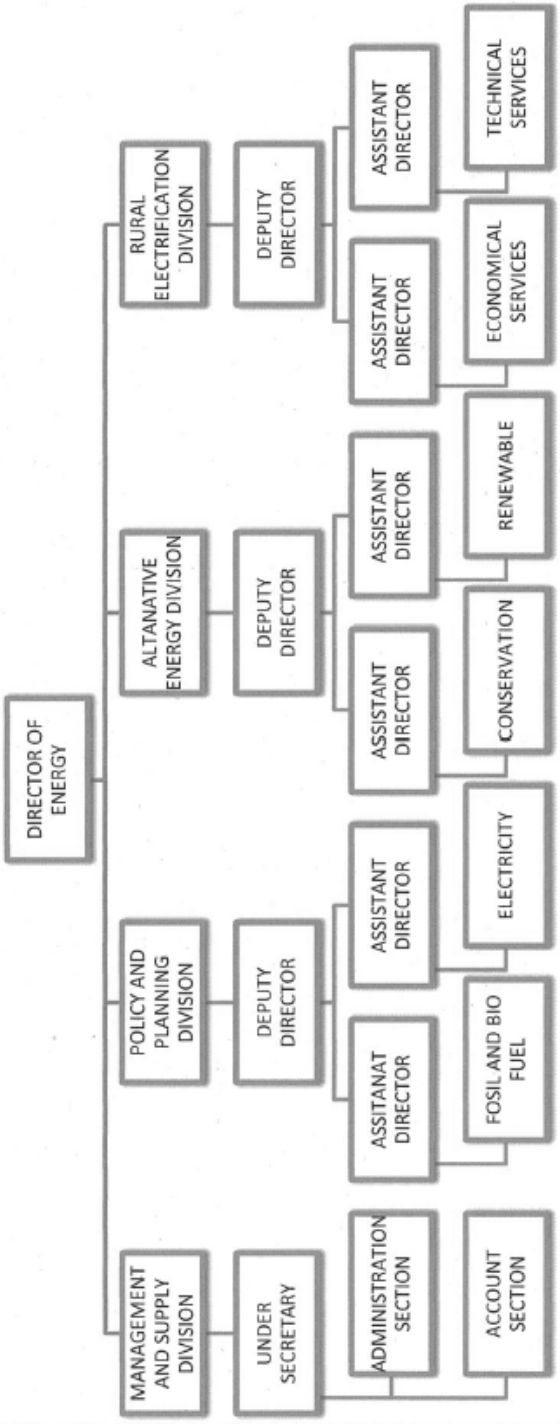
Annex - 1



LOCATION OF THE REQUESTED PROJECT SITE

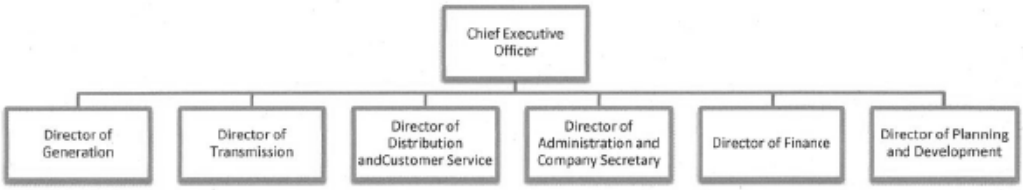
Annex-2



ORGANIZATION STRUCTURE OF DEPARTMENT OF ENERGY AFFARIS

- 4 -

Annex-3



ORGANIZATION STRUCTURE OF ESCOM

JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on the law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is conducted as follows-

- Preparatory Survey (hereinafter referred to as "the Survey")
  - The Survey conducted by JICA
- Appraisal &Approval
  - Appraisal by The GOJ and JICA, and Approval by the Japanese Cabinet
- Determination of Implementation
  - The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - Agreement concluded between JICA and a recipient country
- Implementation
  - Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide a basic document necessary for the appraisal of the Project by JICA and the GOJ. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipien: country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-6.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in

Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to pay and payment commissions to the Bank.

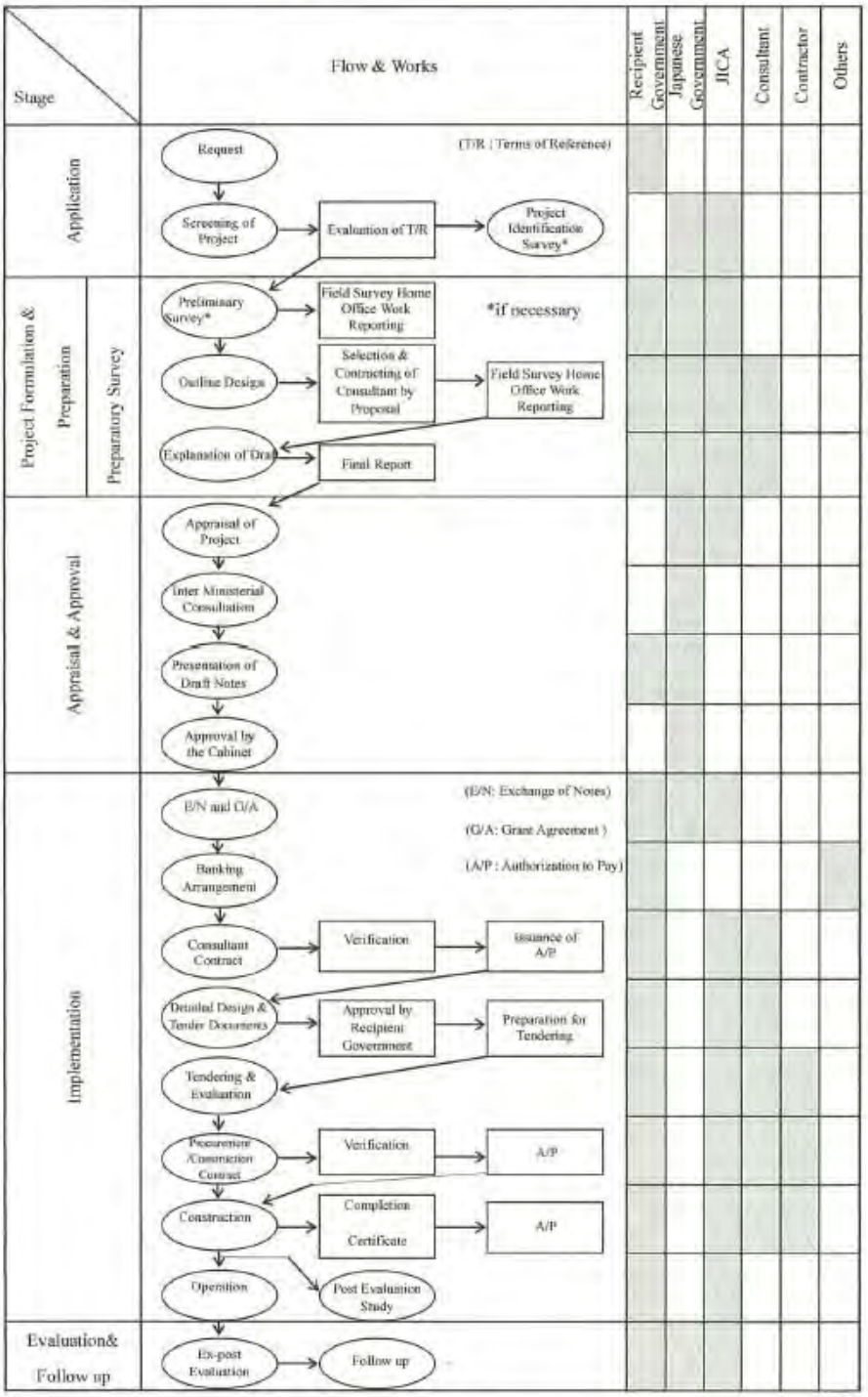
(10) Social and Environmental Considerations

A recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

(End)

Annex-5

Flow Chart of Japan's Grant Aid Procedures



Annex-6

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites;		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site (including Access road)		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame(MDF)/panel of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

(2) M/D (Minutes of Discussions) in the 3rdmission

Minutes of Discussions
of the Preparatory Survey on the Project for
The Extension of Tedzani Hydropower Station in the Republic of Malawi

In response to the request from the Government of the Republic of Malawi (hereinafter referred to as "Malawi"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for The Extension of Tedzani Hydropower Station in the Republic of Malawi (hereinafter referred to as "the Project").

JICA sent to Malawi the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Kazunari Oshima, JICA Visiting Senior Advisor. The Team is scheduled to stay in Malawi from December 8th to December 13th 2013.

The Team held discussions with the officials of Malawian authorities concerned (hereinafter referred to as "the Malawian side"). In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Lilongwe, Malawi
December 12th, 2013

Mr. Kazunari Oshima
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency

Dr. Winford Masanjala,
Principal Secretary,
Ministry of Energy

Mr. John Kandulu
Chief Executive Officer,
Electricity Supply Corporation of Malawi

ATTACHMENT

1. Objective of the Project

The objective of the Project is extension of Tedzani Hydropower Station.

2. Project Site

The Project site based on the request from the Malawian side is located in southern region of Malawi as shown in Annex-1.

3. Responsible and Implementing Organizations

(1) The responsible organization is Department of Energy Affairs (DOE).
(2) The implementing organization is Electricity Supply Corporation of Malawi (ESCOM).
(3) The organization structures of DOE and ESCOM are shown in Annex-2 and Annex-3.

4. Components of the Project

Main item requested by the Government of Malawi (hereinafter referred to as "GOM") to Government of Japan (hereinafter referred to as "GOJ") is extension of hydro power generation facility including transformer installation and transmission line to feed to existing grid.

Table Outline of the Components

	Components
Hydro power station	The type of the power generation scheme is "Run-of-River" with no sizable reservoir and may not impact on considerably both the environmental and social aspects. Extension of hydro power station shall include Intake facility, Headrace canal, Head tank, Penstock, Power house cum Turbine and Generator.
Transmission line	Two towers with height of about 30m for transmission line and 260 m conductor from the power station to the existing line with Step up transformer and Switch gear.

5. Japan's Grant Aid Scheme

(1) The Malawian side understood Japan's Grant Aid Scheme explained by the Team as described in Annex-4 and Annex-5.
(2) The Malawian side will take the necessary measures, as described in Annex-6, for smooth implementation of the Project.

6. Project Cost

The Malawian side agreed that cost of the Project should not exceed the amount agreed on Exchange of Notes (E/N). The Malawian side also agreed that the cost of the Project contains procurement cost of equipment, transportation cost up to the Project site, construction cost and Consultant fees.

7. Confidentiality of the project

(1) **Detailed specifications of the Facilities and Equipment**

Both sides agreed that all the information related to the Project including detailed drawings and specifications of the facilities and equipment and other technical information shall not be disclosed to any outside parties (i.e. outside of JICA and the Malawian side) before the conclusion of all contract(s) for the Project.

(2) **Confidentiality of the Cost Estimation**

The Team explained the estimated cost of the Project as described in Annex 7. Both sides agreed that the estimated cost for the Project should never be duplicated or disclosed to any outside parties (i.e. outside of JICA and the Malawian side) before tender for the Project. Malawian side also understood that the estimated cost for the Project attached as Annex 7 is not the final and is subject to change as a result of examination through revision of the Outline Design Study.

8. Possibility of Change in Scope, Schedule and Cost of the Project

Malawian side and the Team confirmed that the scope, the schedule, and the cost for the Project are tentative and subject to change due to the domestic circumstances in Japan and in Malawi.

9. Environmental and Social Considerations

(1) The Malawian side agreed to ensure access to the project site and undertake necessary countermeasures.

(2) The Malawian side agreed to conduct the required environmental works including Environmental Management Plan and Environmental Management Monitoring Plan.

(3) The Malawian side agreed to comply with the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "JICA Guidelines") as well as laws and regulations in Malawi, and was requested to prepare Environmental Checklist and Monitoring Form which are designated by JICA Guidelines for an outline design.

(4) The Malawian side agreed to make necessary arrangements with concerned governmental organizations in order to secure funding for and execution of the above environmental matters in a schedule as required for smooth execution of the Project.

(5) The Malawian side and the Team confirmed information on environmental and social considerations including major impacts and relevant mitigation measures are summarized in the Environmental Checklist attached as Annex-8. The Malawian side will inform JICA of any major changes which may affect environmental and social considerations made for the Project by revising the Checklist in a timely manner.

(6) The Malawian side and the Team confirmed environmental monitoring will be conducted by ESCOM in accordance with the Environmental Management Plan and Environmental Management Monitoring Plan.

10. Other Relevant Issues

(1) Coordination among relevant donors and agencies

The Team requested the Malawian side to ensure coordination among relevant donors and agencies for smooth implementation of the Project and the Malawian side agreed to it.

(2) Major Undertakings to be taken by the Malawi side

The Malawian side confirmed that major undertakings as shown in Annex-6 should be taken by the Malawian side at its expense. The Malawian side shall specify organizations which will secure enough budget and execute each item listed in the column, "To be covered by Recipient Side" as shown in Annex-6, except Gas supply and Telephone system.

(End)

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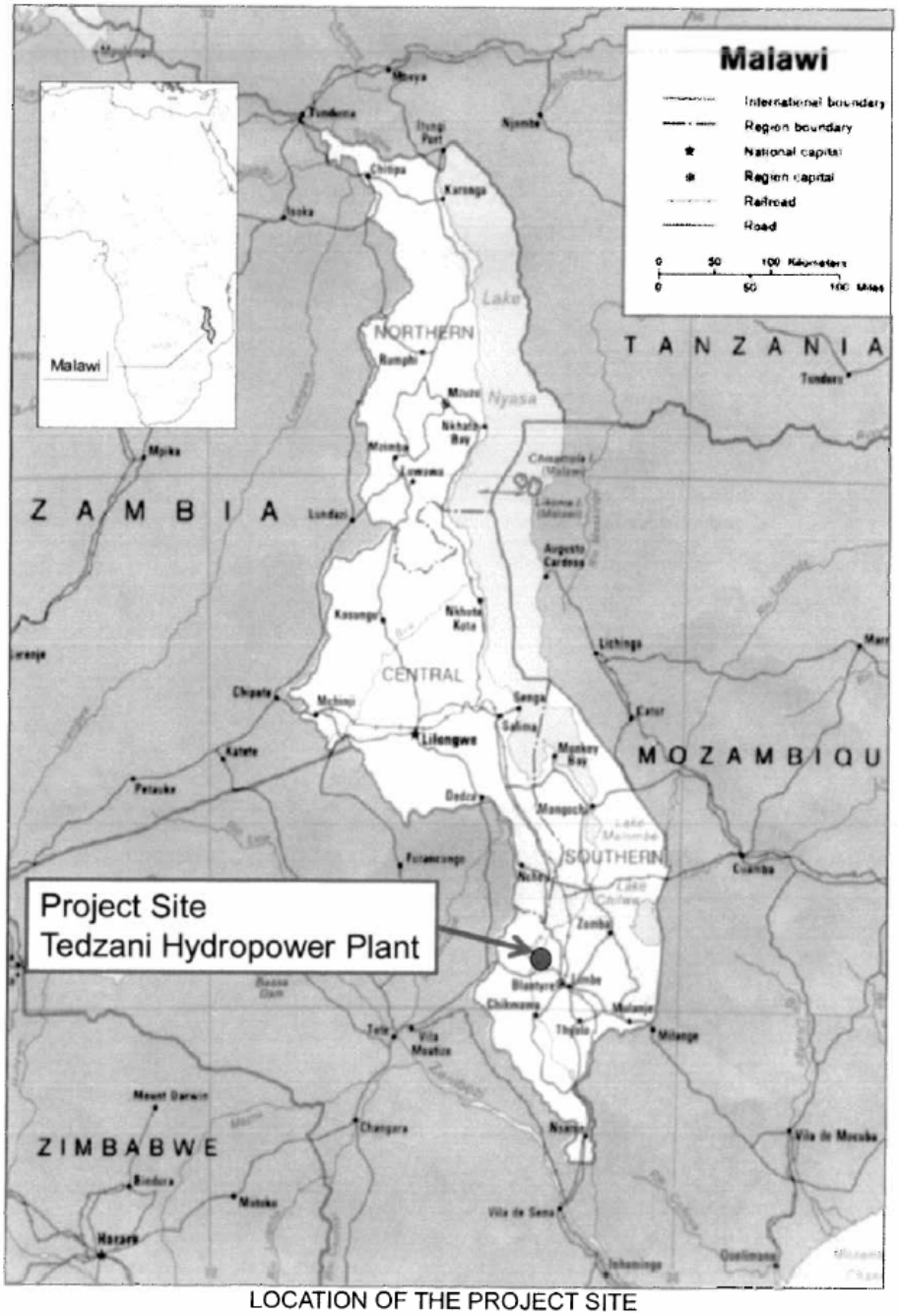
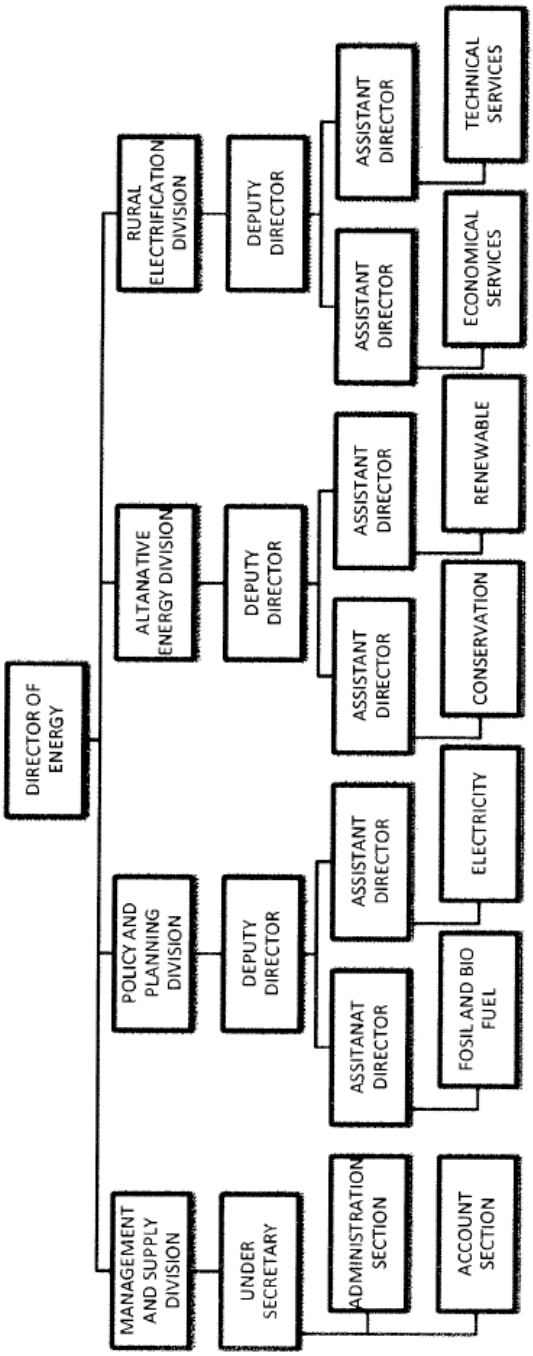
Annex-3	Organization Structure of ESCOM
Annex-4	Japan's Grant Aid
Annex-5	Flow Chart of Japan's Grant Aid Procedures
Annex-6	Major Undertakings to be taken by Each Government
Annex-7	Estimated Project Cost
Annex-8	Environmental Checklist

Annex - 1

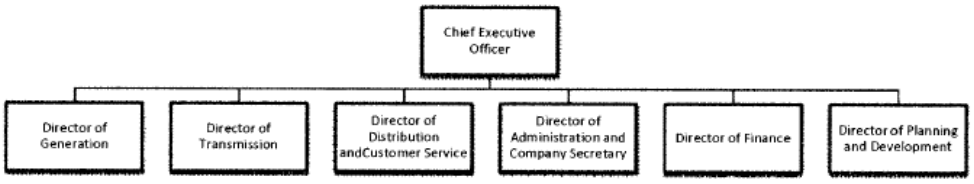


LOCATION OF THE PROJECT SITE

Annex-2


DIRECTOR OF ENERGY
MANAGEMENT AND SUPPLY DIVISION
UNDER SECRETARY
ADMINISTRATION SECTION
ACCOUNT SECTION
POLICY AND PLANNING DIVISION
DEPUTY DIRECTOR
ASSITANAT DIRECTOR
FOSIL AND BIO FUEL
ASSISTANT DIRECTOR
ELECTRICITY
ALTANATIVE ENERGY DIVISION
DEPUTY DIRECTOR
ASSISTANT DIRECTOR
CONSERVATION
ASSISTANT DIRECTOR
RENEWABLE
RURAL ELECTRIFICATION DIVISION
DEPUTY DIRECTOR
ASSISTANT DIRECTOR
ECONOMICAL SERVICES
ASSISTANT DIRECTOR
TECHNICAL SERVICES

Annex-3



ORGANIZATION STRUCTURE OF ESCOM

Annex-4

JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on the law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

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  - The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - Agreement concluded between JICA and a recipient country
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  - Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide a basic document necessary for the appraisal of the Project by JICA and the GOJ. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-6.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open

an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to pay and payment commissions to the Bank.

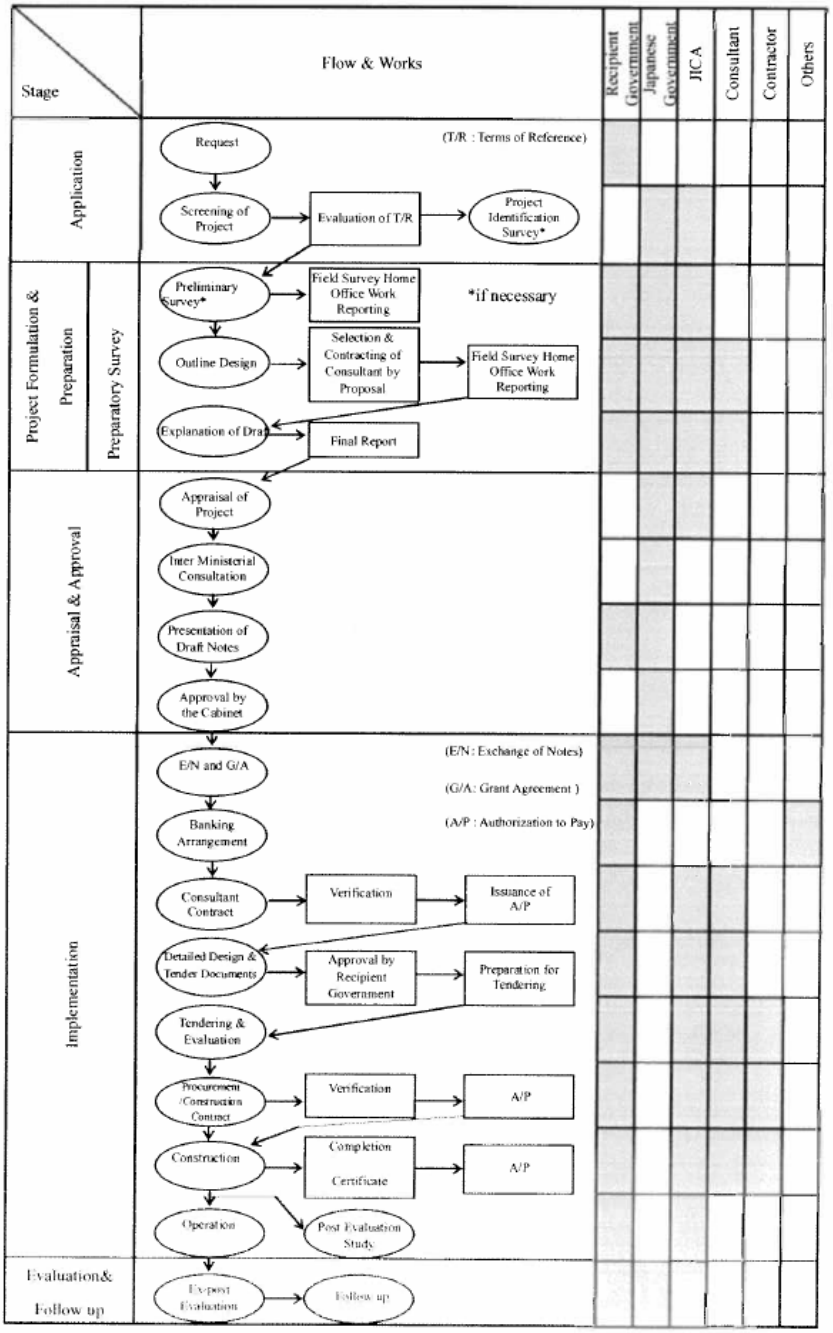
(10) Social and Environmental Considerations

A recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

(End)

Annex-5

Flow Chart of Japan's Grant Aid Procedures



Annex-6

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites;		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site (including Access road)		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame(MDF)/panel of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

Annex-7

(Confidential)

Estimated Project Cost

The cost of the Project is estimated approximately JP¥ 5,745 million in total. The content of the project cost are shown separately for the Japanese borne portion and the Malawian side borne portion in accordance with the conditions in item 3. (3) below.

This cost estimate is provisional and subject to change as a result of examination by the Government of Japan for the approval of the Grant.

1. Cost to be borne by the Japanese side: Approximately JP¥ 5,720 million

Approximate Total cost for Japanese Portion

Cost Items	Approximate Cost (US$)	Approximate Cost (million JP¥)
Equipment and materials Procurement Cost (Including costs for Civil & building works, Ocean & inland Transportation, all insurance, Temporally works, Overhead, other works necessary to complete the Project)	US$ 27.9 million	JP¥ 2,770 million
Electro-mechanical Equipment and materials Procurement Cost (Including costs for Installation works, Ocean & inland Transportation, all insurance, On the Job Training, Temporally works, Overhead, other works necessary to complete the Project)	US$ 26.5 million	JP¥ 2,630 million
Detailed Design & Consultant's Supervision	US$ 3.2 million	JP¥ 320 million
Total	US$ 57.6 million	JP¥ 5,720 million

2. Cost to be borne by the Malawi side: US$ 252,200 (=approximately JP¥ 25 million)

Cost Items	US$	(≒JP¥)
1. Expense for EMP and EMMP	US$ 8,500 -	JP¥ 844,700 -
2. Payment of bank commission based on banking ・Commission of an Authorization to Pay (A/P) ・Payment commission	US$ 60,300 -	JP¥ 6,000,000 -
3. Spare parts for turbine and generator	US$ 183,400 -	JP¥ 18,230,000 -
Approximate Total cost	US$ 252,200 -	JP¥ 25,074,700 -

3. Conditions for estimation

(1) Time of estimation: December, 2013

(2) Foreign exchange rates:
1USD = JP¥99.38 (TTS mean value from June 2013 to August 2013)

(3) Others: The above estimation was carried out in accordance with relevant rules and the guideline of the Japanese Grant Aid.

Annex-8

Environmental Checklist (Hydropower Station)

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) N (b) N (c) N (d) N	(a), (b), (c) This project is exempted from compiling EIA report by the Environmental Law, but compiling both of Environmental Management Plan and Environmental Monitoring Plan is advised/recommended as an condition of exemption project by the Ministry of Environment. Environmental Management Plan and Environmental Monitoring Plan is compiled as IEE Report carried out by JICA Study Team spontaneously. (d)Not required
	(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) N (b) N	(a) Holding SHM is not required on EIA Exemption Project by the Environmental Law (b) No Comments from local people as project activities are limited within developer's asset.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a)Three alternatives are discussed with No option
2 Pollution Control	(1) Water Quality	(a) Does the water quality of dam pond/reservoir comply with the country's ambient water quality standards? Is there a possibility that proliferation of phytoplankton and zooplankton will occur? (b) Does the quality of water discharged from the dam pond/reservoir comply with the country's ambient water quality standards? (c) Are adequate measures, such as clearance of woody vegetation from the inundation zone prior to flooding planned to prevent water quality degradation in the dam pond/reservoir? (d) Is there a possibility that reduced the river flow downstream will cause water quality degradation resulting in areas that do not comply with the country's ambient water quality standards? (e) Is the discharge of water from the lower portion of the dam pond/reservoir (the water temperature of the lower portion is generally lower than the water temperature of the upper portion) planned by considering the impacts to downstream areas?	(a) N (b) – (c) – (d) N (e) N	(a)No reservoir, No dam pond (b)No discharged water from dam (c)No reservoir, no dam pond (d)No change of water flow level (e)No reservoir, no dam pond

Environmental Checklist (Hydropower Station)

	(2) Wastes	(a) Are earth and sand generated by excavation properly treated and disposed of in accordance with the country's regulations?	(a) Y	(a)excavated earth is used for construction materials, rest of earth is carried to other and greened
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) N	(a) No
	(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) Is there a possibility that the project will adversely affect downstream aquatic organisms, animals, plants, and ecosystems? Are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that installation of structures, such as dams will block the movement of the migratory fish species (such as salmon, trout and eel those move between rivers and sea for spawning)? Are adequate measures taken to reduce the impacts on these species?	(a) N (b) N (c) N (d) N	(a) No (b) No (c) No impacts to downstream as maintenance flow is being kept (d) No migratory fish.
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the installation of structures, such as weirs will adversely affect the surface and groundwater flows (especially in "run of the river generation" projects)?	(a) N	(a) No impacts to hydrologic changes as weir is small and no large water diversion
	(4) Topography and Geology	(a) Is there a possibility that reductions in sediment loads downstream due to settling of suspended particles in the reservoir will cause impacts, such as scouring of the downstream riverbeds and soil erosion? Is there a possibility that sedimentation of the reservoir will cause loss of the storage capacity, water logging upstream, and formation of sediment deposits at the reservoir entrance? Are the possibilities of the impacts studied, and adequate prevention measures taken? (b) Is there a possibility that the project will cause a large-scale alteration of the topographic features and geologic structures in the surrounding areas (especially in run of the river generation projects and geothermal power generation projects)?	(a) N (b) N	(a) No reservoir, No dam pond (b) No impacts as small weir and no large water diversion
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?	(a) N (b) N (c) N (d) N	(a) No Resettlement (b) No Resettlement (c) No Resettlement (d) No Resettlement

Environmental Checklist (Hydropower Station)

		(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?	(e) N (f) N (g) N (h) N (i) N (j) N	(e) No Resettlement (f) No Resettlement (g) No Resettlement (h) No Resettlement (i) No Resettlement (j) No Resettlement
	(2) Living and Livelihood	(a) Is there any 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 any possibility that the project causes the change of land uses in the neighboring areas to affect adversely livelihood of local people? (c) Is there any possibility that the project facilities adversely affect the traffic systems? (d) Is there any 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 the minimum flow required for maintaining downstream water uses secured? (f) Is there any possibility that reductions in water flow downstream or seawater intrusion will have impacts on downstream water and land uses? (g) Is there any possibility that water-borne or water-related diseases (e.g., schistosomiasis, malaria, filariasis) will be introduced? (h) Is there any possibility that fishery rights, water usage rights, and common usage rights, etc. would be restricted?	(a) Y (b) N (c)N (d) Y (e) Y (f) N (g) N (h) N	(a) air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts (b) electricity supply will benefits to local people (c) No river use for transportation, not causes potential traffic jam (d) public health education is given construction works (e) maintenance water flow is planned (f) Not change the water flow level, project area is far from sea (g) No possibility as project has not created detention basin (h) No fishery rights, water usage rights at the river near project site
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) N	(a) there are no places such as religious heritages

Environmental Checklist (Hydropower Station)

	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) there are no places such as landscapes designated by laws
	(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 to be respected?	(a) N (b) N	(a) Not anticipated adverse impacts to ethnic minorities (b) Not anticipated adverse impacts to ethnic minorities
	(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) Y (b) Y (c) Y (d) Y	(a) adequate measures are written in IEE and to be implemented (b) adequate measures are written in IEE and to be implemented (c) adequate measures are written in IEE and to be implemented (d) At local office level (ESCOM) , adequate measures is to be planned
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) Y (b) N (c) N	(a) air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts (b) No impacts to surrounding natures as project not needs big civil works (c) No counter measures as no impacts to social environment
	(2) Accident Prevention Measures	(a) Is a warning system established to alert the inhabitants to water discharge from the dam?	(a) N	(a) No dam
	(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	(a) Y (b)Y (c) Y (d) N	(a) Compiling monitoring plan and its implementation is mandatory, items having possibility of adverse impact will be monitored (b) adequate items are written in IEE and to be implemented (c) At local office level (ESCOM) , adequate measures is to be planned (d)these items is not being identified by Law

Environmental Checklist (Hydropower Station)

		and frequency of reports from the proponent to the regulatory authorities?		and Guideline for the EIA Exception Project, but results of monitoring is supposed to submit regularly to DOE
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects in the mountains including large areas of deforestation). (b) In the case of dams and reservoirs, such as irrigation, water supply, and industrial water purposes, where necessary, pertinent items described in the Agriculture and Water Supply checklists should also be checked. (c) 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).	(a) N (b) N (c) Y	(a) No logging as there are no forest near project site (b) No reservoir or dam pond (c) Checklist for T/L is being compiled
	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 trans boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No impacts to global issues as a small project with no impacts to environment

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 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 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.

Annex-8

Environmental Checklist (Transmission Line)

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) N (b) N (c) N (d) N	(a), (b), (c) This project is exempted from compiling EIA report by the Environmental Law, but compiling both of Environmental Management Plan and Environmental Monitoring Plan is advised/recommended as an condition of exemption project by the Ministry of Environment. Environmental Management Plan and Environmental Monitoring Plan is compiled as IEE Report carried out by JICA Study Team spontaneously. (d)Not required
	(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) N (b) N	(a) Holding SHM is not required on EIA Exemption Project by the Environmental Law (b) No Comments from local people as project activities are limited within developer's asset.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) N	(a) No discussion as transmission line and substation is small scale size and not anticipated impacts to environment
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) N	(a) No cutting of earth and turbidity water will be discharged into the river after purification in pond.
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) N	(a) No

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Environmental Checklist (Transmission Line)

	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N	(a)surrounding of project site is mainly man-made forest and shrubbery
			(b) N	(b) Not included
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(c) N	(c)No impacts to ecosystem
			(d) N	(d) Not obstruct to animals behavior, habitats
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(e) N	(e) Not anticipated adverse impact to ecosystem
		(d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock?	(f) N	(f) project site is being developed and no natural resources
		(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?		
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?	(a) N	(a) No possibility of erosion as project site of transmission line is flat and stable slope area
			(b) N	(b) No large cutting or filling of earth
		(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) N	(c) No large cutting or filling of earth, but re-vegetation will be carried out
		(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 to prevent soil runoff?		
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?	(a) N	(a) No resettlement
			(b) N	(b) No resettlement
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(c) N	(c) No resettlement
			(d) N	(d) No 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?	(e) N	(e) No resettlement
			(f) N	(f) No resettlement
			(g) N	(g)No resettlement
		(d) Are the compensations going to be paid prior to the resettlement?	(h) N	(h)No resettlement
		(e) Are the compensation policies prepared in document?	(i) N	(i) No resettlement
			(j) N	(j) No resettlement

Annex-8

Environmental Checklist (Transmission Line)

		(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?		
	(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) N (b) N (c) N (d) N	(a) electricity supply not gives adverse impacts (b) safety and public health education will be done (c) No impacts as not so long power line and just 3 towers with height of 30m (d) No houses under transmission lines
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) N	(a) there are no places such as religious heritages
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) there are no places such as landscapes designated by laws
	(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) N (b) N	(a) Not anticipated adverse impacts to ethnic minorities (b) Not anticipated adverse impacts to ethnic minorities

Annex-8

Environmental Checklist (Transmission Line)

	(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) Y (b) Y (c) Y (d) Y	(a) adequate measures are written in IEE and to be implemented (b) adequate measures are written in IEE and to be implemented (c) adequate measures are written in IEE and to be implemented (d) adequate measures are to be planned at local office level (ESCOM),
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 adequate measures considered to reduce impacts?	(a) Y (b) N (c) N	(a) air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts (b) No impacts to surrounding natures as project not needs big civil works (c) No counter measures as no impacts to social environment
	(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) Y (b) Y (c) Y (d) N	(a) Compiling monitoring plan and its implementation is mandatory, items having possibility of adverse impact will be monitored (b) adequate items are described in IEE (c) At local office level (ESCOM) , adequate measures is to be planned (d) these items is not being identified by Law and Guideline for the EIA Exception Project, but results of monitoring is supposed to submit regularly to DOE
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) N	(a) impacts to existing road is not anticipated

Environmental Checklist (Transmission Line)

	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) N	(a) No impacts to global issues as a small project with no impacts to environment

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.

5. Minutes of Meetings

(1) Minutes of Meeting between ESCOM and TEPSCO in the 1st mission

Meeting on the Results of the First Site Survey
For
The Extension of Tedzani Hydropower Station

Date & Time: Tuesday, 30 July 2013, 10:15am

Attendance

1. ESCOM
Mr. Michael Gondwe, Senior Projects Manager.
Mr. Andrew Senzani,
Mr. Alex Kaitane.
Mr. Charles Chibambo,
Mr. Reuben Mwangonde
Mr. Binnie Banda
Mr. Justice A. Malema
Mr. Lawrence Chilimampunga
Mr. Tanda Kadammanja
Mr. Rex Muhome

2. TEPSCO
Mr. Tetsuo Tejima, Civil Engineer,
Mr. Kiminori Nakamata, Geologist

Agenda
1. Summary Report on the Extension of Tedzani Hydropower Station
2. Study on Waterway Alternatives (refer to the attached report)

Results of Discussion

1. Report of the First Site Survey
TEPSCO explained the results of the first survey for the Project as per attached "Summary Report on the Extension of Tedzani Hydropower Station."

2. Study on Waterway

Based on the survey, TEPSCO also presented the result of "the Study on Waterway Alternatives" that examine the open channel and pressure tunnel alternatives for the Project and that recommended the open channel as more cost effective for the Project.
After several discussion the open channel alternatives was adopted as most preferable to be taken forward for the Project.

3. Revision of Power Station Site

The power station site is proposed to be sited further upstream of the Tezani I Station due to space constraints in the original area that was proposed, which was close to the Tedzani I Station. TEPSCO will study further this new proposed location of the Power Station.

4. Channel Cover

ESCOM suggested that the open channel should be installed with a concrete cover for maintenance of the channel to avoid tree leaves and branches falling into the channel and blocking the screens downstream and also environmental purposes to allow the area of the channel route to be restored with vegetation (trees) after construction and hence camouflage the concrete channel. A cover would also ensure safety, especially for children, since the Tedzani area is inhabited by ESCOM staff running the Station who have families.

5. Transmission Line

JICA will check the power system whether 66kV system or 132 KV system will be used to feed the additional power into the grid. This issue will be finalized during the second site survey scheduled for September 2013.

6. Environmental Considerations

TEPSCO informed ESCOM that through a telephone conversation with Mr.Terao of DOE in the morning on 30th July 2013, it was noted that the Ministry of Environment and Climate Change Management had informed the JICA team that a full EIA was not required for the Project and had agreed that just Initial Environmental Examination (IEE) was acceptable, with some conditions.
This information will be sent to ESCOM by e-mail.

7. Data Collection

ESCOM noted that power generation data for Tedzani I, I & II Stations, from 2006 to June 2013, had been emailed to TEPSCO in the morning. It was further noted that since Tedzani I&II had been out of service for 7 years from 2001 to 2008, the power generation data for these Stations that had been provided electronically through email was for the years 2009 to June 2013. TEPSCO noted that this data would assist them to calculate spillway discharge, since there was no data for such at the Station due to lack of gauging equipment at the Spillway. In line with this missing Spillway data due to lack of gauging equipment, ESCOM requested TEPSCO to consider including the design and installation of Spillway discharge gauging equipment as part of the proposed Tedzani IV Extension Project, since this data will be greatly required during the operation of Tedzani IV Station, as the same will depend on Spillway discharge. TEPSCO took note of request and would consider it when undertaking the detailed design and costing for the Project.

8. Close of meeting

TEPSCO indicated that the team from Japan will be going back via Lilongwe on Wednesday, where they will brief the DOE on the Study findings. The next TEPSCO team will come back to Malawi in September 2013 to continue with the Study, but their local subcontractor for the survey will continue with topographic survey on site for a few more days to complete the work.

ESCOM thanked all for coming and the meeting closed at 11:30am.

SIGNED:

Michael Gondwe	Tetsuo Tejima
Senior Projects Manager,	Civil Engineer,
ESCOM	TEPSCO

29 July 2013

Study on Waterway Alternatives

1. Background of Study

Extension of the Tedzani Hydropower is to utilize the spillway discharge from the existing Tedzani dam to generate additional power.

Considering a layout of an intake and a waterway from the dam to a new Tedzani Power Station, there are two alternatives: an open channel and a pressure tunnel.

An open channel can be laid from an intake installed in the left bank in the downstream area of the spillway to a head tank on the left bank along the contour line at EL 308 approximately.

On the other hand a pressure tunnel can be constructed in the underground in the left bank from the intake to a surge tank, wherever the pressure tunnel can have enough depth over the tunnel.

Although the open channel is required to be installed on the surface of the left bank, the quantities of open excavation and concrete works exceed the pressure tunnel.
Unit costs of tunnel excavation and concrete works are, however, higher than that the open works.

Since there are advantage and disadvantage of both alternatives in design and cost, a following comparative study was carried out to determine the optimum layout for the Project.

(1) Conditions of Power Generation
(2) Layout of the Waterway
(3) Results of Site Survey
(4) Main Work Quantities
(5) Cost Comparison

2. Conditions of Power Generation

The comparative study for the waterway lay out was carried out under the following

hydraulic conditions:

(1) Reservoir level: HWL 318.53
LWL 315.78

(2) Intake water level: WL311.5 for the open channel
WL310.5 for the pressure tunnel

(3) Tail water level: TWL271.950

(4) Effective Head

Open channel

Gross head for open channel=311.5-271.95=39.55m

Head loss for open channel= 2.7m

Effective head= 39.55-2.7=36.85m

Pressure tunnel

Gross head for pressure tunnel=310.5-271.95=38.55m

Head loss for open channel= 1.7m

Effective head for pressure tunnel=38.55-1.7=36.55m

(5) Power generation

The assumption was made for the maximum discharge of the extension project will be 70m^3/s for both alternatives.

Power generated by both the pen channel and pressure tunnel will be:

$P = g \times Q \times He \times \eta = 9.8 \times 70 \times 38.55 \times 0.86 = 21.7MW$

There is no difference in power generation between the open channel and pressure tunnel alternatives.

3. Layout of Waterway

The layout of both the open channel and the pressure tunnel are shown in the drawings. The particular features of each alternative are described below.

(1) Open channel

The spillway discharge will be collected by a small dam constructed in the downstream are of the existing dam.

The sideway intake takes in water to the open channel that conveys the water for about 699m from the intake to a head tank installed in the upstream area above the power station site. In the middle of the open channel, the open channel has to cross the stream by siphon or a bridge for about 70m.

From the head tank, penstock will be installed on the slope to lead the water to a powerhouse for 109m.

In the powerhouse, a vertical Kaplan turbine and generator will be installed.

(2) Pressure tunnel

From the sideway intake and the open channel for 80m from the intake are same layout as of the open channel.

A large pond will be installed at the end of 80m open channel where a morning glory type inlet and vertical shaft for 32m will be installed to take the water into the pressure tunnel.

The pressure tunnel coveys the water for 550m from the vertical shaft to a surge tank. After the surge tank, penstock will lead water for 87m to the power station inlet valve.

The vertical Kaplan turbine will be installed in the powerhouse.

4. Survey Results

The topographic survey reveals that the power station site below the existing Tedzani I switchyard has no area to accommodate the power station building due to the steep slope on the left bank.

After exploring more upstream area it was found that the power station can be relocated to 100m upstream.

This relocation is necessary for the both the open channel and pressure tunnel alternatives.

5. Main Work Quantities

Although the power station site is proposed to relocate further upstream, the cost

comparison was made based on the original power station site below Tedzani I switchyard.

The major quantities of each alternative are estimated based on the layout drawings and cross sections derived from the 1/1000 map.

The open channel work layout needs only open works for the project, while the pressure tunnel alternatives requires both tunnel and open works for excavation and concrete works as shown in the Table-1.

The open channel requires about 120,000m3 of open excavation that is two times that of the pressure tunnel, but the tunnel needs 25,000m3 of tunnel excavation and 8,600m3 of tunnel concrete works.

Table -1 Major Quantities of Civil Works for Open Channel and Pressure Tunnel

Works	Open Channel Works		Tunnel Works	
	Excavation(m^3)	Concrete (m^3)	Excavation(m^3)	Concrete (m^3)
1.Open Channel				
Intake Dam	7,472	3,031		
Intake	3,502	3,289		
Open Channel	42039	4,189		
Siphon	2,398	771		
Head Tank	13,252	4960		
Powerhouse	34,263	1283		
Total of Open Channel	119,955	27,523		
2. Pressure tunnel				
Intake	9,253			
Inlet	9,101			
Tunnel			19,256	6,586
Surge Tank	2,341	1,083	2058	550
Penstock	34,263		2,563	1,460
Powerhouse	6,523	10,000		
Total of pressure Tunnel	61,491	17,097	25,146	8,596

6. Cost Comparison

The cost estimate was made for the Civil Works, Hydro-mechanical Works for gates and penstock, and the Electro-mechanical Works.

Other cost such as preparatory works and cost for environment was priced at 1 % of the Civil Works.

The project management and contingency were counted at 10 % of the total of the direct cost.

From this cost comparison, the cost of pressure tunnel alternative is higher than the open channel at 27%, mainly due to the tunnel excavation and concrete works.

Table -2 Cost Comparison between Open Channel and Pressure Tunnel (1US$=¥100)

Work Items	Open Channel(US$)	Tunnel (US$)	
1. Preparatory Works(1%of Civil)	110,400	188,860	1 % of Civil Works
2. Environment	110,400	188,860	1% of Civil Works
3. Civil Works	11,039,790	18,885,570	
(1) Intake Dam	457,430	457,430	
(2) Intake	647,750	647,750	
(3) Siphon/Bridge	822,880	554,580	
(4) Open Channel/Tunnel	3,936,200	11,570,600	
(5) Head Tank/Surge Tank	1,185,070	252,870	
(6) Penstock and Spillway	449,480	1,736,020	
(7) Powerhouse	3,021,120	3,021,120	
(8) Tailrace	69,870	69,870	
(9) Outlet	233,500	205,502	
(10) Other minor works	216,470	370,371	
4. Hydro-mechanical Works	1,094,400	907,200	
5. Electro-mechanical Works	16,136,620	16,136,620	
Total of Direct Cost 1 to 5	28,491,610	36,307,110	
6. Project Management	2,849,161	3,630,711	10% of Direct Cost
7. Contingency	2,849,161	3,630,711	10% of Direct Cost
Total	34,189,930	43,568,530	
Open Chanel/Tunnel cost	100 %	127%	

7. Results and Recommendation

The results of the cost comparison between the open channel and pressure tunnel indicate that:

(1) The power generation shows almost same output of 21 MW at discharge of 70m³/s.

(2) Work quantities differ much in underground works:

Works	Open Works(m3)	Tunnel Works(m3)
Excavation work		
Open Channel	120,000	O
Pressure Tunnel	61,500	25,000
Concrete work		
Open Channel	27,000	0
Pressure Tunnel	17,000	8,600

(3) The project cost will be US$34.2 million for the open channel, while it will be US$43.6 million for the pressure tunnel.

(4) In addition to the above, the open channel alternative can proceed the works at several locations along the open channel site so that construction works are more flexible to control work progress during construction.

Considering the above, the open channel layout is recommended for the Tedzani extension project.

Further study and geological survey shall be based on the open channel waterway.

(2) Minutes of Meeting between ESCOM and TEPSCO in the 2nd mission

Meeting on the Results of the Second Site Survey
For
The Extension of Tedzani Hydropower Station

Date & Time: Wednesday, 18 September 2013, 11:00am to 2:00pm

Attendance

1. ESCOM
Mr. Evans Msiska – Director of Generation
Mr. Peter Mtonda – Director of Distribution & Customer Service
Mr. Michael Gondwe - Senior Projects Manager.
Mr. Andrew Senzani,- Chief Planning & Design Engineer
Mr. Justice A. Malema - Surveyor
Mr. Lawrence Chilimampunga – Environmental & Wayleave Officer
Mr. E. Kamoto – Senior Operations Engineer – Tedzani Power Station
Mr. G. Kamthunzi – Generation Performance Monitoring

2. Department of Energy Affairs
Mr. Khumbolawo Lungu
Mr.W. Silewa

3. TEPSCO
Mr. Tetsuo Tejima, Civil Engineer,
Mr. Shigeki Wada, Enviroment Expert,
Mr. Keiji Wakamatsu, Tansmission Line Engineer,
Mr.Tomoki Irei, Procurement Engineer,
Mr.Yuichiro Hirohashi, Hydrologist

Agenda
1. Study on Installed Capacity and River Maintenance Flow
2. Transmission Line System
3. Environmental Monitoring Plan
4. Electrical and Mechanical Works of the Tedzani Extension Project
5. Undertakings of Malawi Goverment

Results of Discussion

1. Study on Installed Capacity and River Maintenance Flow

JICA Team presented the report "Study on Installed Capacity and River Maintenance Flow" that reported the comparative study of the installed capacity of 18,700 kW with the maximum discharge of 60m^3/s, 21,800 kW with 70m^3/s and 24,900 kW with 80m^3/s with the river maintenance flow condition.

JICA Team recommended the installed capacity of 21,800 kW, since it showed minimum cost per kWh with zero maintenance flow and it indicated same level of low cost with maintenance flow at 10m^3/s.

JICA Team explained that there they had not come across any Malawi government environmental law or regulation on the issue of river maintenance flow.

ESCOM however informed JICA that the issue of river maintenance flow in Malawi might not be contained in the environmental law, but the Water Resources Act, which is the Law that regulates the use of all water bodies in Malawi. ESCOM thus further advised that it was important to check with the Water Resources Board on this issue for advice with regard to the guidelines for minimum release of water.

The meeting agreed that DOE would check with the Water Resources Board on river water release requirements and inform JICA Team accordingly.

Although the minimum river maintenance flow had not been determined, ESCOM and DOE agreed that the installed capacity of 21,800 kW, with 70m^3/s maximum discharge, was the most optimum and hence worth pursuing for further detailed studies leading to development.

2. Transmission Line

JICA Team reported that their proposal was for the transmission line to be connected into the national power grid through Tedzani I and II Switchyard.

The transmission line would run from the main step-up transformer for the Tedzani IV

Power Station to the Tedzani I and II switchyard, using at least 2No. transmission line towers. The feed-in voltage into Tedzani I&II Switchyard would be 66kV.

ESCOM inquired whether JICA Team studied cost comparison between an overhead line and underground cable system.

JICA Team reported that the comparison study had been done and overhead line system showed lower costs than the underground cable.

JICA Team enquired whether ESCOM had undertaken power flow analysis to determine whether the existing 66kV lines out of Tedzani I&II Switchyard had the capacity to transfer the power to be generated from the proposed Tedzani IV into the national grid.

ESCOM stated that static load flow calculation had been done and confirmed that power from Tedzani IV could be sent through Tedzani I and II switchyard and into the national grid using the existing 66kV lines.

JICA Team requested that the results of power flow calculation be provided to JICA Team for their information.

ESCOM informed the JICA team for their information that the power from Tedzani III is sent to Tedzani I and II switchyard through a 66kV underground cable line.

3. Environmental Monitoring Plan.

(1) JICA Team reported that the Departmental of Environmental Affairs had confirmed that Environmental Impact Assessment was not required for the proposed Tedzani IV, but Environmental Monitoring Plan and Environmental Operation Plan were required, both of which would be submitted in the draft final Feasibility Study Report.

(2) JICA Team confirmed that there was no primeval forest, tropical forest or valuable habitats of flora and fauna in the project site.
It was further noted that although Nile crocodiles were identified, these are just protected by Law but are not listed as threatened spices by IUCN and hence do not need any special attention, apart from sensitizing people during the Project implementation period of the law prohibiting unauthorized killing of the crocodiles

(3) JICA Team confirmed that no involuntary resettlement caused by the project was envisaged.

It was also confirmed that the Tedzani IV project is categorized "B" in accordance with JICA guidelines.

4. Electrical and Mechanical Works

(1) Relationship between Turbine Output and Net Heads

JICA Team proposed the operation method of the Tedzani IV Power Station as follows: When the nest head exceeded the design head of 37 m, the maximum turbine output, 23000kW, would be maintained; and when the head was less than the design, then the outputs would be decreased, even with 100% guide vane opening.

ESCOM agreed with the turbine operation proposal.

(2) Turbine Type and Construction

ESCOM agreed with the proposal for a Francis Turbine type.
JICA Team noted that the proposal was also to have the Turbine Runner dismantled from the draft tube, as was the case with Tedzani III Turbines, with adoption of the intermediate shaft between the turbine shaft and the generator shaft.

(3) Operational Method of Guide Vane

JICA Team proposed two methods of servo motor system for operation of the guide vane, namely; oil pressure driven system; and electric motor driven system.

ESCOM requested JICA team to provide more information about the electric motor driven system, such as existing power station, in Japan or elsewhere, where such electric motor driven system was adopted, including advantages and disadvantages in terms of operation and maintenance.

(4) Short Circuit Ratio (SCR)

JICA team reported that since they could not find any design details for the Tedzani I&II machines, they had decided on an SCR of 0.95.

ESCOM noted that since the proposed Tedzani IV machines would be operating in parallel to the Tedzani I&II machines, since Tedzani IV will be connected with Tedzani I and II Switchyard, their SCR ratio had to be the same. .

JICA Team were to check the name plate of the Tedzani I and II machines to find out the SCR for the machines.

Post Meeting Note 1: JICA Team checked the nameplates and found that there was no information on the name plate of Tedzani I&II generators indicating the SCR, so SCR would be as recommended, i.e. 0.95 as originally proposed by JICA Team

Post Meeting Note 2: After getting above report from JICA Team that the SCR was not indicated on the Tedzani I&II machines, ESCOM checked again in their Projects Library for Tedzani technical documentation and managed to find the Tedzani II Turbine and Generator Contract of 1974, which contained all the detailed specifications for the machines, including SCR. The document was handed over to JICA Team to copy for reference. The SCR as read in the Tedzani II specifications would thus be adopted by JICA Team in for Tedzani IV.

(5) Outlet Air Temperature

ESCOM requested JICA Team to check the Tedzani I and II generator name plate for information on outlet air temperature for possible adoption of the same for Tedzani IV machines.

Post Meeting Note1: JICA Team checked and found that the generator name plate of Tedzani I&II does not indicate the outlet temperature, so the insulation level would be taken as being the same as that of Tedzani III, which was insulation level " F ".

Post Meeting Note 2: ESCOM managed to locate the full technical specifications of Tedzani I&II machines (which would include the information on outlet air temperature

noted not to be indicated on the nameplates) and handed over the same to JICA Team for reference.

(6) Rectifier for Excitation System

JICA Team proposed two independent ignition circuits for manual and automatic control methods.

ESCOM agreed to the proposal.

(7) Synchronization at low voltage side

JICA Team proposed synchronization at low voltage side of Tedzani IV station.

ESCOM noted that Tedzani I&II Station, and indeed all other ESCOM Stations, were synchronized at high voltage side. ESCOM requested JICA Team to check Tedzani I and II Station and verify.

Post Meeting Note: JICA Team checked and noted that Tedzani I Station was indeed synchronized at high voltage side, so Tedzani IV shall be designed to be synchronized at high voltage side as well.

(8) Operating Mode

JICA Team proposed that the Tedzani IV will not have an emergency diesel generator for black start.

ESCOM requested JICA Team to consider in their design for the emergency generator of Tedzani I and II to supply its power directly to Tedzani IV station, since a much higher rated standby diesel generator was being procured for Tedzani I&II Power Station which would have the capacity to serve the proposed Tedzani IV Station as well. This meant that the Emergency generator of Tedzani I and II will be connected with Tedzani IV generator.

JICA Team confirmed that this connection was possible and hence would take the suggestion into consideration in the design of Tedzani IV.

It was further noted that since the emergency generator would be procured by ESCOM as part of Tedzani I&II Station equipment, it was recommended that connection of the emergency generator with Tedzani IV generator should be undertaken by ESCOM

JICA Team proposed the breaking current of the circuit breaker of 25kA, and ESCOM agreed to the JICA proposal.

(9) Firefighting system

JICA proposed the firefighting system by portable dry chemical fire extinguisher and portable CO_2 extinguisher, the same as had been read in the Tedzani III tender documents specifications.

ESCOM noted that there were already plans to upgrade the Tedzani III Station fire fighting system to automatic firefighting system and automatic CO_2 firefighting system. It was thus expected that the Tedzani IV Station would have the same level of firefighting system and fire detection system.

JICA Team agreed to take this proposal on board in their design of the Tedzani IV fire fighting system.

(10) Single Line Diagram of Tedzani III

It was agreed that ESCOM would provide the existing single line diagram on 19 September 2013 in the Tedzani Station office.
At the time of the meeting on 23 September, the single line diagram was not available.
ESCOM to continue to search the drawings.

(11) Spare Parts

JICA Team presented a list of proposed spare parts for Tedzani IV Station for approval by ESCOM.

ESCOM requested to be given time to study the list and provide comments and it was agreed that the list would be finalized on Monday, 23 September 2013.

ESCOM accepted the list of spare parts that JICA Team had prepared and presented, but noted that in the review, ESCOM had not considered any critical spares outside the list that had been presented. Thus ESCOM to look at other critical spare parts that might be required and to provide information on the same to JICA Team as soon as possible.

5. Major Undertakings to be taken by the Malawi Government

JICA Team submitted a list of the undertakings that was agreed between the Malawi Government (DOE and ESCOM) and JICA officials during the first JICA survey in July 2013, as recorded in the Minutes of Discussion, signed on 12th July 2013.

Among these undertakings, the following items were discussed and confirmed, which government organizations will be responsible for each undertaking.

The item number and words underlined below are as quoted from the Annex -6 of the Minutes of Discussion.

No.1
To secure lots of land necessary for implementation of the project and to clear the sites.

ESCOM will provide the land for the project, but site clearing within the Work Site shall be carried out by the contractor as part of his contractual obligation of his contract.

No.2
To construct the following facilities
2) The gates and fences in and around the site

The Tedzani Power Station area is already surrounded by the fence.
Within the Tedzani Power Station Area, the Work Site shall be surrounded by a fence constructed by the Contractor for his safety control, as part of obligation of his contract.

3) Road out side the site

The access roads outside the site have been constructed by ESCOM, hence there was no need for further construction of access road outside the Project Site, from the Tedzani security gate to the national road.

Maintenance of the access roads is currently done by ESCOM, but participation of the contractor during project execution was expected as part of his contractual obligation due to operation of heavy traffic during the construction.

ESCOM also suggested that the heavy traffic should use the access road via Nkula Power Station (about 15km to the main National Road), since the direct access from the National Road to the Tedzani Dam site (about 6.8 km) was not constructed for heavy duty traffic.

Post Meeting Note: As JICA Team enquired the JICA Head Office in Tokyo, JICA Head Office insisted that the access road out of the ESCOM land should be maintained by ESCOM, not by the contractor.

No.3
To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for implementation of the Project out side the site

1) Electricity, a. The distributing power line to the site

ESCOM will provide the power line to the designated terminal points and supply this power without charge, but during construction the contractor should install his own emergency generators for his works to protect his site works in the event of any failure of the ESCOM power, as the contractor's contractual obligation.

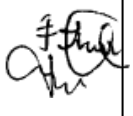
2) Water Supply, a. The distribution main to the site

ESCOM will supply the potable water to the terminal points.

3) Drainage, a The city drainage main (for storm sewer and others to the site)

ESCOM has already established the drainage system in his existing Tedzani Power Station area.

4) Gas Supply, a. The city gas main to the site



Although this clause agreed by ESCOM, ESCOM cannot supply the city gas to the Project since there is no such gas supply system in the Tedzani Power Station area.
Design consideration should thus be given to the fact that the heating system in the kitchen of the powerhouse building will be provided by electricity.

5) Telephone System , a. The telephone trunk line to the main distribution frame (MDF)/panel of the building.

ESCOM will supply the telephone trunk line to the control room in the powerhouse building.

6) Furniture and Equipment, a. General furniture

ESCOM will provide the general furniture required in the powerhouse building.

No.4
To secure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products.
2) Tax exemption and custom clearance of the Products at the port of disembarkation

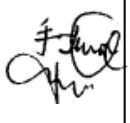
DOE will take charge of tax exemption issue for the Project.

No.5
To ensure the customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and services be exempted.

DOE will take charge of the tax exemption issue for the Project.

No.6
To accord Japanese nationals whose services may be required in coordination with supply of the products and the services such facilities may be necessary for their entry into the recipient country and stay therein for the performance of their work.

DOE will support provision of the work visa and other government procedures for



expatriates for implementation of the Project.

No. 7
To ensure that facilities and the products be maintained and used properly and effectively for the implementation of the Project.

ESCOM will operate and maintain the Tedzani IV Power Station.

No.8
To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project.

Both DOE and ESCOM cannot determine taking this responsibility, since "all the expenses" should be defined in details.

Post Meeting Note: JICA Team confirmed that this clause applies to the minor payments such as the government cost for implementation of the Project.

No.9
To bear the following commissions paid to the Japanese bank for banking services based upon the B/A (Banking Arrangement)

ESCOM requested JICA Team what are the condition for other JICA grant projects.
JICA will report this issue on Monday, 23 September 2013.

Post Meeting Note: It was later confirmed that recipient country shall pay commissions for the Japanese Grant Project.

No.10. To give due environmental and social consideration in the implementation of the Project.

ESCOM will operate and maintain the Tedzani IV Power Station after handover from the contractors.

Post Meeting Note: ESCOM stated that confirmation of the items No.8 and No.9 above

are out of this meeting for the Preparatory Survey, since these clauses refer to the agreement between the Malawi and Japanese Governments.

6. Name of the Tedzani Power Station

JICA Team proposed to refer the Extension of Tedzani Power Station as Tedzani IV Power Station, after the Tedzani I&II, and III Power Stations.

ESCOM thanked all for coming and the meeting closed at 2:00 pm.

SIGNED:

Khumbolawo Lungu
Chief Energy Officer,
Department of Energy Affairs

Michael Gondwe
Senior Projects Manager,
Civil Engineer,
ESCOM

手嶋哲夫

Tetsuo Tejima
Civil Engineer,
JICA Tedzani Extension Project
Survey Team

5 September 2013

Study on Installed Capacity and River Maintenance Flow

1. Background of Study

The first site survey was carried out for the Tedzani Hydropower Extension Project in July 2013.

After the results of the site survey, the survey team concluded that:

(1) A non-pressure culvert type waterway was adopted for a headrace as the result of the meeting held with ESCOM on 30 July 2013.

(2) The power station site is relocated to a farther upstream area of the Tedzani I and II power station, since the originally proposed site right below the Tedzani I and II switchyard was too narrow for the power station.

(4) The Shire River flow data were collected from the Liwonde gauging station.

(5) There is neither environmental law nor regulation to release water for the river course section from the Tedzani Spillway to the outlet of Tedzani I and II power station, but maintenance flow might be necessary for river environment.

In order to determine the most economic installed capacity of the Tedzani Extension Project, a comparative study was carried out for the maximum discharge alternatives for 60 m^3/s, 70 m^3/s and 80 m^3/s with maintenance flow.

2. Conditions of Power Generation

The comparative study for the installed capacity out was carried out under the following conditions:

(1) Hydraulic conditions

The study was made under the following hydraulic conditions.

Table -1 Hydraulic Conditions

Intake water level	312.901	Based on the design
Tailrace water level	272.500	Tedzani III 272.300+0.2m
Gross head	40.401	
Overall head loss	3.401	including 0.388m for others
Effective head	37.000	for 60, 70 and 80m^3/s

(2) Power generation

The assumption was made for the maximum discharge of the extension project to 60 m^3/s, 70 m^3/s and 80 m^3/s.

Power generated by the alternative will be:

$P = g \times Q \times He \times \eta = 9.8 \times 60 \times 37.000 \times 0.86 = 18,700$ kW

= 9.8 x 70 x 37.000 x 0.86 = 21,800 kW

= 9.8 x 80 x 37.000 x 0.86 = 24,900 kW

The flow duration data was derived from the Liwonde Gauging station from 2003 to 2006.

3. Site Survey

The topographic survey reveals that the power station site below the existing Tedzani I switchyard is too small area to accommodate the power station building due to the steep slope on the left bank.

After exploring farther upstream area it was found that the power station can be relocated to about 100 m upstream in the left bank.

4. Design Considerations for Alternatives

The comparative study considerers dimensions of the headrace culvert, head tank penstock and spillway and tailrace according to each discharge..

The following design consideration was made for each discharge alternative.

(1) Layout of the Waterway

The intake structure will be installed in the downstream area of the far left spillway.

The spillway discharge will be released to a low channel , a 15.24m wide and 1.6 m high for 113m long to confine the discharge. About 60 m downstream from the spillway, the sideway intake is installed in the left bank to take in water to a open channel.

After the sideway intake, a box culvert, 5m wide and 4m high for 70m^3/s alternative, is installed for 590 m to covey the water with 1/500 slope to a head tank.

.

After the head tank, the penstock is installed for 99 m from the head tank to an inlet valve in the powerhouse.

The powerhouse accommodates one unit of a turbine and generator.

The discharge is released from a draft tube outlet to a tailrace for about 45 m to the Shire River.

(2) Intake

The spillway discharge will be collected by a small dam constructed in the downstream of the existing dam.

The sideway intake that has 40 m long that overflows water to a open channel.

(3) Headrace

The headrace has a box culvert type structure having 4.5 m wide for 60m^3/s alternative, 5.0 m for 70m^3/s and 5.5 m for 80 m^3/s alternative.

The inside height of the culver will be 4 m with the water level of 3.5 approximately for all the alternatives.

(4) Head Tank

A head tank will be installed at the end of the headrace.

The head tank has a surface area of 1300 m^2 and volume of 8900m^3 that corresponds to 2 minutes of the maximum discharge of 70m^3/s.

The width of the tank is revised to be 16 m for 60m^3/s alternative and 24 m for 80m^3 /s alternative.

(5) Penstock

The penstock diameters were selected for 3.7 m for discharge of 60m^3/s, 4 m for 70 m^3/s, and 4.3 m for 80m^3/s.

5. Main Work Quantities

The major quantities of each alternative are estimated from the layout drawings and cross sections derived from the 1/1000 map.

Table -1 Major Quantities of Civil Works for Alternatives

Max. Discharge	$Q_{max.}$ 60 m^3/s		$Q_{max.}$ 70 m^3/s		$Q_{max.}$ 80 m^3/s	
Works	Excavation (m^3)	Concrete (m^3)	Excavation (m^3)	Concrete (m^3)	Excavation (m^3)	Concrete (m^3)
1. Intake	15,759	5,960	15,759	5,960	15,759	5,960
2. Siphon/Brdige	2,398	771	2398	771	2398	771
3.Headrace	25,293	5,782	27,513	7,434	29,698	10,290
4.Head tank	21,747	4,818	24,039	4,959	27,476	5,100
5. Penstock	6,949	1,552	7,552	1,991	8,156	2,389
6.Spillway	3,258	2,707	3,541	3,470	3,824	4,164
7. Powerhouse	12,262	13,955	46,692	13,955	46,692	13,955
8.tailrace	12,403	754	12656	967	13,688	1,160
Total	100,070	36,299	105,720	39,506	113,240	43,789

6. Cost Comparison

The cost estimate is made for the Civil Works, Hydro-mechanical Works for gates and penstock, and the Electro-mechanical Works.

Other costs such as preparatory works and cost for environment are assumed to be 1 % of the Civil Works.

The project management and contingency are counted at 10 % of the total of the direct cost.

Table -2 Cost Comparison between Open Channel and Pressure Tunnel (1US$=¥100)

Work Items	60 m^3/s(US$)	70 m^3/s(US$)	80 m^3/s(US$)
1. Preparatory Works(1%of Civil)	141,770	158,130	182,770
2. Environment	141,700	158,130	182,770
3. Civil Works	14,176,740	15,812,770	18,276,940
(1) Intake Dam	1,288,470	1,288,470	1,288,470
(2) Siphon/Bridge	822,880	822,880	822,880
(3) Open Channel/Tunnel	4,932,490	6,156,280	8,202,280
(4) Head Tank/Surge Tank	1,228,700	1,276,180	1,339,860
(5) Penstock and Spillway	702,660	885,380	1,051,620
(6) Powerhouse	4,235,230	4,235,230	4,235,230
(7) Tailrace	688,330	838,280	978,220
(8) Other minor works	277,980	310,005	358,370
4. Hydro-mechanical Works	1,096,800	1,173,600	1,327,200
5. Electro-mechanical Works	16,475,670	18,541,820	19,835,020
Total of Direct Cost 1 to 5	32,032,740	35,844,450	39,804,710
6. Project Management	3,203,270	3,584,444	3,980,470
7. Contingency	3,203,270	3,584,444	3,980,470
Total	38,439,290	43,013,340	47,765,650

7. Annual Power Generation and Spillway Maintenance Flow

The annual power generation was estimated based on the Shire River daily discharge at Liwonde from 2003 to 2006.

During this period, the annual average discharge is 358 m^3/s .

The discharge from the spillway is derived by the daily discharge minus 278 m^3/s of the total discharge of Tedzani I, II and III power stations.

The available water for the Tedzani IV station is also deducted for the assumed maintenance flow at 0 , 10, 20 and 30 m^3/s for the spillway.

8. Results of Comparative Study

(1) Annual Power generation

The results of the power generation are estimated for each plant discharge and maintenance flow.

Table-3 Annual Power generation and maintenance Flow (GWh)

Maintenance Flow (m^3/s)	$Q_{max.}$ 60m^3/s	$Q_{max.}$ 70m^3/s	$Q_{max.}$ 80m^3/s
	18,700kW	21,800 kW	24,900 kW
0	160.3	182.9	200.0
10	154.2	172.3	184.9
20	145.7	158.1	164.2
30	130.6	135.5	135.7

GWh= 10^6 kWh

(2) Cost per kWh

The cost per KWh is derived for each maximum plant discharge and maintenance flow

Table-4 Result of Cost per KWh (US Cent/kWh)

Maintenance Flow (m3/s)	$Q_{max.}$ 60m^3/s	$Q_{max.}$ 70m^3/s	$Q_{max.}$ 80m^3/s
	U$ 38,439,239	U$ 43,013,340	US$ 47,765,650
0	24.0	23.5	23.9
10	24.9	25.0	25.8
20	26.4	27.2	29.1
30	29.4	31.7	35.2

If there is no maintenance flow, the maximum discharge at 70 m^3/s shows the lowest cost of US 23.5 Cent/kWh.

As the maintenance flow increases, the smaller installed capacity shows better cost performance, since annual energy will be reduced with higher plant discharge and the maintenance flow.

(3) Recommended Installed Capacity

Although the comparative study shows that the plant with 60m^3/s is most economical for the maintenance flow over 10m^3/s, the plant with 70m^3/s is recommended ,since:

(a) The 70m^3/s plant shows almost same cost per kWh value to the 60m^3/s up to the maintenance flow at 10 m^3/s.

(b) The higher installed capacity is advantageous for the future power supply capability.

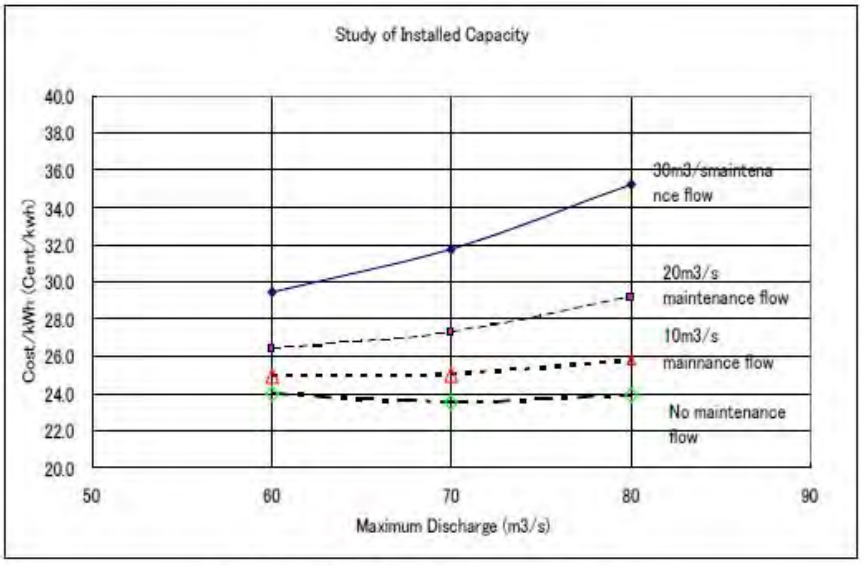


Fig.-1 Results of Installed capacity Analysis

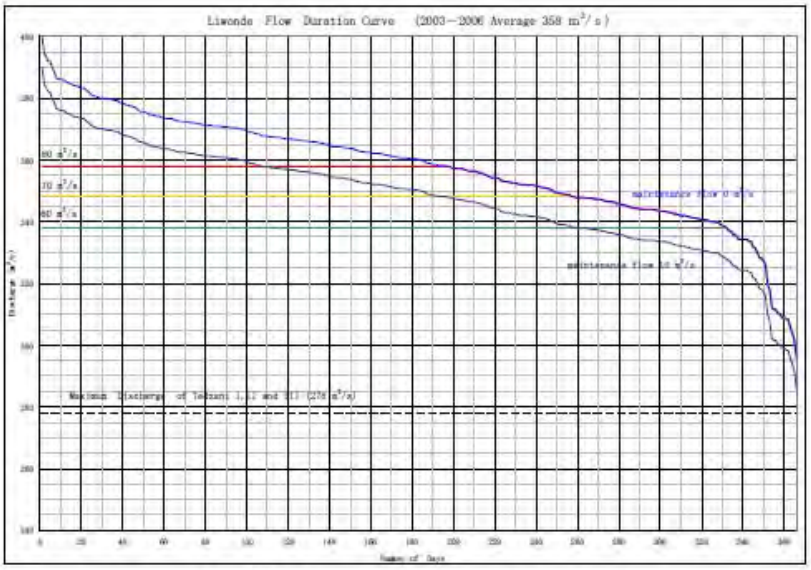


Fig.-2 Flow Duration of Tedzani Extension Project

(3) Minutes of Meeting between ESCOM and TEPSCO in the 3rd mission

Minutes of Discussion
between ESCOM and TEPSCO, on December 10, 2013 at Conference Room of DOE

ITEM		DESCRIPTION	ACTION
1	Power Supply	TEPSCO requested ESCOM to supply electricity mainly for pumping and lighting during construction (45KVA). ESCOM agreed.	ESCOM to cross check available power capacity. To be discussed during detail design.
2	Disposal Area	TEPSCO requested ESCOM to designate possible disposal area within 1km from the excavation area. ESCOM agreed.	ESCOM will check possible disposal area.
3	Water Supply	TEPSCO requested ESCOM to supply clean water to the power house of Tedzani IV to be used as utility and secondary cooling water of generation facilities. ESCOM agreed.	ESCOM to cross check available water capacity
4	Guard House of Substation	ESCOM requested TEPSCO to take care of the guard house and the access road to the guard house when installing new transmission lines. TEPSCO agreed.	TEPSCO to confirm with their Electrical Engineer on countermeasure to be taken.
5	Turbine Shaft	TEPSCO proposed to change type of Turbine, i.e. to omit intermediate shaft aiming at simplifying the powerhouse structure ESCOM noted.	ESCOM to check possibility. Also will be subject during detail design.
6	Single diagram	TEPSCO requested ESCOM to supply 400V of power from a DG (diesel generator). ESCOM noted.	ESCOM to check possibility and availability.

7	Trash removal at intake	ESCOM requested TEPSCO to improvise a system that would remove trash automatically at the intake screen. TEPSCO counter requested ESCOM for manual treatment. ESCOM noted.	ESCOM with assistance from TEPSCO to consider possibility/measures to install rake system.
8	Gate Operation during Construction	TEPSCO requested ESCOM to change gate operation during construction works. i.e., use gates other than gate #5. ESCOM agreed	ESCOM to consider possible gate operations.
9	Resettlement of residents near new waterway	ESCOM requested TEPSCO to provide sufficient information on the impact due to blasting. TEPSCO agreed.	TEPSCO to instruct the contractor to provide/submit safety management plan. ESCoM to take responsibility of necessary measures
10	Spare Parts	TEPSCO requested ESCOM to bear spare parts not included in the scope of Grant Aid. ESCOM agreed while requesting TEPSCO to reconsider spare parts list within agreed price of spare parts.	ESCOM to propose modification of spare parts list.

Lilongwe, 12 December 2013

O

n behalf of ESCOM

EVANS MSISKA

Generation Director

ESCOM

On behalf of TEPSCO

清水 満

Mitsuru SHIMIZU

Leader of Counsultant Team

TEPSCO