

## **Introduction**

Sirkari Bhyol Rupsiabagar Hydro-electric project is located in Munsiyari Tehsil of District Pithoragarh of Uttarakhand. The diversion structure is located at Latitude: 30°11'2.5" and Longitude: 80°13'49". The Project envisages utilization of the waters of the river Goriganga, a tributary of river kali, for power generation in a run of river type development harnessing a gross head of 362.08 m. The diversion structure is a purely run of the river scheme depending upon the technical suitability & site requirement.

The project components comprise of

- 12 m high (from river bed) Barrage, an Intake structure,
- 4 No. intake tunnels combining into 2 Nos. Feeder Tunnels each 3.4 m dia.,
- 2 Nos. Underground Desilting Chambers,
- 4.9 m dia. horse-shoe shaped 1.20 km long HRT,
- 10 m dia. Surge Shaft,
- 3.5 m dia. Pressure shaft/tunnel,
- Underground Power House and
- Tail Race Tunnel.

The FRL and MDDL have been fixed at 2084 m and 2082 m respectively for the Barrage structure.

MoEF vide letter no J-12011/77/2005-IA.I; Dated: 22/12/2005 accorded site clearance as per the provisions of EIA Notification, 1994. EIA/EMP studies was awarded to M/s WAPCOS on 23/09/2005. After clearance from MoEF vide above mentioned letter, M/s WAPCOS (A Central Govt. Entity) carried out three field season studies, against order from UJVNL.

Subsequently MoEF vide their letter no J-12011/57/2008-IA.I; Dated: 17/08/2009, accorded clearance for preconstruction activities at the proposed sites as per the provisions of Environmental Impact Assessment Notification, 2006 along with "Terms of Reference (ToR)" for preparation of EIA report.

Consequent to approval of ToR, various layouts were studied in accordance with MoEF observations on leaving free riverine stretch and Riparian flows, as following :-

- a) Original Capacity of Project as 210 MW – ToR was approved for project capacity 210MW and on basis of layout finalized in PFR, with provision of DAM and Powerhouse.
- b) Capacity Reduction to 172 MW – To avoid major submergence of land and protect flora & fauna, Dam was replaced with barrage. The barrage was then shifted upstream to make the project technically viable.
- c) Further, Capacity Reduction to 168 MW – After the flood of June 2013, and further site visits conducted by UJVNL & experts, it was envisaged that barrage to be shifted further upstream to a geologically stable location. Thereafter, preliminary studies got carried out after consideration of MoEF's observations, further reducing the capacity of project to 168 MW. Thereafter, Proposal was

submitted to Government of Uttarakhand for freezing the capacity & levels of project.

- d) GoU vide its letter no. 1298/1/2014-04(08)/44/2005; Dated: 03/12/2014 has given concurrence to the revised capacity of the project as 168 MW with changed FRL & TWL

Further water availability for the project is being worked out in accordance to MoEF observation's, for other projects of UJVNL. Accordingly proposed Riparian flows shall be as following:-

Period	Months	Riparian Flows	Actual Discharge as per Draft Power Potential
Lean Period	December to March	20% of the average of the four lean months	3.42 Cumecs
Monsoon Period	June to September	30% of the average flow during the monsoon months	19.735 Cumecs
Non Lean Period	October to December & April to May	25% of the average of the Four non-lean months	9.34 Cumecs

Presently no project has been sanctioned so far on either side of this project, the suitable Free Riverine stretch between 2 cascading projects can be adhered to in case of implementation of the project in due course on upstream & downstream side.

As the river slope is steep & run off river project is proposed, the submergence area is very low. Rehabilitation & resettlement issues are also not involved. The project site conditions were reviewed after June 2013 flood & proposed diversion site was relocated on technical requirement. This led to change in the FRL, generating head, Installed capacity etc. The proposed revised project parameters are:

Parameter	Magnitude
Installed Capacity	168 MW
Full Reservoir Level (FRL)	2084.00m
Minimum Drawn Down Level (MDDL)	2082.00m
Normal Tail Water Level (4 unit in operation)	1721.25m
Minimum Tail Water Level (1 unit at 10% load)	1720.30m
Average Operating level of the Reservoir in the Non-monsoon Period	=MDDL + 2/3 (FRL-MDDL) =2082 + 2/3 (2084-2082) =2083.33m
Head Loss	10m

The revised proposal was submitted to GoU on which the necessary clearance has been communicated by the GoU to CEA vide its letter no. 1298/1/2014-04(08)/44/2005; Dated: 03/12/2014.

**Salient Features**

<u>LOCATION</u>	
State	Uttarakhand
District	Pithoragarh
River	Goriganga
Diversion Site	U/s of confluence of Ralam Gad with Goriganga river, 470m D/s of confluence of Jaulchidda Gad with Goriganga river
Nearest Airport	Jolly-Grant (Dehradun)
Nearest Rail Head	Tanakpur
Geographical Coordinates of Barrage site	
(a) Longitude	80° 14'05"E
(b) Latitude	30° 11'1.5"N
<u>HYDROLOGY</u>	
River Basin	Goriganga
Catchment area at Barrage Site	957 sq.km
Average Discharge at Barrage site	111.61 cumec
Annual Runoff	1180.30 MCM
Standard Project Flood	2,742 cumecs
Probable Maximum Flood	3,652 cumecs
<u>RESERVOIR</u>	
Maximum water level (MWL)	2084.90 m
Full reservoir level (FRL)	2084.0 m
Minimum draw down level (MDDL)	2082.0 m
Gross storage at FRL	0.14 MCM
Live storage	0.05 MCM
Area under Submergence at FRL	0.03 ha
<u>COFFER DAM</u>	
Type	Boulder with wire crate(Stage-1) Boulder with wire crate (Stage-2)
Max. Height (Stage-1)	7.00 m high
Crest Elevation (Stage-1)	Varies
Length (Stage-1)	254.50 m
Max. Height (Stage-2)	4.50m high

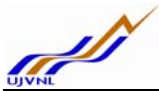


Crest Elevation (Stage-2)	Varies
Length (Stage-2)	201 m (plus, in the barrage portion 61m length of divide wall which already will have been constructed in Stage-1)
<b><u>DIVERSION STRUCTURE</u></b>	
Type	Barrage
Barrage Top	2087.00 m
Height of Barrage	12.00 m
River Bed Level	2075.00 m
Total length of Barrage at top	118.30 m
<b><u>MAIN SPILLWAY</u></b>	
Design flood	2,742 cumecs (SPF)
Type	Gated Spillway
Length of spillway	56.00 m
Number of bays	4 Nos. Main bays
Crest level of Barrage	2075.0 m
Size of spillway radial gates	14.0 m (W) x 9.0 m (H)
<b><u>AUXILLIARY SPILLWAY</u></b>	
No. of bays	1
Width of bay	6 m
Size of gate	6.00m (W) x 9.00m (H) (The height of gate is inclusive of a 2.50m flap gate)
Design flood	340.00 cumecs
Crest level of spillway	2075.00 m
Features	D/s floor level at glaxis toe 2072.00m and 32m Length of floor
<b><u>INTAKE</u></b>	
Type	Reservoir Intake
Shape	Bell mouth
Maximum Design Discharge	Intake-1 –16.5 cumec, Intake-2 –16.5 cumec, Intake-3 –16.5 cumec,

	Intake-4 –16.5 cumec (Each considering 10% overload discharge and 15% flushing discharge)
Invert level	2076.75 m
Number of Reservoir Intakes	4
Intake (Emergency / Service )gate opening size	Intake 1-2.5m (W) x 2.5m (H), Intake 2-2.5m (W) x 2.5m (H), Intake 3-2.5m (W) x 2.5m (H), Intake 4-2.5m (W) x 2.5m (H)
Trash rack in each intake	Intake -1 -3.5m (W) x 4.18m (H); 2 openings Intake -2 -3.5m (W) x 4.18m (H); 2 openings Intake -3 -3.5m (W) x 4.18m (H); 2 openings Intake -4 -3.5m (W) x 4.18m (H); 2 openings
Intake Structure Height	11.75 m
<b><u>HEAD RACE TUNNEL</u></b>	
Shape	Horse Shoe
Diameter	4.90 m
Length	1200.0 m
Design discharge	52.90 cumecs
<b><u>FEEDER TUNNELS</u></b>	
Number	Two
Size and Shape	3.4 m, D-shape
Length	200m each
Design discharge	33 cumec each (considering 10% overload discharge and 15% flushing discharge)
<b><u>DESILTING CHAMBERS</u></b>	
Number	Two
Size / Shape	13.0 m(W) x 16.0 m(H)
Length	180.0 m
Inlet discharge	33 cumec each (considering 10% overload discharge

	and 15% flushing discharge)
Size of gate opening (2 nos.):	3.0m (w) x 3.0m (h)
<u>SILT FLUSHING TUNNEL</u>	
Number	One
Size of Duct upto Gate Chamber	Duct -1.50m (w) x 1.50m (h) in
Size of SFT after Junction up to portal	Channel -2.0m (w) x 1.5m (h)
Emergency/Service Gate (2 nos.)	1.50 m x 1.50m (w x h)
Length up to Gate Chamber	85 m/ 58m
Length from Gate Chamber upto Junction	124 m/ 81m
Length after junction upto portal	470m
Silt flushing discharge	7.94 cumec
<u>CONNECTING/LINK TUNNEL TO HRT</u>	
Number	Two
Size	3.0m Dia.
Shape	D-shape
Length	93m each
Design discharge	26.45 cumec each
<u>SURGE SHAFT</u>	
Number	One
Type	Restricted Orifice Underground surge shaft
Size	10m Dia.
Orifice dia	2.80 m diameter
Height	34.50 m
Top EL	EL 2100.5 m
Bottom EL	EL 2066.0 m
Size of gate opening (1 no.)	3.6m x 3.6m
Maximum surge level	EL 2097.98 m
Minimum surge level	EL 2070.58 m
<u>PENSTOCK/PRESSURE SHAFT</u>	
Type	Underground
Number	3.6 m dia. bifurcating into two 2.50 m dia. branch penstocks each of which further bifurcates into two branch penstocks of 1.75 m Dia. each

Diameter	3.6m, 2.50 m and 1.75m
Length up to Bifurcation of main pressure shaft	570m
Grade of Steel	ASTM-537 Class II/ASTM 517 Gr.A
Liner Thickness	Varies from 20mm to 34 mm
<b><u>POWER HOUSE</u></b>	
Type	Underground
Installed Capacity	168 MW
Units	4 (4 x 42.00 MW)
Power house cavern size	100.0m (L) x 18.0 m (W) x 41.00 m (H)
Transformer Hall cavern size	80.0m (L) x 16.0 m (W) x 28.0 m (H)
C.L. of turbine	1717.00 m
Type of Turbine	Vertical Francis
Design Discharge	52.90 cumecs
Rated Head	352.08 m
Normal TWL	1721.25 m
Minimum TWL	1720.25 m
Annual Design Energy (50% dependable year)	763.03 GWh
Annual Energy in 50% dependable year on 95% machine availability	743.25 GWh
Annual Design Energy (90% dependable year)	680.06 GWh
Annual energy in 90% dependable year on 95% machine availability	662.08 GWh
Annual Plant Load Factor in 90% Dependable year	46.21%
Annual Plant Load Factor in 50% Dependable year	51.85%
<b><u>TAIL RACE ARRANGEMENT</u></b>	
Type	Pressure Flow Tunnel
Size & Shape	5.00 m dia. D shape
Length	140 m
Normal TWL at outlet	1721.25 m
<b><u>COST ESTIMATES &amp; FINANCIAL ASPECT (Rs. Crores)</u></b>	
Civil Works including Hydro-Mechanical	554.04



Works	
Electro Mechanical Works	266.88
Total Basic Cost including Direct & Indirect Charges	833.23
Interest during construction (excluding financing cost)	214.03
Escalation	177.89
Financing Charges	8.64
Total Cost including Escalation and IDC	1233.79
<u>LEVELLISED TARIFF AT 90% DEP. YRS. (in Rs./KWhr)</u>	
After considering 12% free power & 1% for local area development (levelised)	4.23
<u>LEVELLISED TARIFF AT 50% DEP. YRS. (in Rs./KWhr)</u>	
After considering 12% free power & 1% for local area development (levelised)	3.77