WEST SETI HYDRO LIMITED

WEST SETI HYDROELECTRIC PROJECT

PRELIMINARY DECOMMISSIONING PLAN

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1. INTRODUCTION

1.1. PRELIMINARY DECOMMISSIONING PLAN

This Preliminary Decommissioning Plan (Plan) has been prepared as an outline for the Detailed Decommission Plan that will be prepared for the West Seti Hydroelectric Project (Project) in the event that it is to be decommissioned. The Plan outlines the likely scenario under which decommissioning will occur, the aims of decommissioning, several decommissioning options and the likely option, likely essential decommissioning actions for the Project and the issues that will be addressed in the Detailed Decommissioning Plan.

Hydropower project decommissioning can be defined as the full or partial preparation of facilities for the suspension or permanent cessation of power generation. Dam decommissioning is commonly defined as "the full or partial removal of an existing dam or its associated facilities or significant changes to the operations" (United States Society on Dams, 2001).

Preparation and implementation of the Detailed Decommissioning Plan will be the responsibility of the Government of Nepal (GoN) as it will take on full ownership of the Project after the initial 25 year generation period.

1.2. PROJECT LIFE

The life of the Project is likely to be determined by the rate of reservoir sedimentation and the impact of deposited sediment on the power conduit intake in the Sani Gad. To estimate the sediment deposition pattern within the proposed Project reservoir, sediment surveys from reservoirs in the USA were used (USBR method). Approximately 85-90% of the inflow sediment load will be retained in the reservoir. It is estimated that the power conduit intake could be affected within about 50 years, when an estimated 83% of the reservoir dead storage could potentially be filled. The estimated reservoir dead storage volumes over time are presented in Table 1.1.

Table 1.1: Estimated Project Reservoir Dead Storage Volumes Over Time

Year	Dead Storage (million m^3)
0	640
10	533
20	427
35	267
50	107

As sediment accumulation occurs, the "flow-through" velocity down the reservoir will gradually increase, leading to material coarser than 0.1 mm contributing to deposition in the reservoir. The actual rate of sediment deposition in the reservoir will be reliant upon the occurrence of major floods (say 1:50 year floods or larger events), as these events transport

the majority of the sediment within the catchment.

Once the power conduit intake is affected by deposited sediment a higher intake above the deposited sediment can be installed to allow generation to continue for a considerable period, albeit at a reduced rate per annum due to reduced live storage.

Project decommissioning is only likely to occur if the Project becomes uneconomic to operate. The most likely reason for a poor economic return would be a substantial reduction in reservoir live storage, when Project operation and maintenance costs exceed the revenue from electricity sales due to the reduced volume of water for generation.

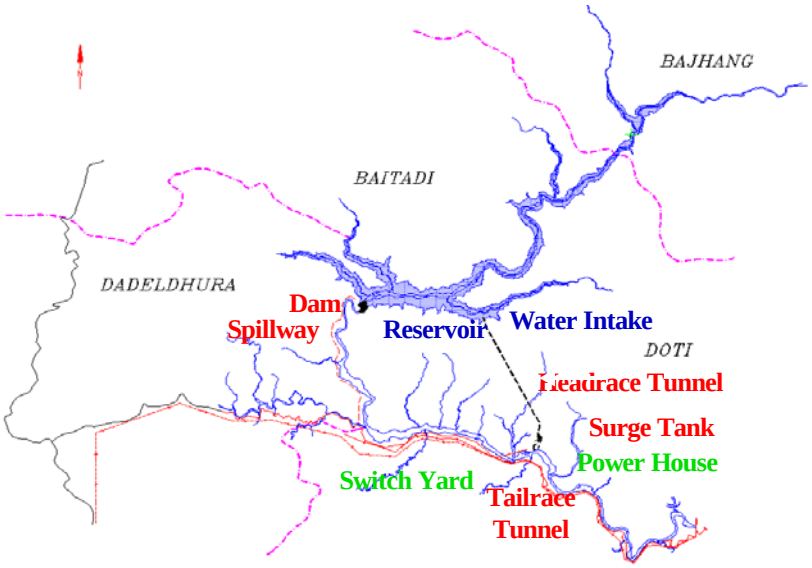
1.3. PROJECT FACILITIES REQUIRING DECOMMISSIONING

Project facilities that will require decommissioning (removal or a change in operation) are:

1. dam;
2. spillway;
3. underground powerhouse, tunnels and shafts;
4. surface facilities;
5. surge tank;
6. re-regulating weir;
7. transmission line and switch yard; and
8. miscellaneous systems.

Details on the above physical components of the Project are contained in the *Detailed Engineering Report* (1997), the *Environmental Impact Assessment – Volume 1: Main Report* (2000) and subsequent project design reports. The general layout of the main Project facilities, excluding the transmission line, are illustrated in Figure 1.

Figure 1: General Project Layout



2. DECOMMISSIONING OPTIONS

2.1. AIMS OF DECOMMISSIONING

Dams are decommissioned for a variety of reasons, including:

- structural safety;
- reservoir sedimentation;
- marginal benefits versus economic costs; and
- restoration of the river to pre-project conditions.

The primary aims of decommissioning the Project are likely to be:

- minimising on-going costs;
- preventing social and environmental impacts; and
- ensuring that facilities do not pose a safety hazard.

2.2. DECOMMISSIONING OPTIONS

Two decommissioning options are available for the Project:

- **Mothball**: the owner suspends all operations and maintains equipment in working condition until operation recommences. This option is only applicable if there is the potential for the Project to become economically viable after a period of time.

- **Abandon**: the owner ceases all activities, disposes of equipment and materials and abandons the site. This option may also involve the demolition of structures.

Both decommissioning options would result in the total natural Seti River flow discharging over the spillway instead of being diverted through the headrace and tailrace tunnels where the majority of water will flow during power generation.

For both options the reservoir would be maintained at or near full supply level as it is not practical to modify or remove the dam wall. The low level outlet would only used for emergency reservoir draw down as it is not designed for continuous use to regulate the reservoir water level.

Mothball Option

Mothballing the project structures and facilities requires maintenance to be continued on many Project facilities. Maintenance requirements, the removal of equipment and other preparation activities were evaluated for the mothball option. Table 2.1 lists all significant maintenance activities required to mothball the Project.

Table 2.1: Mothball - Decommissioning Activities

Project Facility	Decommissioning Activity
Dam	Continuation of normal dam safety surveillance, with the Disaster Management Plan remaining in place and supported by appropriate staff.
Spillway	Continuation of normal safety surveillance.
Transmission Line	400 kV transmission line de-energised if only used for Project electricity transmission. Power supply for the dam and power station maintained from a local lower voltage supply for maintenance purposes. Six-monthly inspection for safety and stability.
Re-regulating Weir	For a gated weir, gates moved into the raised position to prevent flow obstacle. Monthly safety inspection.
Generators and Turbines	Turbine runner left full of water. Turbine oil kept topped up. Generator rotor jacked up to relieve pressure on the bearings due to the weight of the rotor, thereby avoiding damage to the thrust bearings. Stop logs installed upstream of the intake structure and at the tailrace.
Governors	All governors regularly maintained Governor and servo motors left full of oil. Governor pumps and air compressor maintained.
Dewatering Pumps	Dewatering pumps maintained as per the operational schedule to avoid flooding the galleries. Annunciation systems maintained in operating condition.
Transformers	Nitrogen system maintained as per on a regular maintenance schedule. Oil checked for moisture on a regular basis. Insulator status checked on a regular basis.
Lubricating Systems	Lubricating systems maintained on a regular basis.
Fuel Tanks	Maintain the fuel pumps maintained on an annual basis. Fuel tanks kept full.
Compressed Air Systems	Replace the air system lubricants replaced on a regular basis. Units exercised on a monthly basis.
Emergency Diesel Generators	Emergency generator kept online to provide power to the alarm system and the drainage pumps. Lubricants replaced on a regular basis. Each unit exercised and test-operated on a weekly basis.
Control Room	Keep the recorders operational as well as the phone lines for external communications.
Main Units (hydraulic turbines)	Turbines jacked up and blocked to relieve pressure on the thrust bearings. Lubricate the bearings and/or immerse them in oil to avoid corrosion. Paint all surfaces that have a tendency to rust with an appropriate rust preventative paint.
Cranes	Gear boxes oiled and protected with wire rope. Atmospheric conditions within the powerhouse maintained to avoid corrosion of the bridge crane. All wire rope removed from the outside cranes. Diesel engine removed from the intake crane and stored within the powerhouse.
Lighting Systems	Lamp fixtures replaced, as necessary, to provide a safe working environment.
Station Batteries	Record alarms using an alternating current system with an uninterruptible power system for back up. Batteries removed.
Domestic Water	Maintain the water system on the current maintenance schedule.
Wastewater Treatment Plant	Maintain all sewage lift pumps and associated equipment on the annual maintenance schedule.
Ventilation	Maintain ventilation according to maintenance schedule.
General	General clean up of unnecessary infrastructure and scrap materials around facilities.

Abandon Option

The abandonment of the Project would require some facilities to be fully decommissioned, on-going surveillance of some Project features and minor on-going maintenance to be undertaken to maintain other facilities in a stable form. The activities required to abandon the Project are summarised in Table 2.2.

Table 2.2: Abandon - Decommissioning Activities

Project Facility	Required Activity
Dam	Continuation of normal dam safety surveillance, with the Disaster Management Plan remaining in place and supported by appropriate staff.
Spillway	Monthly inspection for safety and stability.
Underground Power Station	Entomb underground power station by closing accesses in headrace and tailrace tunnels, surge tank shaft and access shafts
Transmission Line	Transmission line de-energized. Six-monthly inspection for safety and stability.
Re-regulating Weir	If a gated weir, gates locked in the upright position. Monthly safety inspection.
Surface Facilities	Transfer to local community or remove and dispose
Equipment and Property	Remove and dispose movable equipment and property.
Fuel Tanks	Remove the abandoned fuel tanks and dispose of in accordance with environmental requirements.
General	General clean up of unnecessary infrastructure and scrap materials around project facilities.

Abandoning the Project would allow facilities such as the administration buildings and staff housing to be used for Government and/or community purposes.

Although the decommissioning of many hydropower projects involves the removal or modification of the dam or modification of the spillway, this is mainly undertaken for small projects. The removal or modification of the Project dam is likely to be impractical and undesirable due to the volume of fill in the dam, and hence the prohibitive cost of removal. In addition, the release of accumulated sediment in the reservoir due to dam removal would be undesirable, while certain values would be lost if the reservoir is removed, such as the reservoir fishery and seasonal migratory bird habitat on the reservoir lake.

2.3. FEASIBILITY OF DECOMMISSIONING OPTIONS

The decision to mothball or abandon the Project will most likely only be made once the Project becomes uneconomic. Project decommissioning is likely to be triggered by poor economic return from the Project, most likely the result of reservoir sedimentation excessively reducing live storage. At decommissioning, much of the equipment will be at the extreme end of its useful life and would likely require replacement during a Project restart. It would be uneconomic to maintain the equipment for an extended period (e.g. 10 years) and then replace it if the Project is restarted. Most equipment will be customized for the Project and therefore would require modification if moved, whilst the cost of relocating the equipment would be high. For these reasons it is likely that the equipment will be uneconomic to salvage. Consequently, the likely decommissioning option that will be implemented is the

abandoning of the Project.

The Abandon option results in the Seti River flowing over the spillway, returning full river flows to the 19 km section of river between the dam and the tailrace outlet, thus re-establishing the natural daily and seasonal river flow regime. The reservoir will be maintained at or near full supply level after decommissioning, maintaining or providing options for the local community to develop commercial or livelihood activities on the reservoir.

3. DETAILED DECOMMISSIONING PLAN

The Detailed Decommissioning Plan will be prepared for the Project prior to decommissioning. The Plan will:

1. ensure that the Project decommissioning process is consistent with applicable laws;
2. ensure that Project decommissioning will not impair or be detrimental to the public interest;
3. protect the environment;
4. protect public health and safety; and
5. recognize other uses and ancillary benefits that the dam provides that may be compromised or foregone as a consequence of Project operation ceasing.

The Detailed Decommissioning Plan will assess the feasibility of different decommissioning options and actions, considering economic, safety, environmental and social factors. It will address:

- a hazard and risk assessment of dam stability;
- removal of selected facilities;
- new and maintained uses of retained facilities;
- removal, recycling and disposal of material and waste - including hazardous materials;
- impact on the aquatic ecosystems;
- impact on river/water uses;
- foregone/curtailed economic benefits;
- security of retained facilities;
- permitting requirements;
- roles and responsibilities of key personnel involved in decommissioning, on-going surveillance and maintenance;
- the transfer of the Project water rights;
- decommissioning program; and
- budget for decommissioning activities.

The main components of the Detailed Decommissioning Plan are discussed below.

3.1. DAM STABILITY ASSESSMENT AND ON-GOING SURVIELLANCE

A hazard and risk assessment relating to the stability of the dam will be required to plan on-going surveillance and maintenance. The dam will require on-going surveillance as per the operational program as the identified hazards to structural stability will remain. The surveillance reporting system and disaster management provisions will be retained as per the operational requirements.

3.2. REMOVAL OF FACILITIES

Some facilities are likely to be removed when the Project is decommissioned. These facilities may include buildings that have reached the end of their life and are uneconomic to maintain or are not required for other purposes, the water treatment plant and the switchyard.

The transmission line, either the entire length or part thereof, may be removed if the line is of no current or future use as part of the transmission grid in Nepal. Line materials will be reused, recycled or disposed of.

3.3. RETAINED FACILITIES

Project buildings used for offices and staff accommodation may be used for other purposes such as Government offices and community facilities, depending upon the condition of these structures. Workshop facilities may also be retained to be used by the Government, community or commercial enterprise.

The Project water treatment plant near the power station may be retained and operated to supply local villages, but retention of the plant is likely to be based on the running and maintenance costs and life of the plant.

3.4. REMOVAL, RECYCLING AND DISPOSAL OF MATERIALS

The demolition of facilities will generate building material and other waste, while any hazardous materials and wastes at Project sites will have to be removed upon decommissioning. A general clean up may also be required around facilities to remove any residual wastes.

A waste management plan will have to be developed, commencing with an inventory of hazardous materials and waste. Management will include the reuse or recycling of removed materials where possible, preferably locally, and the safe disposal of non-recyclable materials.

The following hazardous materials and wastes are normally found at a hydropower facilities, requiring reuse, recycling or disposal:

- oil;
- greases;
- pesticides, herbicides and wood preservatives;
- petroleum contaminated materials;
- petrol and diesel;
- batteries and acid; and
- water treatment sludge.

Asbestos and polychlorinated biphenyls (PCBs) will not be used at the Project.

Oil: a large volume of oil will be in use at the Project when decommissioning occurs, primarily in the power station and switch yard. Disposal or reuse options for this oil will depend upon the presence of contaminants in the oil. Oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludges are also common in tanks.

Greases: greases used in turbines and other equipment will have to be disposed of. In most cases, used grease can be burned for energy recovery, while greases in their original containers can be reused elsewhere or recycled. Uncontaminated greases in open containers can also be reused or recycled.

Pesticides, herbicides and wood preservatives: pesticides, herbicides and wood preservatives will be used in and around Project facilities to control insects and weeds, although only minor quantities are likely to be used. Unused chemicals can be removed and used at other facilities, while small volumes of contaminated or out of date chemicals will have to be safely disposed of. Rinsed pesticide containers can be recycled or disposed of in a solid waste landfill.

Fuel: petrol and diesel storage tanks at the Project must be emptied upon decommissioning, apart from those storage facilities that will be utilised during on-going surveillance and maintenance. Unused fuel will be used elsewhere, while contaminated fuel can be burned for energy recovery. Sludge remaining in fuel tanks may contain regulated waste compounds (benzene) or metals (lead) and must be disposed of as dangerous waste.

Hydrocarbon contamination: hydrocarbon-contaminated soil and other materials will usually be cleaned up when a spill occurs, but some areas may not have been treated (e.g. at workshops or fuel storage areas) and removed contaminated material may be stockpiled prior to treatment. This material will probably require testing and a treatment plan will have to be developed.

Batteries: batteries, including spent lead-acid batteries and battery acid (electrolyte), used in the power station and other Project facilities must be disposed or recycled upon decommissioning.

Wastewater treatment sludge: power station wastewater treatment and septic tank sludge will require removal and disposal at decommissioning. Sewage sludge can contain toxic pollutants therefore sludge will require testing prior to disposal.

Specific disposal sites for project hazardous materials and wastes will be identified in the Detailed Decommissioning Plan, while safe disposal sites used during project operation may be utilised.

3.5. IMPACT ON RESERVOIR, RIVER AND WATER USES

River uses that rely upon Project operation will need to be assessed. These uses are likely to include commercial fisheries in the reservoir, recreation on the reservoir, water supply and downstream irrigation.

The decommissioning of the project could have a significant impact on downstream irrigation that may be at least partly reliant upon Project regulated river flows, primarily during the dry season. Whilst this dependence may have developed, diminishing generation (and regulated river flows) from the Project in the years prior to decommissioning is likely to have reduced this impact.

3.6. IMPACT ON AQUATIC ECOSYSTEMS

The net impact of project decommissioning on riverine ecology will be positive due to the restoration of full river flows along the 19 km section of the river between the dam and tailrace outlet, and the restoration of seasonal river flows downstream of the dam. Project decommissioning is likely to include the monitoring of changes to aquatic biodiversity.

3.7. PROJECT SECURITY

Project facilities that are not removed or used for new uses will have to be secured to prevent a safety hazard and damage to these structures. Security for these facilities is likely to consist of:

- security fencing to prevent entry where possible;
- sealing off the power station from general access;
- warning signs;
- regular security surveillance of all retained facilities; and
- blocking of access roads to facilities, although access to local villages, access to the reservoir and thoroughfares provided by Project roads will remain open.

4. CONCLUSIONS

Decommissioning of the West Seti Hydroelectric Project is not anticipated to occur until well after the initial 50 years of predicted operation of the Project at full generation capacity. The project, with the addition of a new high level intake structure, could continue to generate at a reduced energy output for a further 50-65 years. It is not possible to prepare a Detailed Decommissioning Plan for the Project at this stage as conditions at the time of decommissioning cannot be predicted. Features that will change prior to decommissioning include socio/economic conditions in the Project area, options for the use of facilities, economic or social dependence on project-regulated river flows and new waste management methods.

This Preliminary Decommission Plan describes the most likely reasons for Project decommissioning. The Plan outlines the actions likely to be undertaken to decommission the Project and outlines the contents of the Detailed Decommissioning Plan that will be developed at the end of the Project's life.

The primary objectives of Project decommissioning are likely to be to:

- minimising on-going costs;
- preventing social and environmental impacts; and
- ensuring that facilities do not pose a safety hazard.

The input of stakeholders, particularly reservoir and downstream river uses, will be required during the preparation of the Detailed Decommissioning Plan to ensure that the assessment of decommissioning options accounts for river, reservoir and water uses.

5. REFERENCES

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