

T@W Good Practice Form

Setting

Title:	Varja and Chaskman small hydro projects of Vindhyachal Hydro Power Ltd., Maharashtra, India
Country:	India
Location:	Maharashtra
Start date:	2000
End date:	2030
Technology keyword(s):	
Host:	India

General description

Summary:

Vajra small hydro project (SHP) is a run-of-the-river small power project, where water from the river is diverted through the power house to generate renewable power. Whereas Chaskaman SHP is a dam toe project set up on an existing dam. The water released through the canal for agriculture is routed through the power house to generate electricity. Small hydro power projects of Vindhyachal Hydro Power Ltd (VHPL) are constructed in the existing water bodies i.e. there was no water reservoir constructed in the project activity. The project sites Vajra and Chaskaman are located in Thane and Pune district of Maharashtra state respectively. Together these projects have an installed capacity of 6 MW (3 MW each). The project activity is generating electricity and wheeling it to INOX air products limited through Maharashtra state electricity grid. The project proponent has signed power wheeling agreement with Maharashtra State Electricity Board (MSEB) and Power Purchase Agreement (PPA) with INOX air products limited.

Aims:

The purpose of the project activity is to generate electricity by using the renewable hydro resources to meet the ever-increasing demand for energy in the region. The development of the project activity is reducing and would reduce the Green House Gas (GHG) emissions produced by the western regional grid generation mix, which is mainly dominated by fossil fuel based power plants.

Summary of Results:

The project will generate electricity by using renewable hydra resources and will also contribute to the following:

- a) Sustainable development, through utilisation of renewable hydro resources available in the project region
- b) Rural area development since the projects is in the rural area

- c) Capacity addition to the present installed capacity and increase in the energy availability
- d) Generation of additional employment

The project will result in total CO₂ emission reduction of **191,322** tons.

Planning Time:	n.a
Planning issues:	n.a
Operation Time:	10 year
Feasibility Study:	n.a

Technical details

Technical details:

The project activity is a run-of-the-river small hydro power generation project. The technology or power generation process uses hydro resource and converts the potential energy available in the water flow into mechanical energy using hydro turbines and then to electrical energy using alternators. The generated power is to be supplied to the nearest grid sub-station for proper interconnection and smooth evacuation of power.

The technology employed is the small hydro turbines used for hydro electric power generation. The installed capacity on small hydro power plant is 3.0 MW each, i.e.; (6,0 MW in total). The technology is the Kaplan 'S' type hydro turbine. The generation voltage at the generator terminals is 11 kV, which is being stepped-up to 100 kV at Vajra site and 33 kV at Chaskaman site to match the nearest substation voltage level.

Varja Small Hydro Power Project:

The project site is located 6 km downstream of Bhatsa dam. The small hydro power project is installed on a natural river fall which is about 12.5 metre in height. The project site is located at village Sarlambe, Taluka Shahapur, District Thane, Maharashtra, India.

The Vajra plant is a run of the river project, exploiting the natural water fall, about 6 km downstream of Bhatsa dam. A diversion weir upstream of the natural fall diverts the water through a 20m wide approach channel and water conducting system on to the horizontal Full Kaplan 'S' type turbine and then the water through tail race is fed back into the river. If plant is down for any reason, water overflows from above the diversion weir.

The rated capacity of the plant is 3 MW and the generation voltage is 11 kV. It is stepped up to 100 kV by a power transformer and connected to 100 kV line of MSEB, 500m away from plant through a breaker for evacuation of power.

The 'S' type double regulated full Kaplan has been chosen on account of cost competitiveness. Further double regulated wicket gate control ensures:

Quick and safe closure of unit under all emergencies.

Regulation at all loads.

Optimum generation with high efficiency for varying heads and discharge conditions.

No need of additional fast closing BFV or Intake gate, as Wicket gate closure ensures complete closure within 10 seconds.

Horizontal configuration and layout ensures Crane approach to all assemblies and ease of maintenance.

For Full Kaplan machines, Guide vanes distributor, regulator mechanism acts as shut off device.

The other components of the project are:

- Water falls from head of 12.5 m.
- The diversion weir is 270 m long with 260 m of overflow section
- The intake is 5 m wide and 28m long with an intake gate of 5 m x 5.6 m.
- One penstock of 3.08 m diameter and 19 m long conveys the water from fore bay to power-house.
- Power house of 18 m x 8.5 m machine bay houses the equipment and 6.5 x 8.5 m service bay is provided.
- It has a fixed gross head of 12.5m and rated design discharge of the machine is $28.67 \text{ m}^3/\text{second}$.

Chaskaman Small Hydro Power Project:

The project site is located at Bibi Taluka Rajgurunagar, District Pune Maharashtra, India. The small hydro power project is installed above the main canal which is a part of existing dam. Power generated by this installation is 1 x 3.0 MW. Water is used for agricultural purpose after utilizing the potential energy.

This is a dam toe project utilizing irrigation discharge from the dam for power house generation. The water releases from the dam goes to the irrigation channel through the power house.

The rated capacity of the plant is 3 MW with a 33% continuous overload provision and the generation voltage is 11 kV. It is stepped up to 33 kV by a power transformer and connected to 33 kV MSEB sub-station about 5 km away from the plant.

This plant is also having 'S' type Double regulated Full Kaplan machine. and the other components of the project are:

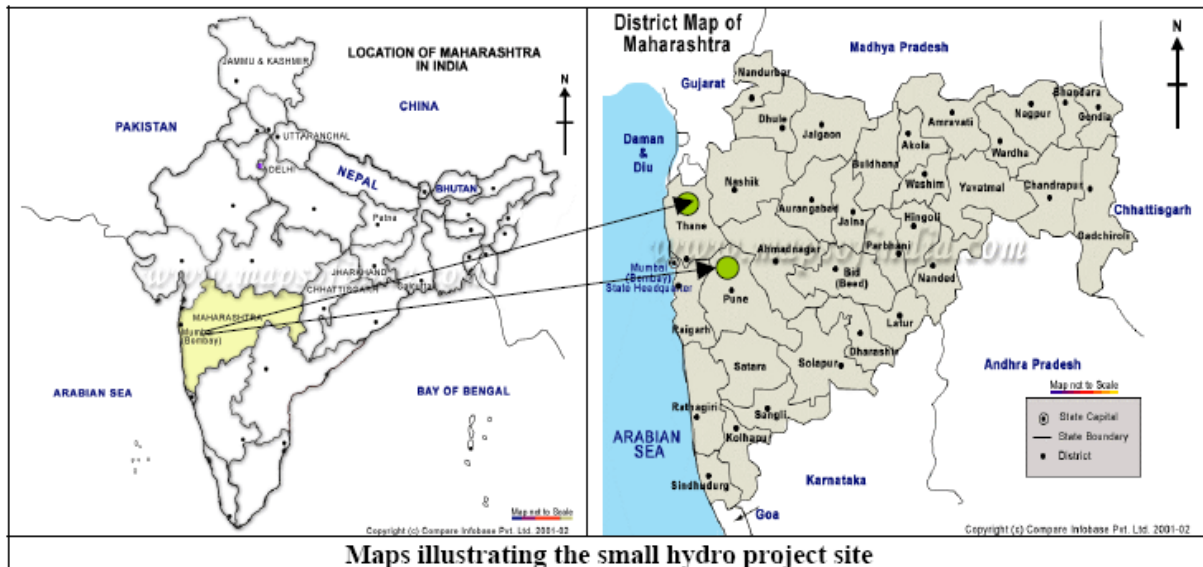
A 3.08 m extension penstock of 19 m length.

Power house of 18 m x 8.5 m machine bay houses the equipment and 6.5 m x 8,5 m service bay is provided.

An open tail race channel with varying width from 5 m to 20 m and 76 m in length.

The available head varies depending on the water level in reservoir of the dam. The gross maximum head is 22.72 m, when the dam is full and the minimum head is 8.78 m.

The rated head is 18.4 m and the design discharge per second is $27 \text{ m}^3/\text{second}$.



Energy data

Energy data: Installed capacity of 6 MW

Energy saved/generated: 251 739 million kWh

Monitoring: n.a

Environmental data

Environmental data:

The project activity; utilises renewable resources (water), which reduces anthropogenic GHG emissions as per the combined margin carbon intensity of the western regional grid which is mainly dominated by fossil fuelbased power plants. Since there is no storage of water in the project activity, there are no GHG emissions from the project activity. In the absence of project activity conventional energy equivalent of 251 739 million kWh (171 958 million kWh-Vajra small hydro power generation site & 79 781 million kWh-Chaskaman hydro power generation site) would be utilized for a period of 10 years. The project would thereby result in total CO₂ emission reduction of 191 322 tonnes (130 688 tons of CO₂ from Vajra site and 60 634 tons of CO₂ from Chaskaman site) over the 10 year crediting period. In the case of absence of the project equivalent electricity had to be supplied to the western regional grid customers from a mix of power plants supplying power to grid.

Project GHG-emissions: 0

GHG-emission reductions:

Emission reductions at Vajra small hydro power generation

Year	Annual estimation of emission reduction in tonnes of CO ₂ e
2002-2003	11314
2003-2004	11459
2004-2005	12155
2005-2006	13680
2006-2007	13680
2007-2008	13680
2008-2009	13680
2009-2010	13680
2010-2011	13680
2011-2012	13680
Total estimated reductions (tonnes of CO₂ e)	130688
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO₂ e)	13069

Emission reductions at Chaskaman small hydro power generation site

Year	Annual estimation of emission reduction in tonnes of CO ₂ e
2002-2003	4748
2003-2004	5832
2004-2005	4834
2005-2006	6460
2006-2007	6460
2007-2008	6460
2008-2009	6460
2009-2010	6460
2010-2011	6460
2011-2012	6460
Total estimated reductions (tonnes of CO₂ e)	60634
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO₂ e)	6063

The project will result in a total CO₂ emission reduction of 191 322 tonnes (130688 tonnes from Varja site and 60 634 tonnes from Chaskaman site).

Baseline

A complete analysis of western regional electricity grid has been carried out for preparation of baseline scenario and calculation of baseline emission factor of the grid. The project activity would displace an equivalent amount of electricity that would have been drawn from the grid generation-mix.

Carbon emission factor of grid

Present generation mix for western regional grid with sector wise installed capacities, emission co-efficient and generation efficiencies are used to arrive at the net carbon intensity/baseline factor of the chosen grid. As per the provisions of the methodology the emission coefficient for the electricity displaced would be calculated in accordance with provisions of paragraph 7 of Type I.D. of Appendix B of Simplified Modalities and Procedures for Small Scale CDM Project Activities.

For small-scale CDM projects the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kgCO₂/kWh) calculated in a transparent and conservative manner as:

a) The average of the “approximate operating margin” and the “build margin”, where:

i. The “approximate operating margin” is the weighted average emissions (in kgCO₂eqv/kWh) of all generating sources surviving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

ii. The “build margin” is the weighted average emissions (in kgCO₂eqv/kWh) of recent capacity additions to the system, defined as the higher (in MWh) of most recent 20% of plants built or the 5 most recent plants;

OR

b) The weighted average emissions (in kgCO₂eqv/kWh) of current generation mix.

The baseline emission factor is calculated based on both approaches i.e. a & b above and the combined margin emissions factor of generation mix have been selected to calculate the baseline emission factor.

In the case of project activity:

Combined margin factor = 760.01 tonnes CO₂/MU

Weighted average emission of current generation mix = 791.54 tonnes CO₂/MU

The value of grid emission factor for combined margin emission factor of grid mix is less with respect to weighted average emission of current generation mix emission factor. Considering conservative calculations the combined margin emission factor is considered in calculations.

Emissions factors:

The emission factors are based on IPCC Guidelines for National Greenhouse Gas Inventories and are given below.

Fuel	Emission factor (tC/TJ)	Emission factor (tCO ₂ /TJ)
Natural gas	15.3	56.1
Sub-bituminous coal	26.2	96.1
Diesel	20.2	74.1

Monitoring

Generation of electricity using hydro power resources leads to mitigation of GHG emissions that would have been produced by the western regional grid mix dominated by fossil fuel based power plants. In order to monitor the mitigation of GHG due to the project activity, the net electricity supplied to the grid need to be measured. The net electricity supplied to grid by the project activity multiplied by emission factor for regional grid, would form the baseline for the project activity. The project activity has one electronic meter to record the net power supplied to the grid. The monitoring and verification system would mainly comprise of this meter as far as power supplied to the grid is concerned. The project proponent has one check meter under full control for the verification of the main meter readings. All instruments would be calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time.

Contribution to Sustainable Development:

Government of India has stipulated the following indicators for sustainable development in the interim approval guidelines for CDM projects:

1. Social well being:

Since, the project activity is in a rural area, it has already initiated the development of the region. It has helped to improve the conditions of the roads connecting site and nearby villages to existing roads. Generated employment opportunities for the local people, both during construction and operation phases.

2. Environmental well being:

Since, the project uses renewable hydro resources for power generation; it does not lead to any emissions in the environment. The project activity is a step towards environmental sustainability by saving exploitation and

depletion of a natural, finite and non-renewable resource like coal/gas. VHPL has carried out plantation in area surrounding the projects.

3. Economical well being:

The project has created a business opportunity for local stakeholders such as suppliers, manufacturers, contractors etc.

4. Technological well being:

The technology selected for the power project would use well established Kaplan type turbines.

Economic data:

Economic data:	n.a
Financing:	n.a
Capital cost:	n.a
Operational Costs:	n.a
Payback:	n.a
Energy Production costs:	n.a
Other savings:	n.a

Additional Information

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