BHAGIRATHI ECO-SENSITIVE ZONE
DISTRICT: UTTARKASHI
ZONAL MASTER PLAN
FOR
POWER SECTOR

ENERGY DEPARTMENT,
GOVERNMENT OF UTTARAKHAND
### INDEX

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td><strong>GENERATION PLAN</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>LIST OF MICRO, MINI &amp; SMALL HYDRO PROJECTS</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>LOCATION MAP OF MICRO, MINI &amp; SMALL HYDRO PROJECTS</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>TYPICAL LAYOUT PLAN OF MICRO, MINI &amp; SMALL HYDRO PROJECTS</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>LIST OF PROJECTS UNDER OPERATION ON ESZ</td>
<td>6</td>
</tr>
<tr>
<td>5.</td>
<td>LIST OF PROJECTS UNDER CONSTRUCTION ON ESZ</td>
<td>7</td>
</tr>
<tr>
<td>6.</td>
<td>LIST OF PROJECTS UNDER IMPLEMENTATION ON ESZ</td>
<td>8</td>
</tr>
<tr>
<td>7.</td>
<td>ROPOESD LIST OF MICRO AND MINI HYDRO PROJECTS IN ESZ</td>
<td>9</td>
</tr>
<tr>
<td>8.</td>
<td>DETAILS OF MEETING HELD WITH VILLAGERS IN ESZ FOR FINALIZATION OF ZONAL MASTER PLAN</td>
<td>10</td>
</tr>
<tr>
<td>9.</td>
<td>NECESSITY &amp; JUSTIFICATION OF MICRO, MINI &amp; SMALL HYDRO PROJECTS</td>
<td>11</td>
</tr>
<tr>
<td>10.</td>
<td>PROPOSED STANDARD TO BE FOLLOWED FOR THE PROJECTS UNDER SURVEY &amp; INVESTIGATION</td>
<td>12</td>
</tr>
<tr>
<td>11.</td>
<td>PROPOSED STANDARD TO BE FOLLOWED FOR THE PROJECTS UNDER CONSTRUCTION</td>
<td>13</td>
</tr>
<tr>
<td>12.</td>
<td>SCHEDULE OF IMPLEMENTATION OF THE PROJECT</td>
<td>14-21</td>
</tr>
<tr>
<td>13.</td>
<td>OBSERVATIONS ON ESZ NOTIFICATION</td>
<td>22-23</td>
</tr>
<tr>
<td>14.</td>
<td>DETAILS OF LAND REQUIREMENT</td>
<td>24-26</td>
</tr>
<tr>
<td>15.</td>
<td>COMPLIANCE OF DIRECTIONS ISSUED BY MONITORING COMMITTEE</td>
<td>27</td>
</tr>
</tbody>
</table>

(B)   MANERI BHALI HEP STAGE –I & II PLAN  28-45

(C)   TRANSMISSION AND DISTRIBUTION PLAN  46-52

(D)   PROJECT WISE DETAILS

1. SWARIGAD SMALL HYDRO PROJECT  53-61
2. LIMCHAGAD SMALL HYDRO PROJECT  62-70
3. ASIGANGA-I SMALL HYDRO PROJECT  71-92
4. ASIGNAGA-II SMALL HYDRO PROJECT  93-109
<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>KALDIGAD SMALL HYDRO PROJECT</td>
<td>110-120</td>
</tr>
<tr>
<td>6.</td>
<td>PILANGAD-I SMALL HYDRO PROJECT</td>
<td>121-130</td>
</tr>
<tr>
<td>7.</td>
<td>SONGAD SMALL HYDRO PROJECT</td>
<td>131-135</td>
</tr>
<tr>
<td>8.</td>
<td>PILANGAD-II SMALL HYDRO PROJECT</td>
<td>136-138</td>
</tr>
<tr>
<td>9.</td>
<td>KAKORAGAD SMALL HYDRO PROJECT</td>
<td>139-147</td>
</tr>
<tr>
<td>10.</td>
<td>SIYANGAD SMALL HYDRO PROJECT</td>
<td>148-156</td>
</tr>
<tr>
<td>11.</td>
<td>JALANDHARYGAD SMALL HYDRO PROJECT</td>
<td>157-166</td>
</tr>
<tr>
<td>No.</td>
<td>Project Description</td>
<td>Capacity</td>
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<tr>
<td>-----</td>
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<td>1.</td>
<td>Pilangad-I</td>
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</tr>
<tr>
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<tr>
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<td>14.</td>
<td>Jalandharygad</td>
<td>24 MW</td>
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</table>
Location of SHPs

Sonegad SHP (2X3500 kW) 
(Proposed)

Pilangad - I SHP (2X1125 kW) 
(Existing)

Kaldigad SHP (2X4500 kW) 
(Under Construction)

Pilangad - II SHP (2X2000 kW) 
(Proposed)

Limchigad SHP (2X1750 kW) 
(Under Construction)

Suwarigad SHP (2X1000 kW) 
(Under Construction)

Asiganga - I SHP (2X2250 kW) 
(Under Construction)

Asiganga - II SHP (2X2250 kW) 
(Under Construction)

Siyangad SHP (2X5750 kW) 
(Under Implementation)

Jalandharygad SHP (2X9250 kW)+ (2x2750 KW) 
(Under Implementation)

Kakoragad SHP (2X6250 kW) 
(Under Implementation)
TYPICAL LAYOUT PLAN OF SHPs
## COMMISSIONED SMALL HYDRO POWER PROJECTS

**FALLING UNDER ESZ**

1. Pilangad-I (2250 KW) - UJVNL
2. Harshil (200 KW) - UREDA
3. Kedar Ganga (20 KW) - UREDA
4. Rudraganga (150 KW) - UREDA

**TOTAL: 3.07 MW**
### UNDER CONSTRUCTION SMALL HYDRO POWER PROJECTS

#### FALLING UNDER ESZ

1. Assiganga – I (4500 KW) - UJVNL
2. Assiganga – II (4500 KW) - UJVNL
3. Kaldigad (9000 KW) - UJVNL
4. Limachagad (3500 KW) - UJVNL
5. Swarigad (2000 KW) - UJVNL

**TOTAL: 23.50 MW**
SHPS UNDER IMPLEMENTATION FALLING IN ESZ

1. Songad (7 MW) - UJVNL
2. Pilangad-II (4 MW) - UJVNL
3. Siyangad (11.50 MW) - Harsil Hydro Ltd.
4. Kakoragad (12.50 MW) - Harsil Hydro Ltd.
5. Jalandharygad (24 MW) - Harsil Hydro Ltd.

TOTAL: 59.00 MW
## ROPOESD LIST OF MICRO AND MINI HYDRO PROJECTS IN ESZ

<table>
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<tr>
<th>SN</th>
<th>NAME OF THE PROJECT</th>
<th>CAPACITY (MW)</th>
<th>DISTRICT</th>
<th>RIVER VALLEY</th>
<th>SUB-TRIBUTARY /GADERA NAME</th>
<th>NAME OF AGENCY</th>
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<td>Bhagirathi</td>
<td>Rano ki gad</td>
<td>UREDA</td>
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<td>0.08</td>
<td>Uttarkashi</td>
<td>Bhagirathi</td>
<td>Varuni gad</td>
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<td>4</td>
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<td>Dharashugad</td>
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<td>Bhagirathi</td>
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DETAILS OF MEETING HELD WITH VILLAGERS IN ESZ FOR FINALIZATION OF
ZONAL MASTER PLAN

- As per the Point No. 02 (1) of ESZ Gazette Notification, Zonal Master Plan was to be made in consultation with the local people, particularly women within two years from the date of notification (18.12.2012).

- In compliance of District Magistrate letter no 5720 / 21-04 (2010-11) dated 09.15.2015, meetings were held at the different places with the local people to incorporate their suggestions/proposal in Zonal Master Plan.

- UJVNL’s officials participated in the meetings but local people opposed the Gazette Notification and disrupted the meetings and suggestions/proposal could not be obtained for Zonal Master Plan.

Meetings conducted for preparation Zonal Master Plan in ESZ

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Date &amp; Time of Meeting</th>
<th>Place of Meeting</th>
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<td>1</td>
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<tr>
<td>2</td>
<td>24/09/2015 at 11:00 AM</td>
<td>Junior High school Sunagar.</td>
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<tr>
<td>3</td>
<td>28/09/2015 at 11:00 AM</td>
<td>Block Auditorium Room, Bhatwari</td>
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<tr>
<td>4</td>
<td>01/10/2015 at 11:00 AM</td>
<td>Govt. Inter College Netala</td>
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<td>5</td>
<td>03/10/2015 at 11:00 AM</td>
<td>Govt. Inter College Gangori</td>
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<tr>
<td>6</td>
<td>05/10/2015 at 11:00 AM</td>
<td>Suman Auditorium Room, Bhatwari</td>
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NECESSITY & JUSTIFICATION OF MICRO, MINI & SMALL HYDRO PROJECTS

The development of new and renewable sources of green energy particularly hydropower, has become a global priority. For many developing countries like India, the generation of electric power from small hydro power plants provide a option for providing reliable source of energy for economic development of country.

Huge & fast consumption of fossil fules is a severe problem to the developing world. Reserves of fossil are decreasing day by day. As such renewable energy resources are very important for upcoming generation of the world.

Strategies for exploitation of renewable energy constitute a major part of the policies which aim at reducing dependence on fossil fuels to satisfy the growing demand for energy. In developing countries like India, particularly those short of fossil fuel resources, the renewable resources of energy constitute a promise for meeting part of the future energy at a reasonable price and by accelerating the process of development in rural areas. Hydro Power is an important renewable resource of energy and water resources in India is sufficient to meet the major energy demands of the future. Hydro Power is pollution free & clean energy.

Structures of Small Hydro Power plant are very small. Therefore, their construction does not affect the environment and they take less time for their construction. For construction of small hydro Power plants no reservoir is to be constructed and negligible rehabilitation occurs. The small hydro power Projects are run-off the river scheme. They donot affect any wildlife and the environment and also there is no possibility of submergence of any forest property, agriculture land.

Construction of the Small Hydro Projects is completed under the supervision of experienced technical experts and inconformity with the approved standards. The technology for Small Hydro Power plants is available in India itself and therefore, it helps in the economic growth of India. Due to construction of these plants, local population is benefited in the form of enhanced job opportunities and further their power requirements are met. Hence construction of Small hydropower Projects is an important step towards fulfilling State's energy requirement & towards enabling economic empowerment of the State.
PROPOSED STANDARD TO BE FOLLOWED FOR THE PROJECTS UNDER SURVEY & INVESTIGATION STAGE IN ESZ

- For site selection, survey and investigation in SHPs, temporary bridal paths shall be constructed in the Project area. Cutting of trees may be minimum as per the site requirement in unavoidable situations. The survey pedestrian routes shall be absolutely temporary and will be used only for survey/investigation work.

- While fixing alignment of the project, it will be ensured by project authority that no population is required to be rehabilitated due to construction of the project.

- The rights and privileges of the residents of the project area shall not be affected due to construction of the Project and construction may only be started after obtaining formal approvals from the residents as per laid down rules.

- During construction or operation of the project local residents shall be given priority in employment according to their qualifications.

- During alignment of the Project Component, loss of vegetation cover shall be avoided or it shall be kept minimum.

- Demolition of any natural heritage site shall be avoided during construction of and its pedestrian routes shall also be protected in its natural state.

- The project alignment shall not be proposed in landslides area and fault zone.

- In the design for construction of hydraulic structures, the Indian Standards & Specifications shall be followed in such a manner so that stability of the hill slopes is not jeopardized.

- It shall be ensured that 20% of average flow of lean period or as stipulated by State/Central Govt. shall be released in the river continuously from ecological and environmental point of view so that bio-diversity and aquatic environment is protected.

- Services of experts for environment protection and pollution control shall be taken during project implementation and it shall be ensured that periodic inspection reports of experts are submitted to Pollution Control Board timely.

- To acquire an adequate discharge for generation of the power, the construction of Diversion Structure shall be done in such a manner that the natural boundaries of the river are not affected and no reservoir shall be formed due to structures.
PROPOSED STANDARD TO BE FOLLOWED FOR THE PROJECTS UNDER CONSTRUCTION

- Construction of water conductor system at the project site shall be preferred where the excavation work will be minimum. Surface Channel shall be constructed in the water conductor system for the mild/moderate slope and small tunnels for the steep slope.

- Construction material required for construction work such as stone, sand and aggregate etc shall be used by transport only from pre-approved mines. No excavation/mining shall be done for the requirement of the above material at the site.

- Stone/Boulder/Sand obtained from the excavation of structures etc. shall be used for construction of project. The portable small stone crusher shall be established at the site after obtaining required permission to meet requirement of aggregate through crushing stones/boulders obtained from the excavation.

- Material excavated from construction shall be used for construction only and unused material/debris shall be dumped only at the places indentified for Muck Dumping Yards with treatment for providing vegetative cover.

- Use of heavy explosives shall be prohibited during Project construction and controlled blasting shall be used under guidance of the expert including monitoring of the vibration due to blasting.

- For disposal of natural and seasonal water discharge in Project Area, construction of drains shall be made where ever required. Flow resulting from the drains will be connected with natural drainage flow/river flow.

- The treatment for hill slopes shall be carried out in the project area near project components so as to provide stability and avoid erosion. Protective works shall be undertaken on the suggestions from technical/ geological experts.

- Sewerage Treatment Plant (STPs) shall be constructed for the treatment of effluent from the Power Plant & Colony area.
# Schedule of Implementation of the Project

## Schedule of Implementation of Suwarigad SHP (2.0 MW)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Activity</th>
<th>Year-1</th>
<th>Year-2</th>
<th>Year-3</th>
<th>Year-4</th>
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</tr>
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<td></td>
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<tr>
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<td></td>
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<td></td>
<td></td>
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### Schedule of Implementation of Asiganga-II SHP (4.5 MW)

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Schedule of Implementation of Siyangad SHP (11.50MW)

Project implementation schedule will be determined after final directions of Hon’ble Supreme Court of India in matter of Alaknanda Hydropower co. Ltd vs Anuj Joshi & Others in Case no 6736 of 2013 for review of 24 Hydropower Projects in Alaknanda_Bhagirathi River Basin. Commissioning from start of construction on ground was earlier estimated 3years, after receipt of all clearances, financial closure, and land transfer.

Schedule of Implementation of Kakoragad SHP (12.50MW)

Project implementation schedule will be determined after final directions of Hon’ble Supreme Court of India in matter of Alaknanda Hydropower co. Ltd vs Anuj Joshi & Others in Case no 6736 of 2013 for review of 24 Hydropower Projects in Alaknanda_Bhagirathi River Basin. Commissioning from start of construction on ground was earlier estimated 3years, after receipt of all clearances, financial closure, and land transfer.

Schedule of Implementation of Jalandharygad SHP (12.50MW)

Project implementation schedule will be determined after final directions of Hon’ble Supreme Court of India in matter of Alaknanda Hydropower co. Ltd vs Anuj Joshi & Others in Case no 6736 of 2013 for review of 24 Hydropower Projects in Alaknanda_Bhagirathi River Basin. Commissioning from start of construction on ground was earlier estimated 3years, after receipt of all clearances, financial closure, and land transfer.
OBSERVATIONS ON ESZ NOTIFICATION

Prior to ESZ Notification, Status of SHPs falling under ESZ are as under:

(A) Under Construction:

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Name of Project</th>
<th>Capacity (MW)</th>
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<tbody>
<tr>
<td>1</td>
<td>Limchi Gad</td>
<td>3.50</td>
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<tr>
<td>2</td>
<td>Suwari Gad</td>
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<tr>
<td>3</td>
<td>Assiganga-I</td>
<td>4.50</td>
</tr>
<tr>
<td>4</td>
<td>Assiganga-II</td>
<td>4.50</td>
</tr>
<tr>
<td>5</td>
<td>Kaldigad</td>
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</tbody>
</table>

(B) Under Implementation and/or Clearance:

<table>
<thead>
<tr>
<th>SN</th>
<th>Name of Project</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Son Gad</td>
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</tr>
<tr>
<td>2</td>
<td>Pilangad- II</td>
<td>4.00</td>
</tr>
<tr>
<td>3</td>
<td>Jalandharigad</td>
<td>24.00</td>
</tr>
<tr>
<td>4</td>
<td>Kakoragad</td>
<td>12.50</td>
</tr>
<tr>
<td>5</td>
<td>Syangad</td>
<td>11.50</td>
</tr>
</tbody>
</table>
OBSERVATIONS REGARDING BHAGIRATHI ESZ NOTIFICATION

- SHPs (below 25MW) under construction/implementation or allocated to developers prior to ESZ Notification would not be covered with retrospective effect under prohibited category.

- MOEF & CC vide OM dt 20.12.2013 on the Western Ghats Eco-sensitive Area has clarified that Prohibited Category of Projects /Activities which have applied for Environmental Clearance before date of listing HLWG Report on MOEF&CC website would not be by covered by the prohibition. All such prior projects would continue to be implemented as per the rules and guidelines prevailing at the time of submission of their applications.

- SHPs (below 25MW) come under Green Category of CPCB/Uttarakhand Pollution Control Board. Furthermore, Environmental Clearance is not applicable for SHPs due to low its impact.

- MOEF & CC’s Guidelines dt 9.2.2011 for declaring Eco-sensitive Zones around National Parks & Sanctuaries states that ESZ should be “Regulatory” and not “Prohibitory”. Guidelines do not include Small Hydro Power Projects in Prohibited category.
## DETAILS OF LAND REQUIREMENT

<table>
<thead>
<tr>
<th>SL.NO.</th>
<th>PROJECT NAME</th>
<th>TYPE &amp; AREA OF LAND REQUIREMENT</th>
<th>LAND STATUS</th>
</tr>
</thead>
</table>
| 1     | SWARIGAD SMALL HYDRO PROJECT        | A) CIVIL SOYAM LAND – 2.934 Ha.  | 1. IN PRINCIPAL APPROVAL OF CIVIL LAND 2.934 Ha HAS BEEN OBTAINED ON JUNE, 2013 & COMPLIANCES OF CONDITION LAYDOWN BY MOEF HAS BEEN COMPLIED AND FORMAL APPROVAL IS AWAITED.  
<p>|                                    | B) NAAP LAND- 0.198 Ha.          | 2. NAAP LAND OF 0.198 Ha PURCHASED FROM THE OWNER THROUGH MUTUAL NEGOTIATION                                                                |
|       |                                    | C) TOTAL LAND - 3.132 Ha.        |                                                                                                                                             |
| 2     | LIMCHAGAD SMALL HYDRO PROJECT       | RESERVE FOREST LAND – 4.275 Ha.  | 1. LEASE DEED OF 0.9875 Ha HAS BEEN DONE ON APRIL, 2006                                                                                     |
|       |                                    |                                 | 2. LAND CASE OF ADDITIONAL LAND 3.288 Ha HAS BEEN SUBMITTED AT NODAL OFFICE DEHRADUN ON MARCH, 2013                                                   |
| 3     | ASIGANGA-I SMALL HYDRO PROJECT      | RESERVE FOREST LAND – 2.162 Ha.  | 1. FINAL APPROVAL OF .923 Ha HAS BEEN RECEIVED ON JUNE, 2012                                                                                  |
|       |                                    |                                 | 2. FINAL APPROVAL OF 1.239 Ha HAS BEEN RECEIVED ON MARCH, 2014                                                                               |</p>
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<tr>
<th>SL.NO.</th>
<th>PROJECT NAME</th>
<th>TYPE &amp; AREA OF LAND REQUIREMENT</th>
<th>LAND STATUS</th>
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</table>
| 4      | ASIGNAGA-II SMALL HYDRO PROJECT | A) RESERVE FOREST LAND – 2.302 Ha.  
B) ADDITIONAL RESERVE FOREST LAND – 1.103 Ha.  
C) TOTAL – 3.405 Ha. | 1. FINAL APPROVAL OF 0.719 Ha HAS BEEN RECEIVED ON JUNE, 2000  
2. FINAL APPROVAL OF 1.583 Ha HAS BEEN RECEIVED ON AUGUST, 2010  
3. LAND CASE OF ADDITIONAL LAND 1.103 Ha HAS BEEN SUBMITTED AT NODAL OFFICE DEHRADUN ON FEBRUARY, 2013 |
| 5      | KALDIGAD SMALL HYDRO PROJECT  | D) RESERVE FOREST LAND – 2.351 + 1.685 = 4.036 Ha.  
E) CIVIL SOYAM LAND – 0.66 Ha.  
F) ADDITIONAL LAND – 1.147 Ha  
G) TOTAL – 5.843 Ha | 1. FINAL APPROVAL OF 2.351 & 1.685 Ha HAS BEEN RECEIVED IN APRIL, 2008 & MARCH, 2010 RESPECTIVELY AND LEASE DEED FOR BOTH HAVE BEEN EXECUTED IN FEBRUARY, 2012  
2. LAND CASE OF ADDITIONAL LAND 1.147 Ha HAS BEEN SUBMITTED AT NODAL OFFICE DEHRADUN ON JUNE, 2013  
3. LAND CASE OF ADDITIONAL 0.66 Ha WAS SUBMITTED TO NODAL OFFICE DEHRADUN ON JUNE, 2013 |
<p>| 6      | PILANGAD-I SMALL          | NOT APPLICABLE                   | COMMISSIONED ON                                                                                                                               |</p>
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<tr>
<th>SL.NO.</th>
<th>PROJECT NAME</th>
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<td>SONGAD SMALL HYDRO PROJECT</td>
<td>NOT APPLICABLE</td>
<td>SURVEY AND INVESTIGATION WORKS UNDER PROGRESS</td>
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<td>8</td>
<td>PILANGAD-II SMALL HYDRO PROJECT</td>
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<td>9</td>
<td>SIYANGAD SMALL HYDRO PROJECT</td>
<td>FOREST LAND- 4.990 Ha</td>
<td>FOREST CLEARANCE APPLICATION SUBJUDICE UNDER HON’BLE SUPREME COURT IN MATTER OF 24 HYDROPROJECTS.</td>
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<tr>
<td>10</td>
<td>KAKORAGAD SMALL HYDRO PROJECT</td>
<td>FOREST LAND- 4.9675 Ha</td>
<td>FOREST CLEARANCE APPLICATION SUBJUDICE UNDER HON’BLE SUPREME COURT IN MATTER OF 24 HYDROPROJECTS.</td>
</tr>
<tr>
<td>11</td>
<td>JALANDHARYGAD SMALL HYDRO PROJECT</td>
<td>FOREST LAND- 13.2175 Ha</td>
<td>FOREST CLEARANCE APPLICATION SUBJUDICE UNDER HON’BLE SUPREME COURT IN MATTER OF 24 HYDROPROJECTS.</td>
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COMPLIANCE OF DIRECTIONS ISSUED BY MONITORING COMMITTEE

In compliance to the Directions received in the Meeting headed by Hon’ble Chief Secretary, Uttarakahand held on dated 21.11.2015 at Dehradun, further submission is as here under:

- The criterion of “Permitted Category” of Small Hydro Project Upto 02 MW capacity in the Eco Sensitive Zone seems technically irrelevant.
- The Design of any Hydro Power Project is done mainly on the basis of Available Head & Discharge of the River.
- Capacity of the Project is calculated as per the formula given below:
  \[ P = 8.47 \times Q \times H \]
  Where \( P \) = Proposed Capacity of the Plant (in KW)
  \( Q \) = Design Discharge of the Project (in Cumec)
  \( H \) = Net Available Head (in Meters)
- From the above formula, capacity of the Project is directly proportional to \( Q \) & \( H \). Hence it is clear that for more discharge low head or for High Head Less discharge is required to achieve same capacity of the Project.
- For the design of Small Hydro Project of same capacity, less Discharge is required for High head. Therefore small structures of the Project shall be required due to less discharge.
- In the case of UJVNL, almost all the Small Hydro Projects are high head Projects (more than 100 m) and Projects are proposed on Small River/Gad (i.e. Tributary of the Main River) due to which structures of Projects are very small in sizes.
- Necessary measures with respect to safeguard the ecology & environment are already explained under the head of “proposed standard to be followed during construction of Small Hydro Project”.

Point wise compliance of directions is as under:

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<tr>
<th>S.No</th>
<th>Direction received</th>
<th>Direction incorporated</th>
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<tbody>
<tr>
<td>1</td>
<td>Storing excess water flowing during monsoon only.</td>
<td>Since SHPs are run off the river Projects, hence no storage of excess water shall be made during monsoon.</td>
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<td>2</td>
<td>Allowing non-monsoon flow of water downstream of the project as usual.</td>
<td>20% water of average non-monsoon flows is released continuously at the downstream of the Project for the ecological and environmental point of view.</td>
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<tr>
<td>3</td>
<td>Providing fish ladder in the reservoir area so that fishes can migrate from upstream to downstream and vice-versa as and when required.</td>
<td>As the Small Hydro Projects are run off the river &amp; there is no formation of reservoir, hence, no fish ladder is required in the projects.</td>
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<tr>
<td>4</td>
<td>Doing proper treatment in the catchment area of the project.</td>
<td>Proper treatment in catchment area shall be ensured as already explained under the heading “proposed standard to be followed during construction of SHP”.</td>
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</table>
BHAGIRATHI ECO SENSITIVE ZONE
ZONAL MASTER PLAN
For
MANERI BHALI HEP STAGE –I & II
UJVN Ltd
• NOTIFICATION REGARDING BHAGIRATHI ECO SENSITIVE ZONE REGULATES THE ACTIVITIES OF EXISTING POWER PLANTS

• UJVN LTD SEEKS TO INCORPORATE THE ACTIVITIES OF ITS EXISTING HYDRO-POWER PLANT LOCATED IN BHAGIRATHI VALLEY UNDER THE PROVISION OF SAID ACT.

In Uttarakashi District UJVNL has two existing Hydro-Electric Projects on Bhagirathi River

1. Maneri Bhali HEP Stage-I: 3x30 MW: Stretching from Village Maneri to Village Tiloth
2. Maneri Bhali HEP Stage-II: 4x76 MW: Stretching from Village Kansain to Dharasu

**Maneri Bhali HEP Stage-I**

- Project was commenced in 1973
- Project was commissioned in 1984
- Brief Description of Project

  Dam is located in D/s of Maneri Village. It is a diversion dam from where Head Race Tunnel of length 8.63 km takes off. Power house of project is located near Tiloth village, across the Bhagirathi river, in Uttarkashi city with total installed capacity 90MW (3x30MW)

  Geographical Location of Maneri Dam: Longitude 78°30’E ; Latitude 30°’44.5’N

  Salient features are appended as Annexure-I

**Routine Operational Activity**

- For generating the power 90MW , flow of water in tunnel is maintained to 70 cumeccs. (2662.5 cusecs)
- Water level is kept at 1294m El except monsoon season.
- During monsoon season water level is kept at 1290m. and excess discharge is allowed to flow into the river.
- Usually, river discharge becomes more than 70 cumeccs from May to mid of October
- When river discharge is decreased below 70 cumeccs, all spillway Gates are fully closed. This condition usually prevails from mid of October to end of April.
- During monsoon, quantum of trash flowing in the river is used to very high, hence trash rack often gets choked and caused head loss. Limit of head loss is 100cm.
- Similarly during monsoon, silt content in river water is used to very high and power house can not be run when silt content in river water reaches up to limiting value of 1500 ppm.
- Whenever one of the above two condition prevails at Dam, shut down for power house is allowed and all gates of dam are fully opened.

  Before release of water from dam, warning is communicated in down stream through public address system and bulk sms

**ROUTINE MAINTENANCE & Repair Activity**
• After retreat of monsoon, structures and hydro-mechanical components of dam and power house, detail is in Annexure-I, are inspected and damages are repaired. In monsoon season, most of the damages occurred in roller bucket and spillway of dam. Hence a periodic repair in every three years is required. Under this activity, after de-silting of roller bucket, spillway and roller bucket are repaired accordingly. This activity enhances the life of dam.

**BENEFIT**

• Generation from the project : 460 MU
• Market Rate (Approx) : Rs4.50 per unit
• Market Cost of Generated Electricity from the project (Approx) : Rs270/- crore
• Nos of Employees employed in the project (Permanent/Temporary) : 260 Nos
• Nos of person employed through contractor (Approx) : 100Nos

**Cost of Project:-**

• Cost of Project (1990 base) : Rs 92.19 crore
• Cost of Project (2015) : Rs 700/- crore (Approx)
• As Hydro-mechanical component like gates, sills, guides and stop-log gates etc always faced moist condition hence a periodic epoxy painting after sand blasting on surfaces is required which enhances the life of hydro-mechanical components
• Besides dam and power house, Joshiyara Barrage colony, Shaktipuram Colony Chinyalisaur are also maintained regularly where personnel deputed in operation and maintenance of Barrage and power house resides. Sweeping, cleaning and garbage disposal is an essential part of this activity.
• All above repair and maintenance are of regular schedule and mandatory for smooth operation of HEP’s
MANERI BHALI HEP STAGE – II

- Project was commenced in 1981.
- Project was commissioned in 2008
- Brief description of project: Barrage of the project is located just D/s of Uttarkashi city near village Kansain. It is a diversion barrage from where Head Race Tunnel of length 16 Kms takes off. power house of projects is located at Dharasu with total installed capacity 304 MW(4X76MW).
- Geographical location of Joshiyara Barrage Longitude 78°25’25” E; Latitude 30°43’46” N
- Salient features are appended as Annexure-II

**Routine Operational Activity**

- For generating the power 304MW, flow of water in tunnel is maintained to 142 cumecs (5041 cusecs)
- Water level is kept at 1108m El except monsoon season.
- During monsoon season water level is kept at 1106m and excess discharge is allowed to flow into the river. Usually, river discharge becomes more than 142 cumecs from June to September
- When river discharge is decreased below 142 cumecs, all spillway Gates are fully closed. This condition usually prevails from October to May.
- During monsoon, quantum of trash flowing in the river is used to very high, hence trash rack often gets choked and caused head loss. Limit of head loss is 100cm.
- Similarly during monsoon, silt content in river water is used to very high and power house can not be run when silt content in river water reaches upto limiting value of 3000 ppm.
- Whenever one of the above two condition prevails at Dam, shut down for power house is allowed and all gates of dam are fully opened.
- Before release of water from dam, warning is communicated in down stream through public address system and bulk sms
- Every year after retreat of monsoon, structures and hydro mechanical components of dam and power house, detail is in annexure-II are inspected and damages are repaired.
- In monsoon season, most of the damages occurred in Floor and Glacis of spillway of Barrage. Hence a periodic repair in every three years is required. Under this activity, after de-silting of Floor in U/s as well in D/s, spillway and floor are repaired accordingly. This activity enhances the life of Barrage.
- As Hydro-mechanical component like gates, sills, guides and stop-log gates etc always faced moist condition hence a periodic epoxy painting after sand blasting on surfaces is required which enhances the life of hydro-mechanical components
- Besides dam and power house, Joshiyara Barrage colony, Shaktipuram Colony Chinyalisaur are also maintained regularly where personnel deputed in operation and maintenance of Barrage and power house resides. Sweeping, cleaning and garbage disposal is an essential part of this activity.
- All above repair and maintenance are of regular schedule and mandatory for smooth operation of HEP’s
**BENEFIT**

- Generation from the project: 1533 MU
- Market Rate (Approx): Rs4.50 per unit
- Market Cost of Generated Electricity from the project (Approx): Rs689/- crore
- Nos of Employees employed in the project (Permanent/Temporary): 350 Nos
- Nos of person employed through contractor (Approx): 150Nos

**COST**

Cost of Project (2008 base): Rs 2323/- crore

**APDA RELATED WORK**

- During unprecedented flood of 2012 and 2013 both banks of Bhagirathi river got severally damaged hence threat was ahead incoming monsoon of 2014.

- To save the life and property of people of uttarkashi, protection of river banks was started before monsoon of 2014 from Joshiyara Barrage to Tiloth Bridge under Disaster Management Act 2005 issued by Govt Of India

- Under the provision of clause-72 of this act, work related to disaster are not effected by the Act of Eco sensitive Zone. Hence Apda related on going works should be exempted from Prohibited and Regulated category of Eco sensitive zone.

- At present most of the river training works are on verge of completion.

  Following are Apda related work carried by UJVNL:

  1. River training work including misc. associated works on both banks of Bhagirathi river from Joshiyara Jhula pul to Tiloth bridge excluding left bank from Tiloth bridge to switch yard

  2. Construction of protection wall around the resevoir rim of Joshiyara Barrage, uttarakashi.

  3. River Training works on left bank of Bhagirathi River near Tiloth Power House from TRC to 50 u/s of Tiloth Bridge

  - All training works are constructed with rigid CC gravity / RCC wall.
  - No protruding structures / spurs are constructed in river training works are co
  - No flexible structures like gabions or CC blocks are constructed for training works.
MANERI BHALI HYDRO ELECTRIC PROJECT STAGE-I
(3 X 30 MW)
SALIENT FEATURES

1-DAM
LOCATION
Tehsil Bhatwari
District Uttarkashi
Longitude 78° 32'E
Latitude 30° 44.5'N
Source of Supply Bhagirathi River
Catchment Area 4024 sq. km.
Average Rain fall 1000mm to 1500mm
Design Discharge 5000 Cumecs
Type Concrete Gravity
R.L. of Top of the Dam 1298.00 m
Deepest Foundation Level 1259.00 m
Height of the Dam above Deepest Foundation 39.00 m
Crest Length 127.00 m
Crest Width 6.50 m
R.L. of Spillway Crest 1280.50 m
Spillway crest Length Including Piers 64.00 m
No. & Size of Spillway Gates 4 Nos. Each of 13.00 x 14.55 m Size
Type of Spillway Gates Radial Tainted Type with Electrically Operated Hoists.
Energy Dissipaters Slotted Roller Bucket Type
Volume content of Dam 600000.00 Cum
Maximum Storage Level 1294.50 m
Free Board 2.70 M
Seismic Intensity 8.00
Depth and Width of Cutoff 1.50 m & 1.00 m

2- Intake Works:
R.L. of Crest 1283.25 m
No. & Size of Bays 3 nos. 9.00 m Wide Each
By Pass Channel 3.00 m Wide on the Left Side
Trash Rack Opening From Elevation 1283.252 m to 1289.00 m
Spacing of Trash Strips 85 mm Center to Center
Size of Each Trash Rack Unit 1750 mm Wide x 5840 mm Height

3. Sedimentation Tank

4. H.R.T.
Type 4.75 M Dia Circular Section
Length 8.63 Km.
1278.50/1249.10
1:160,1:150
300 mm is General and in Some Small Length it is 500 mm Thick
At chainage 158.5 m of H.R.T. 7.00 m Dia and
Adits

5. Surge Shaft

Type

Size
Height
Lower Expansion Chamber
Upper Expansion Chamber
Ventilation Tunnel

5. Penstock

Number and Type
Length

6. Power House

Gross Head
Size
Installed Capacity
Firm Power Capacity
Type of Turbines
General Level of Power House
Lowest Foundation Level of Power House

Annual Power Generation

7. The Tail Race

Length
Type & Size of Tail Race Channel

8. Cost

9. Year of Commencement

10. Year of Completion

23.00 m Depth
One at chainage 3332 m of H.R.T. is of 4.80 m width and 473.00 m Length. Another at Chainage 8476 m of H.R.T. is of 4.80 m Width and 274 m Length

Restricted Office Type Underground with Underground Lower and Upper expansion Chambers.
11.00 Dia
69.00 m
89.50 m Long and 6.00 Dia.
316.00 m Long and 6.00 m Dia
118.00 m Long x 4.00 m x 4.50 m

Single Underground Penstock of 3.80 m Dia, With 3 Branches Each of 2.50 m Dia
415 m

180.00 m
56.00 m 19.45 m
3x30 MW
33.23MW at 90% Availability of Discharge
Francis Vertical Shaft
1122.85 m
1100.00 m
545.829 x 106 K.W.H. The Power is Generated at 11.00 KV and is Stepped upto 220 KV by Three nos. 11/220 Transformers.

120.00 m
Trapezoidal Section 27.50 m Bed Width with Side Slopes 1:5:1

92.19 Crores. (1990 Base)

1973

1984
## MANERI BHALI HYDROELECTRIC PROJECT STAGE-II

### SALIENT FEATURES

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Geographic Location</strong></td>
</tr>
<tr>
<td>2.</td>
<td><strong>Location of Barrage</strong></td>
</tr>
<tr>
<td>3.</td>
<td><strong>Hydrology</strong></td>
</tr>
<tr>
<td></td>
<td>i. Catchment area of Barrage Site</td>
</tr>
<tr>
<td></td>
<td>ii. Snow catchment area above 12000 ft.</td>
</tr>
<tr>
<td></td>
<td>iii. 90% available discharge</td>
</tr>
<tr>
<td></td>
<td>iv. Design Flood</td>
</tr>
<tr>
<td></td>
<td>a. For hydraulic design</td>
</tr>
<tr>
<td></td>
<td>b. For over topping</td>
</tr>
<tr>
<td>4.</td>
<td><strong>Barrage</strong></td>
</tr>
<tr>
<td></td>
<td>i. Overall length</td>
</tr>
<tr>
<td></td>
<td>ii. Clear Spans</td>
</tr>
<tr>
<td></td>
<td>iii. Number &amp; Size of 5 Nos. gates</td>
</tr>
<tr>
<td></td>
<td>iv. Crest level of barrage</td>
</tr>
<tr>
<td></td>
<td>v. Pond level</td>
</tr>
<tr>
<td></td>
<td>a. Max.</td>
</tr>
<tr>
<td></td>
<td>b. Min.</td>
</tr>
<tr>
<td></td>
<td>vi. Top of gate</td>
</tr>
<tr>
<td>5.</td>
<td><strong>Intake</strong></td>
</tr>
<tr>
<td></td>
<td>i. Location</td>
</tr>
<tr>
<td></td>
<td>ii. Total length</td>
</tr>
<tr>
<td></td>
<td>iii. No. of bays</td>
</tr>
<tr>
<td></td>
<td>iv. Crest elevation</td>
</tr>
<tr>
<td></td>
<td>v. Number and size of gates</td>
</tr>
<tr>
<td>6.</td>
<td><strong>Sedimentation Chamber</strong></td>
</tr>
<tr>
<td></td>
<td>i. Size of silt settling tank</td>
</tr>
<tr>
<td></td>
<td>ii. Number of hoppers</td>
</tr>
<tr>
<td></td>
<td>iii. Size of hoppers</td>
</tr>
<tr>
<td></td>
<td>iv. Top level of hoppers</td>
</tr>
<tr>
<td></td>
<td>v. Bottom level of conduits at exit</td>
</tr>
<tr>
<td></td>
<td>vi. Design discharge of flushing</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------</td>
</tr>
<tr>
<td></td>
<td>vii. Full supply level in tank</td>
</tr>
<tr>
<td></td>
<td>viii. Particle size to be removed</td>
</tr>
<tr>
<td>7</td>
<td>Fore Bay</td>
</tr>
<tr>
<td></td>
<td>i. Location</td>
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<tr>
<td></td>
<td>ii. Total length</td>
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<td></td>
<td>iii. Number of bays</td>
</tr>
<tr>
<td>8</td>
<td>Cut and cover section</td>
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<td>i. Location</td>
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<td></td>
<td>ii. Length</td>
</tr>
<tr>
<td></td>
<td>iii. Size</td>
</tr>
<tr>
<td></td>
<td>iv. Invert level at Junction with H.R.T.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Head Race Tunnel</td>
</tr>
<tr>
<td></td>
<td>i. Type</td>
</tr>
<tr>
<td></td>
<td>ii. Length</td>
</tr>
<tr>
<td></td>
<td>iii. Thickness of lining</td>
</tr>
<tr>
<td></td>
<td>iv. Design Discharge (Max.)</td>
</tr>
<tr>
<td></td>
<td>v. Maximum Velocity</td>
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<tr>
<td></td>
<td>vi. Invert Elevation</td>
</tr>
<tr>
<td></td>
<td>a. Inlet</td>
</tr>
<tr>
<td></td>
<td>b. Intermediate adit junction</td>
</tr>
<tr>
<td></td>
<td>c. Invert level at Surge tank</td>
</tr>
<tr>
<td></td>
<td>vii. Grade</td>
</tr>
<tr>
<td></td>
<td>a. Upto intermediate adit</td>
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<tr>
<td></td>
<td>b. Beyond</td>
</tr>
<tr>
<td></td>
<td>viii. Intermediate adit at Dhanarigad</td>
</tr>
<tr>
<td></td>
<td>a. Size</td>
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<tr>
<td></td>
<td>b. Length</td>
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<tr>
<td></td>
<td>ix. Surge Tank adit</td>
</tr>
<tr>
<td></td>
<td>a. Type</td>
</tr>
<tr>
<td></td>
<td>b. Size</td>
</tr>
<tr>
<td>9</td>
<td>Surge Tank</td>
</tr>
<tr>
<td></td>
<td>i. Type</td>
</tr>
<tr>
<td></td>
<td>ii. Size</td>
</tr>
<tr>
<td></td>
<td>iii. Bottom Elevation Of tank</td>
</tr>
<tr>
<td>10</td>
<td>Penstocks</td>
</tr>
<tr>
<td></td>
<td>i. Main Penstocks</td>
</tr>
<tr>
<td></td>
<td>ii. Length of each</td>
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<tr>
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</tr>
<tr>
<td>12.</td>
<td><strong>Power House</strong></td>
</tr>
<tr>
<td>i.</td>
<td>Location</td>
</tr>
<tr>
<td>13.</td>
<td>ii.</td>
</tr>
<tr>
<td>a.</td>
<td>Gross Head</td>
</tr>
<tr>
<td>b.</td>
<td>Net Head at discharge of 142 Cumecs</td>
</tr>
<tr>
<td>iii.</td>
<td>Installed Capacity</td>
</tr>
<tr>
<td>iv.</td>
<td>Type of Turbine</td>
</tr>
<tr>
<td>v.</td>
<td>Generator floor level</td>
</tr>
<tr>
<td>vi.</td>
<td>Rated flow</td>
</tr>
<tr>
<td>14.</td>
<td><strong>Tail Race Channel</strong></td>
</tr>
<tr>
<td>i.</td>
<td>Shape of TRC</td>
</tr>
<tr>
<td>ii.</td>
<td>Width of TRC</td>
</tr>
<tr>
<td>iii.</td>
<td>Length of TRC</td>
</tr>
<tr>
<td>iv.</td>
<td>Bed level of TRC</td>
</tr>
<tr>
<td>v.</td>
<td>Top level of front wall of TRC</td>
</tr>
<tr>
<td>vi.</td>
<td>Draft tube opening</td>
</tr>
<tr>
<td>vii.</td>
<td>Minimum TRC water level for 1 machine</td>
</tr>
<tr>
<td>viii.</td>
<td>Minimum TRC water level for 4 machine</td>
</tr>
<tr>
<td>ix.</td>
<td>Maximum TRC water level for 4 machine</td>
</tr>
<tr>
<td>x.</td>
<td>Design discharge of each machine</td>
</tr>
<tr>
<td>15.</td>
<td><strong>Year of commencement</strong></td>
</tr>
<tr>
<td>16.</td>
<td><strong>Year of completion</strong></td>
</tr>
</tbody>
</table>
MANERI BHALI HYDRO ELECTRIC PROJECT STAGE-I (3 X 30 MW)
SALIENT FEATURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1-DAM</strong></td>
<td></td>
</tr>
<tr>
<td><strong>LOCATION</strong></td>
<td></td>
</tr>
<tr>
<td>Tehsil</td>
<td></td>
</tr>
<tr>
<td>District</td>
<td></td>
</tr>
<tr>
<td><strong>Longitude</strong></td>
<td>780 32'E</td>
</tr>
<tr>
<td><strong>Latitude</strong></td>
<td>300 44.5'N</td>
</tr>
<tr>
<td><strong>Source of Supply</strong></td>
<td>Bhagirathi River</td>
</tr>
<tr>
<td><strong>Catchment Area</strong></td>
<td>4024 sq. km.</td>
</tr>
<tr>
<td><strong>Average Rain fall</strong></td>
<td>1000mm to 1500mm</td>
</tr>
<tr>
<td><strong>Design Discharge</strong></td>
<td>5000 Cumecs</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Concrete Gravity</td>
</tr>
<tr>
<td><strong>R.L. of Top of the Dam</strong></td>
<td>1298.00 m</td>
</tr>
<tr>
<td><strong>Deepest Foundation Level</strong></td>
<td>1259.00 m</td>
</tr>
<tr>
<td>**Height of the Dam above Deepest Foundation</td>
<td>39.00 m</td>
</tr>
<tr>
<td><strong>Crest Length</strong></td>
<td>127.00 m</td>
</tr>
<tr>
<td><strong>Crest Width</strong></td>
<td>6.50 m</td>
</tr>
<tr>
<td><strong>R.L. of Spillway Crest</strong></td>
<td>1280.50 m</td>
</tr>
<tr>
<td><strong>Spillway crest Length Including Piers</strong></td>
<td>64.00 m</td>
</tr>
<tr>
<td><strong>No. &amp; Size of Spillway Gates</strong></td>
<td>4 Nos. Each of 13.00 x 14.55 m</td>
</tr>
<tr>
<td><strong>Type of Spillway Gates</strong></td>
<td>Radial Tainted Type with Electrically Operated Hoists.</td>
</tr>
<tr>
<td><strong>Energy Dissipaters</strong></td>
<td>Slotted Roller Bucket Type</td>
</tr>
<tr>
<td><strong>Volume content of Dam</strong></td>
<td>600000.00 Cum</td>
</tr>
<tr>
<td><strong>Maximum Storage Level</strong></td>
<td>1294.50 m</td>
</tr>
<tr>
<td><strong>Free Board</strong></td>
<td>2.70 M</td>
</tr>
<tr>
<td><strong>Seismic Intensity</strong></td>
<td>8.00</td>
</tr>
<tr>
<td><strong>Depth and Width of Cutoff</strong></td>
<td>1.50 m &amp; 1.00 m</td>
</tr>
<tr>
<td><strong>2- Intake Works:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>R.L. of Crest</strong></td>
<td>1283.25 m</td>
</tr>
<tr>
<td><strong>No. &amp; Size of Bays</strong></td>
<td>3 nos. 9.00 m Wide Each</td>
</tr>
<tr>
<td><strong>By Pass Channel</strong></td>
<td>3.00 m Wide on the Left Side</td>
</tr>
<tr>
<td><strong>Trash Rack Opening</strong></td>
<td>From Elevation 1283.252 m to 1289.00 m</td>
</tr>
<tr>
<td><strong>Spacing of Trash Strips</strong></td>
<td>85 mm Center to Center</td>
</tr>
<tr>
<td><strong>Size of Each Trash Rack Unit</strong></td>
<td>1750 mm Wide x 5840 mm Height</td>
</tr>
<tr>
<td><strong>Sedimentation Tank</strong></td>
<td>8 nos. Hoppers in Two Rows. Size of Hoppers 15.00 x 15.70 m connected to a Single Flushing Conduit of 2.20 m Dia and 300 m Length</td>
</tr>
</tbody>
</table>

38
3. H.R.T.
Type
Length
Slope
Thickness of Lining
Construction Shaft
Adits

4. Surge Shaft
Type
Size
Height
Lower Expansion Chamber
Upper Expansion Chamber
Ventilation Tunnel
5. Penstock
Number and Type
Length
6. Power House
Gross Head
Size
Installed Capacity
Firm Power Capacity
Type of Turbines
General Level of Power House
Lowest Foundation Level of Power House
Annual Power Generation

7. The Tail Race
Length
Type & Size of Tail Race Channel

8. Cost
9. Year of Commencement
10. Year of Completion

4.75 M Dia Circular Section
8.63 Km.
1278.50/1249.10
1:160, 1:150
300 mm is General and in Some Small Length it is 500 mm Thick
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H.R.T. is of 4.80 m Width and 274 m Length

Restricted Office Type Underground with Underground Lower and Upper expansion Chambers.

11.00 Dia
69.00 m
89.50 m Long and 6.00 Dia.
316.00 m Long and 6.00 m Dia
118.00 m Long x 4.00 m x 4.50 m

Single Underground Penstock of 3.80 m Dia, With 3 Branches Each of 2.50 m Dia
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33.23MW at 90% Availability of Discharge
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1122.85 m
1100.00 m
545.829 x 106 K.W.H. The Power is Generated at 11.00 KV and is Stepped upto 320 KV by Three nos. 11/220
Transformers.

120.00 m
Trapezoidal Section 27.50 m Bed Width with Side Slopes 1:5:1

92.19 Crores. (1990 Base)
1973
1984
## MANERI BHALLI HYDROELECTRIC PROJECT STAGE-II

### SALTIENT FEATURES

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>In Uttarakhand, India (District-Uttarkashi)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location of Barrage</strong></td>
<td>At 950m downstream of Joshiyara steel bridge and about 2.5 Kms downstream of confluence of Tail Race Channel of Power house of Stage-I</td>
</tr>
<tr>
<td><strong>Hydrology</strong></td>
<td></td>
</tr>
<tr>
<td>i. Catchment area of Barrage Site</td>
<td>4416 Sq. Kms.</td>
</tr>
<tr>
<td>ii. Snow catchment area above 12000 ft.</td>
<td>3199 Sq. Kms</td>
</tr>
<tr>
<td>iii. 90% available discharge</td>
<td>27.0 Cumeecs.</td>
</tr>
<tr>
<td>iv. Design Flood</td>
<td></td>
</tr>
<tr>
<td>a. For hydraulic design</td>
<td>5000 Cumeecs.</td>
</tr>
<tr>
<td>b. For over topping</td>
<td>8000 Cumeecs.</td>
</tr>
<tr>
<td><strong>Barrage</strong></td>
<td></td>
</tr>
<tr>
<td>i. Overall length</td>
<td>81 Metres</td>
</tr>
<tr>
<td>ii. Clear Spans</td>
<td>5 bay each 13 M wide with 4 M intermediate piers.</td>
</tr>
<tr>
<td>iii. Number &amp; Size of 5 Nos. gates</td>
<td>Radial gates of size 13 M(Width) x 15.35 M (height)</td>
</tr>
<tr>
<td>iv. Crest level of barrage</td>
<td>El. 1093.0 M</td>
</tr>
<tr>
<td>v. Pond level</td>
<td></td>
</tr>
<tr>
<td>a. Max.</td>
<td>El. 1108.0 M</td>
</tr>
<tr>
<td>b. Min.</td>
<td>El. 1103.0 M</td>
</tr>
<tr>
<td>vi. Top of gate</td>
<td>El. 1108.35 M</td>
</tr>
<tr>
<td><strong>Intake</strong></td>
<td></td>
</tr>
<tr>
<td>i. Location</td>
<td>On left bank of barrage at an angle of 113° with the barrage axis</td>
</tr>
<tr>
<td>ii. Total length</td>
<td>56.0 Metres</td>
</tr>
<tr>
<td>iii. No. of bays</td>
<td>6 bays of 8.0 M wide with 1.5 M intermediate piers.</td>
</tr>
<tr>
<td>iv. Crest elevation</td>
<td>El. 1099.25 M</td>
</tr>
<tr>
<td>v. Number and size of gates</td>
<td>6 Nos. fixed wheel gates of size 8 M (width) x 6.75 M (height)</td>
</tr>
<tr>
<td><strong>Sedimentation Chamber</strong></td>
<td></td>
</tr>
<tr>
<td>i. Size of silt settling tank</td>
<td>93.00 M wide x 182 M long</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>ii.</td>
<td>Number of hoppers</td>
</tr>
<tr>
<td></td>
<td>97 Nos.</td>
</tr>
<tr>
<td>iii.</td>
<td>Size of hoppers</td>
</tr>
<tr>
<td></td>
<td>13 M x 13 M</td>
</tr>
<tr>
<td>iv.</td>
<td>Top level of hoppers</td>
</tr>
<tr>
<td></td>
<td>El. 1098.8 M</td>
</tr>
<tr>
<td>v.</td>
<td>Bottom level of conduits at exit</td>
</tr>
<tr>
<td></td>
<td>El. 1096.4 M</td>
</tr>
<tr>
<td>vi.</td>
<td>Design discharge of flushing</td>
</tr>
<tr>
<td></td>
<td>77.6 Cumecs.</td>
</tr>
<tr>
<td>vii.</td>
<td>Full supply level in tank</td>
</tr>
<tr>
<td></td>
<td>El. 1108.0 M</td>
</tr>
<tr>
<td>iii.</td>
<td>Particle size to be removed</td>
</tr>
<tr>
<td></td>
<td>Above 0.15 MM</td>
</tr>
<tr>
<td>Fore Bay</td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Location</td>
</tr>
<tr>
<td></td>
<td>Downstream of the sedimentation chamber with gate arrangement.</td>
</tr>
<tr>
<td>ii.</td>
<td>Total length</td>
</tr>
<tr>
<td></td>
<td>93.0 M</td>
</tr>
<tr>
<td>iii.</td>
<td>Number of bays</td>
</tr>
<tr>
<td></td>
<td>10 Nos. fixed wheel gate of size 7.7 x 8.25 M</td>
</tr>
<tr>
<td>Cut and cover section</td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Location</td>
</tr>
<tr>
<td></td>
<td>Between the forebay and head race tunnel</td>
</tr>
<tr>
<td>ii.</td>
<td>Length</td>
</tr>
<tr>
<td></td>
<td>About 43 Metres</td>
</tr>
<tr>
<td>iii.</td>
<td>Size</td>
</tr>
<tr>
<td></td>
<td>6 M dia horse shoe shape</td>
</tr>
<tr>
<td>iv.</td>
<td>Invert level at Junction with H.R.T.</td>
</tr>
<tr>
<td></td>
<td>El. 1094.0 Metres</td>
</tr>
<tr>
<td>Head Race Tunnel</td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Type</td>
</tr>
<tr>
<td></td>
<td>Horse shoe 5.0 M dia.</td>
</tr>
<tr>
<td>ii.</td>
<td>Length</td>
</tr>
<tr>
<td></td>
<td>16.00 Km</td>
</tr>
<tr>
<td>iii.</td>
<td>Thickness of lining</td>
</tr>
<tr>
<td></td>
<td>30 Cms. To 40 Cms.</td>
</tr>
<tr>
<td>iv.</td>
<td>Design Discharge (Max.)</td>
</tr>
<tr>
<td></td>
<td>142 Cumecs.</td>
</tr>
<tr>
<td>v.</td>
<td>Maximum Velocity</td>
</tr>
<tr>
<td></td>
<td>4.75 M per sec.</td>
</tr>
<tr>
<td>vi.</td>
<td>Invert Elevation</td>
</tr>
<tr>
<td></td>
<td>El. 1094.0 M</td>
</tr>
<tr>
<td>a.</td>
<td>Inlet</td>
</tr>
<tr>
<td>b.</td>
<td>Intermediate adit. Junction</td>
</tr>
<tr>
<td></td>
<td>El. 1040.0 M</td>
</tr>
<tr>
<td>c.</td>
<td>Invert level at Surge tank</td>
</tr>
<tr>
<td></td>
<td>El. 1000.0 M</td>
</tr>
<tr>
<td>vii.</td>
<td>Grade</td>
</tr>
<tr>
<td>a.</td>
<td>Upto intermediate adit</td>
</tr>
<tr>
<td></td>
<td>1 in 159</td>
</tr>
<tr>
<td>b.</td>
<td>Beyond</td>
</tr>
<tr>
<td></td>
<td>1 in 189</td>
</tr>
<tr>
<td>ii.</td>
<td>Intermediate adit. at</td>
</tr>
</tbody>
</table>

41
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dhanarigad</strong></td>
<td></td>
</tr>
<tr>
<td>a. Size</td>
<td>D-Shaped 6 M dia.</td>
</tr>
<tr>
<td>b. Length</td>
<td>760 Metres</td>
</tr>
<tr>
<td><strong>Surge Tank adit</strong></td>
<td></td>
</tr>
<tr>
<td>a. Type</td>
<td>D-Shaped 6 M dia.</td>
</tr>
<tr>
<td>b. Size</td>
<td>137 Metres</td>
</tr>
<tr>
<td><strong>Surge Tank</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Restricted orifice type</td>
</tr>
<tr>
<td>ii. Size</td>
<td>13.7 M dia and about 172 M high</td>
</tr>
<tr>
<td>ii. Bottom Elevation Of tank</td>
<td>El. 1062.20 M</td>
</tr>
<tr>
<td><strong>Penstocks</strong></td>
<td></td>
</tr>
<tr>
<td>i. Main Penstocks</td>
<td>4 Nos., 3.0 M dia.</td>
</tr>
<tr>
<td>ii. Length of each Penstock</td>
<td>About 800 M</td>
</tr>
<tr>
<td><strong>Power House</strong></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Near Dhasasu on left bank of river Bhagirathi to be located in a cut at the terrace at El. 892 M.</td>
</tr>
<tr>
<td>ii. Head</td>
<td></td>
</tr>
<tr>
<td>a. Gross Head</td>
<td>285 Metres</td>
</tr>
<tr>
<td>b. Net Head at discharge of 142 Cubecs</td>
<td>247.30 Metres (on low level of Tehri reservoir)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>237.60 Metres (on full level of Tehri reservoir)</td>
</tr>
<tr>
<td>iii. Installed Capacity</td>
<td>304 MW (4 Machines of 76 MW each)</td>
</tr>
<tr>
<td>iv. Type of Turbine</td>
<td>Francis Vertical Shaft</td>
</tr>
<tr>
<td>v. Generator floor level</td>
<td>832.42 M</td>
</tr>
<tr>
<td>vi. Rated flow</td>
<td>35.5 m/sec through each turbine</td>
</tr>
<tr>
<td><strong>Tail Race Channel</strong></td>
<td></td>
</tr>
<tr>
<td>i. Shape of TRC</td>
<td>Rectangular section</td>
</tr>
<tr>
<td>ii. Width of TRC</td>
<td>16.00 m</td>
</tr>
<tr>
<td>iii. Length of TRC</td>
<td>51.35 m</td>
</tr>
<tr>
<td>iv. Bed level of TRC</td>
<td>El815.995 m</td>
</tr>
<tr>
<td>v. Top level of front wall of TRC</td>
<td>El838.000 m</td>
</tr>
<tr>
<td>vi. Draft tube opening)</td>
<td>two opening of size 4.2415 m width and 2.24 m height</td>
</tr>
</tbody>
</table>

42
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii.</td>
<td>Minimum TRC water level for 1 machine</td>
<td>El 822.0 m</td>
</tr>
<tr>
<td>iii.</td>
<td>Minimum TRC water level for 4 machine</td>
<td>El 823.0 m</td>
</tr>
<tr>
<td>x.</td>
<td>Maximum TRC water level for 4 machine</td>
<td>El 830.0 m</td>
</tr>
<tr>
<td>x.</td>
<td>Design discharge of each machine</td>
<td>35.3 Cumec</td>
</tr>
<tr>
<td>Year of commencement</td>
<td>1981</td>
<td></td>
</tr>
<tr>
<td>Year of completion</td>
<td>2008</td>
<td></td>
</tr>
</tbody>
</table>
THE DISASTER MANAGEMENT ACT, 2005
No. 53 of 2005

An Act to provide for the effective management of disasters and for matters connected therewith or incidental thereto:

Be it enacted by Parliament in the Fifty-sixth Year of the Republic of India as follows:

CHAPTER I
Preliminary

1. (1) This Act may be called the Disaster Management Act, 2005.

(2) It extends to the whole of India.

(3) It shall come into force on such date as the Central Government may, by notification in the Official Gazette appoint; and different dates may be appointed for different provisions of this Act and for different States, and any reference to commencement in any provision of this Act in relation to any State shall be construed as a reference to the commencement of that provision in that State.
71. No court (except the Supreme Court or a High Court) shall have jurisdiction to entertain any suit or proceeding in respect of anything done, action taken, order made, direction, instruction or guidelines issued by the Central Government, National Authority, State Government, State Authority or District Authority in pursuance of any power conferred by, or in relation to its functions, by this Act.

72. The provisions of this Act shall have effect, notwithstanding anything inconsistent therewith contained in any other law for the time being in force or in any instrument having effect by virtue of any law other than this Act.

73. No suit or proceeding for other proceeding shall lie in any court against the Central Government or the National Authority or the State Government or the State Authority or the District Authority or local authority or any officer or employee of the Central Government or the National Authority or the State Government or the State Authority or the District Authority or local authority or any person working for on behalf of such Government or authority in respect of any work done or purport to have been done or intended to be done in good faith by such authority or Government or such officer or employee or such person under the provisions of this Act or the rules or regulations made thereunder.

74. Officers and employees of the Central Government, National Authority, National Executive Committee, State Government, State Authority, State Executive Committee or District Authority shall be immune from legal process in regard to any warning in respect of any impending disaster communicated or disseminated by them in their official capacity or any action taken or direction issued by them in pursuance of such communication or dissemination.

75. (1) The Central Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act.

(2) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:

(a) the composition and number of the members of the National Authority under sub-section (2), and the term of office and conditions of service of members of the National Authority under sub-section (4), of section 3;

(b) the allowances to be paid to the members of the advisory committee under sub-section (2) of section 7;

(c) the powers and functions of the Chairperson of the National Executive Committee under sub-section (1) of section 8 and the procedure to be followed by the National Executive Committee in exercise of its powers and discharge of its functions under sub-section (4) of section 8;

(d) allowances to be paid to the persons associated with the sub-committee constituted by the National Executive Committee under sub-section (1) of section 9;

(e) the number of members of the National Institute of Disaster Management under sub-section (2), the term of the office and vacancies among members and the manner of filling such vacancies under sub-section (3) and the manner of constituting the Governing Body of the National Institute of Disaster Management under sub-section (4) of section 42;

(f) the manner of constitution of the Force, the conditions of service of the members of the Force, including disciplinary provisions under sub-section (2) of section 44;

(g) the manner in which notice of the offence and of the intention to make a complaint to the National Authority, the State Authority, the Central Government, the State Government or the other authority or officer under clause (b) of section 60;

(h) the form in which and the time within which annual report is to be prepared under section 70;
Zonal Master Plan of UPCL in Eco sensitive zone from Matli to Gangotri
Detail of Departmental assets established for continuous electric supply at Eco sensitive zone from Barethi bridge to Dharali, Gangotri.

33/11 S/s Ladari : 8+8MVA Power T/f
33/11 S/s Gangori : 3+3MVA Power T/f
33/11 S/s Malla, Bhatwari : 3 MVA Power T/f
Length of 33 KV line : 53.5 Km.
Length of 11 KV line : 157 Km.
Length of LT line : 360 Km.
11/0.4 KV 400 KVA S/s : 8 Nos.
11/0.4 KV 250 KVA S/s : 22 Nos.
11/0.4 KV 100 KVA S/s : 65 Nos.
11/0.4 KV 63 KVA S/s : 47 Nos.
11/0.4 KV 25 KVA S/s : 83 Nos.
11/0.4 KV 16 KVA S/s : 14 Nos.
No. of consumers : 11250 Nos.

The current status of announcement no. 59/2008 by Hon’ble CM, Uttarakhand government.

According to the Hon’ble Chief Minister, Uttarakhand government announcement the construction of 33/11 Kv S/s has been proposed at Jhala, Harshil. The proposal for transferring of forest land to UPCL has been uploaded on the website of forest department. After transferring forest land to UPCL, the construction of 33/11 KV S/s at Jhala will be started soon.

Total Cos of work : 338.61 Lakh.
The proceeding work detail under financial year 2015-16, at Eco sensitive zone (Barethi bridge to Dharali, Gangotri)

- Increasing capacity of power T/F from 1.5 MVA to 3.15 MVA at 33/11 KV S/s Malla, Bhatwari. (24.60 Lakh)
- Laying of LT Aerial bunch cable at Vill. Utraon, Ganeshpur, Pata ] Sangrali, Kelsu, Agoda, Dasda, Dandalka, Bhankoli, Naugaon & Chinwa (33.10 Lakh)
- Laying of LT Aerial bunch cable at different places of Uttarkashi town like Bhairaw chowk, Vishwanath chowk, Barahaat, Tambakhani, Guphiyara, Ujeli, Ganga nagar & Kot-bangla. (91.491 Lakh)
- Construction of 4 No’s 11 KV feeder from 33/11 KV S/s Gangori. (23.83 Lakh)
- Laying of LT aerial bunch cable at different places of block Bhatwa (24.85 Lakh)
- Laying of LT aerial bunch cable at Vill. Jaspur, Purali, Sukki, Jhala, Harsi, Mukhba, Dharali etc (37.47 Lakh)
- Laying of LT aerial bunch cable at Vill. Gorsali, Malla, Lata, Raithal, Nateen etc (55.53 Lakh)
- I/c of S/s from 100+100 KVA & construction of 11 KV line at vill. Raithal. (6.81 Lakh)
- Construction of 11 KV line from Harsil to Mukhba, Markunda, Dharali (29.37 Lac)

The on-going work details under RAPDRP Project at Eco-sensitive zone at Uttarkashi Town (Barethi bridge to Dharali, Gangotri) (Expected to be completed by April-2016)

Total Cost of Work : 753.10 Lakh.

- Construction of 16.17 Kms 11 KV line at different places of Uttarkashi Town.
- Replacement of ACSR weasel conductor by laying of ACSR Raccoon conductor at different places of Uttarkashi town.
- Increasing capacity of different capacity 11/0.4 KV 59 No’s DTR’s at different places of Uttarkashi Town.
- Replacement of ACSR weasel conductor by laying of LT aerial bunch cable at different places of Uttarkashi town.
- Construction of HT/LT capacitor bank at 33/11 KV S/s Ladari.
The electrification work under Deen Dayal Upadhyay Gramya Jyoti Yojna (DDUGJY) of un-electrified Villages/toks of Block Bhatwari.

The electrification work of un-electrified villages/toks of block Bhatwari has been proposed under DDUGJY which has been approved by MoP, GoI. For electrification of un-electrified villages/toks 63.560 kms 11 KV/LT line & 18 nos. 11/0.4 kV S/s has to be constructed at the different places of block Bhatwari.

Total cost of the project is Rs. 547.91 Lac.

**PROPOSED WORK UNDER IPDS**

At present no UPCL grid supply is available at Gangotri Dham for which scheme for its electrification has been approved by MoP, GoI under IPDS in which following works are proposed

- Construction of 8 kms 11 KV line from Bhaironghati to Shri. Gangotri dham for connecting Shri. Gangotri dham to Grid supply.
- Replacement of old and damaged ACSR rabbit conductor from Gangotri to Harshil-17 kms.
- New LT line with LT ABC - 4 kms.
- New DTRs – 5Nos.

Total cost of work – 179.95 Lacs

The routine/necessary work for continuous electric supply by Electricity Department.

In case of damage of different capacity 11/0.4 KV DTR the damaged transformer has to be replace on priority basis as soon as possible for continuous supply.

District Uttarkashi has already got the largest area & also the border district of Uttarakhand state & also known as very sensitive according to the Devi apda point of view. So, due to Devi apda the lines & Sub-station are usually damage in apda period. Causes this for restoration of power supply repairing work of lines & sub-station has to be done on priority basis.
Zonal Master Plan of PTCUL in Eco sensitive zone from Matli to Gangotri
Zonal Master Plan of PTCUL in Eco sensitive zone from Matli to Gangotri

- No fixed asset is present in Eco sensitive zone.
- As per UERC connectivity and long term open access Regulations 2015 PTCUL has planned evacuation for more than 10 MW generators.
- Proposed transmission plan for evacuation of power from proposed HEPPs in Bhagirathi basin.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Name of proposed HEP</th>
<th>Proposed lines/Substations</th>
<th>Present Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lohaninagpala (600 MW) - NTPC</td>
<td>400 KV D/C Lohaninagpala – Koteshwar line</td>
<td>Work has been stopped as per the decision of National Ganga River Basin Authority.</td>
</tr>
<tr>
<td>2</td>
<td>Pala Maneri (480 MW) - UJVNL</td>
<td>LILO of 1 circuit 400 KV D/C Lohaninagpala – Koteshwar line at Palamaneri</td>
<td>Work has been stopped as per the decision of National Ganga River Basin Authority.</td>
</tr>
<tr>
<td>3</td>
<td>Bhaironghati (381 MW) - UJVNL</td>
<td>400 KV D/C Bhaironghati – Dehradun Line</td>
<td>Work has been stopped as per the decision of National Ganga River Basin Authority.</td>
</tr>
<tr>
<td>4</td>
<td>Karmoli (140 MW) - THDC</td>
<td>1. 220 KV D/C Karmoli – Maneribhali –I Line. 2. LILO of 220 KV D/C Karmoli – Maneribhali –I Line at Jadhganga, Jalandharigad, Kakoragad &amp; Syangad HEPs</td>
<td>Transmission system shall be constructed after application for grid connectivity by proposed generators &amp; approval from appropriate authority/regulator.</td>
</tr>
<tr>
<td>5</td>
<td>Jadghanga (50 MW) - THDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Jalandharigad (24 MW) - Harshil Hydro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Kakoragad (12.50 MW) - Harshil Hydro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Syangad (11.50 MW) - Harshil Hydro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Assiganga-I (4.50 MW), Assiganga-II (4.50 MW), Kaligad (9 MW), Limchi Gad (3.50 MW), Sawari Gad (2 MW), Assiganga-III (9 MW), Songad (7.50 MW), Pilangad-II (4 MW) - UJVNL</td>
<td></td>
<td>To be evacuated through nearest UPCL network.</td>
</tr>
</tbody>
</table>
SUWARIGAD SHP
(2x1000 Kw)
(UNDER CONSTRUCTION)
Suwarigad Small Hydro Project; (2 X 1000 Kw) Under Construction

- Eco-Sensitive Zone within the Project's status: Regulated
- Type of Project (Proposed / Operation/ Under Construction): Under Construction
- Geographical Co-ordinates
  - Tranch Wier - 78° 37' 18.3'' East 30° 50' 49.03 '' North
  - Power House - 78° 37' 42.52' 'East 30° 50' 34.13 '' North
- River on which the Project is located – Suwarigad
- Trench Weir river water catchment area - 35.67 sq km
- Area & Type of the land required for Construction of Project –
  - Civil Soyam Land - 2.934 Ha
  - Naap Land - 0.198 Ha
  - Total Land - 3.132 Ha
- Water conductor system type and length - Surface channel 500 m, Power Pipe 315 m

Project description:

Suwarigad hydropower of capacity (2000 KW) classified as “MINI” Hydro Power Project. In accordance with the provisions contained in Gazette notification the Project of 02 MW the micro or small hydropower Project. To fulfill the energy requirements of the local communities with the consent of the Gram Sabha and other required subject to objections.

The Project comes under the “Regulated” category governed by gazette notification.

The Project Suwarigad is located on the right bank of the tributary of the Bhagirathi River in the mid from 1828 m to 1675 m. The provision shall be made for continuous flow in river, 20 percent water of minimum flow of the river flows continuously.

(A) Trench Weir:

To acquire an adequate discharge for generation of the power, the construction of Diversion Structure 20 M Width (Equals to River width) shall be constructed in such a manner that neither any reservoir shall be formed nor any displacement or position of the sinking of the vegetative resources is involved due to structures to be constructed. The river flow will be sustained and it will always be ensured the flow in the river will be minimum 0.14 cumec i.e. 20% of the minimum flow of river. Natural boundaries of the river shall not affected due to construction of Trench Weir.

(B) Water Conductor System:

The Total length of Water Conductor System will be 1240 m. In Water Conductor System, surface Channel (500 m X 1.5 m), Disilting Tank (35 m X 6.0 m), Power duct (30 m X 1.2 m) Pipe Channel (315 X 1.2 m), Forebay Tank (30 X 6.0 m) and Penstock Pipe (330 X 0.770 m) etc. are proposed.

The minimum cutting shall be done as per width of Proposed Hydraulic structures viz Power Pipes and Penstock Pipe whose lengths are 315 m and 330 m respectively. A steel Power Pipe of
1.20m dia is proposed to be laid in 1.20 m wide strip land. The surface of hill is proposed to be laid according to natural slope of the hill in width strip of 1.50 m and 1.20 m. Due to which Cutting of hill will be minimal. No tunnel is proposed in the Project. Surface channel & Power pipe are the main structures in the Water Conductor System. In which water will be carried up to Forebay for the production of electricity through1.20m dia pipe in place of the channel. Hence due to use of 1.20m dia pipe in place of the channel, minimum land is required and hill cutting also shall be minimal accordingly.

(C) Land requirement for the construction of project: -

For the construction of the project Total 3.132 Ha Civil Soyam forest land & Private land is required. Mutation of 0.198 Ha land already has been done and in-principle approval of 2.934 Civil Soyam forest land has been received by Ministry of Environment and Forests, Government of India on 20.03.2013 after obtaining consent of local communities & Village Council in the prescribed forms.

In continuation of above land transfer proposal of 2.934 ha Civil Soyam forest land is still awaited for the formal approval from Environment and Forests, Government of India, Dehradun office since December 2014.

The suitable land have been identified and included in the proposal for the proper muck disposal excavated from construction. During Construction of the Project Provisions of task force and Indian Forest Conservation Act would be strictly followed.

(D) Switchyard and Power House : -

The construction of a Surface Power House of Size 35x8 m & Switchyard is of Size 30x36 m is proposed. Construction of Power House is proposed on a sloping terrace on the right bank of the river of Suwarigad about 15 meters from Uttarkashi-Gangotri National highway. Because of Power House is proposed on the terrace having gradient (5^0-10^0). So no hill cutting is required for the construction of Power House. Only small excavation shall be needed for leveling and foundation of the Terrace.

(E) Residential colony: -

Residential colony for the Project shall not be required. During the Project construction and operation the officers & officials of the project shall reside in Pre constructed residential colony in Bhatwari against the Pala Maneri Hydro Project. During the Project's operation personnel posted in shifts, shall go from Pala Maneri colony to Power House through vehicle.

(F) Technology to be adopted in the construction of Project: -

Detailed Project Report was prepared by the Technical experts of the IIT Roorkee after the Detail investigation, survey and study of site. The design of hydraulic structures was done after finding site suitability with the conformity of the site by site survey, detail investigation of the Technical and Geological experts of the IIT Roorkee prior to preparing the detailed Project report.
(G) COST BENEFIT ANALYSIS:

i. Total cost of the project
   - Rs 1550.00 lac (without interest during construction)
   - Rs 1606.88 lac (with interest during construction)

ii. Debt Equity Ratio
   - 70:30

iii. Loan Repayment Period
    - 07 years

iv. Financing Institution
    - NABARD

v. Expenditure till date
    - Rs 200.00 lac

vi. Net Saleable energy
    - 10.90 Million Unit

vii. Levelized cost of generation
     - Rs 2.50 per unit

viii. Annual Revenue from sale of energy
      - Rs 382.00 lac

➢ No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

The following standards shall be followed strictly during Project construction:

1. Heavy explosives as well as heavy machinery shall be prohibited during Project construction and all the construction work shall be done through labours and small machinery only.

2. Material excavated from construction and unused material/Debris shall be dumped only at the places indentified by the forest department.

3. Construction material required for construction work such as stone, sand and aggregate etc shall be used by transport only from pre-approved mines. No Excavation/mining shall be done for the requirement of the above material on the site. Construction material required for Remaining works shall also be transported only from pre-approved mines.

4. The natural boundaries of the Suwarigad River shall not be changed due to construction of Trench Weir and even after completion of Remaining works; natural boundaries of the river shall not change.

5. A minimum 0.14 Cumec i.e. 20% of minimum water flow in river flows shall be continuously for the environmental point of view.

6. It shall be ensured that Monthly inspection report of the experts on the environment and pollution control board shall be forwarded to Environment and Pollution control board.

7. The treatment for slopes of the hills from erosion in the Project Area shall be carried out for stability through protection works and bio-engineering techniques shall be used in protection works.

8. Treatment of debris/Muck and landscaping shall be done through Bio Engineering & Suggestions received from technical experts shall be incorporated therein.

9. In Project area construction of drains shall be made for prevention of seepage and these shall have obstacle-free flow. Flow resulting from the drains will be connected with natural drainage flow/River flow.

10. In the design for construction of hydraulic structures, the Indian standards & specifications shall be followed.
11. Appropriate design standards for the construction of hydraulic structures will be followed so that the hill is not eroded.

12. There is no landslide and fault zone in the Project area.

13. There is no any irrigation or water supply scheme proposed in the upstream of the project & Project area on Suwarigad River. Hence any other scheme will not be affected due to construction of the project.

14. In the Project area there is no population and agriculture land. So there shall be no need to change agriculture land use and due to small structures of the project, no Reservoir shall be formed and hence no population shall be rehabilitated.

15. The rights and Privileges of the residents of the Project area shall not be affected with the construction of the Project and construction shall be started only after obtaining formal approvals from the residents as per rules.

16. The priority in employment shall be given to the local residents according to their qualifications during Project construction or operation.

17. The alignment of the structures of the Project shall be marked such that Loss of vegetative cover shall be minimal.

18. Construction of the Project will not affect any natural heritage site built in the Project area and pedestrian routes will be protected in its natural state.

(H) Clarification for the “Regulated” category of the project under the Gazette notification of the Eco-Sensitive Zone:-

1. Government Gazette Notification No. 2429 dated 18.12.2012 Page No.- 31 Regulated activities in the Eco-Sensitive Zone, only mini or micro hydropower projects in river valley projects, which would serve the energy requirements of the local communities can only be permitted.

2. In principle approval for the required land was obtained before the declaration of partial area into Eco-Sensitive Zone in district Uttarkashi and construction of the project had been started in year 2010. Under construction projects are also not Prohibited in the above Gazette.

3. As per gazette notification provision No. 3 (a) (i) at page number 31 contains that this Project of capacity (2000 KW) is classified as “MINI” Hydro Power Project. In accordance with the provisions contained in Gazette notification the construction of the project is not prohibited.

4. In reference to the project, it is to apprise that the estimated annual Power Generation of the project shall be 10.90 MU from which state government shall receive annual revenue of Rs 3.82 Crore. The above Electricity shall be consumed by the villegers & state residents as per government policies of the Uttarakhand.

Hence it is requested from the Eco-Sensitive Zone monitoring committee to grant the permission for works of above Project.
Layout of Suwarigad SMALL HYDRO PROJECT (2000 Kw):

SUWARIGAD SHP (2X1.00) MW
(As Per DPR)

Trench Weir (20x1.5 m)

INTAKE
L = 3.10 m
W = 2.50 m
D = 10.58 m

D. TANK
L = 35.0 m
W = 6.0 m
D = 4.0 m

Power Channel/Power Pipe
L = 50.0 m
W = 1.50 m
D = 1.30 m

Power Channel
L = 50.0 m
W = 1.50 m
D = 1.30 m

Power Pipe
L = 315.0 m
Diameter = 1.20 m

FOREBAY
L = 30.0 m
W = 6.0 m
D = 3.0 m
FSL 1823.50 m

Legend
Work Executed
Work yet to be done
Suwarigad River

New Belly Bridge
L = 30.0 m
W = 1.50 m
D = 1.0 m

TRC
L = 35.0 m
W = 8.0 m
H = 8.0 m
EL 1675.0 m

POWER HOUSE
L = 35.0 m
W = 8.0 m
H = 8.0 m
EL 1675.0 m

PENSTOCK
Length = 330.0 m
Main Penstock D = 770 mm
Unit Penstock D = 600 mm

SWITCH YARD

SUWARIGAD RIVER
EL 1828.0 m

Power Channel
L = 30.0 m
W = 36 m

ESCAPE Channel

POWER HOUSE
The Salient features of the Project are given as below:

**SALIENT FEATURES**

**LOCATION:**
- State: Uttarakhand
- District: Uttarkashi
- Village: Pala
- Nearest Town: Bhatwari, Uttarkashi
- Geographical Coordinates: Longitude 78° 37’
  - Latitude 30° 51’

**HYDROLOGY:**
- Name of stream: Suwarigad
- Catchment Area: 35.67 sq. km. upto diversion weir site
- 50% dependable flow: 1.60 cumec
- Minimum flow: 0.70 cumec
- Maximum flow (Flood): 220 cumec

**DIVERSION WORK:**
- Weir: Trench type intake
- Weir Elevation (Top): 1828.00 m
- H.F.L.: 1831.45 m
- Design Discharge: 2.12 Cumec

- Size of Weir: Width 1.5 m
- Depth Varies from: 1.20 m to 2.20m
- Length: 20m
- Intake Bulk Head Gate: 2.0 m x 2.5 m
- Intake Service Gate: 1.50 m x 1.65 m

**INTAKE WELL, INTAKE CHANNEL AND SHINGLE FLUSHING CHANNEL:**
- Shape: Rectangular
- Size
  - Width: 2.50 m
  - Height: 10.58 m
  - Length: 3.10 m
- Intake Channel
  - Size: 1200mm X 1200mm
  - Length: 30m
  - Type: RCC Rectangular Channel
- Shingle Flushing Channel
  - Size: 400mm diameter M.S. Pipe
  - Length: 25m
  - Type: Circular M.S. Pipe
- Mode of operation of Intake Gates: Electrically / Manually operated Gates
- Mode of operation of Sluice Valve: Manually operated Gates/ Sluice Valve
flushing Channel/ Pipe

**DESILTING CHAMBER**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Supply Elevation</td>
<td>1827.63 m</td>
</tr>
<tr>
<td>Length</td>
<td>35 m (Including splay &amp; Fluming)</td>
</tr>
<tr>
<td>Maximum Width</td>
<td>6 m</td>
</tr>
<tr>
<td>Nos. of Chamber</td>
<td>One</td>
</tr>
<tr>
<td>Depth</td>
<td>4.0 m</td>
</tr>
<tr>
<td>Design Discharge</td>
<td>2.02 Cumec</td>
</tr>
<tr>
<td>Discharge for flushing</td>
<td>0.26 Cumec</td>
</tr>
<tr>
<td>Flow through Velocity</td>
<td>0.22 m/sec.</td>
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</table>

**Power Channel / Conduit**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Width</td>
<td>1500 mm</td>
</tr>
<tr>
<td>Depth</td>
<td>1300 mm</td>
</tr>
<tr>
<td>Length</td>
<td>500 m</td>
</tr>
<tr>
<td>Bed Elevation at beginning</td>
<td>1826.33 m</td>
</tr>
<tr>
<td>Slope</td>
<td>1 in 500</td>
</tr>
<tr>
<td>Flow Velocity</td>
<td>1.25 m/sec.</td>
</tr>
<tr>
<td>Depth of Flow</td>
<td>1 m</td>
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</tbody>
</table>

**Conduit (M.S. Pipe)**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Width</td>
<td>1200mm dia</td>
</tr>
<tr>
<td>Depth</td>
<td>150 mm free board</td>
</tr>
<tr>
<td>Length</td>
<td>315 m</td>
</tr>
<tr>
<td>Bed Elevation at beginning</td>
<td>1826.33 m</td>
</tr>
<tr>
<td>Slope</td>
<td>1 in 500</td>
</tr>
<tr>
<td>Flow Velocity</td>
<td>1.6 m/sec.</td>
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<tr>
<td>Depth of Flow</td>
<td>1.05 m</td>
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**BYEPASS STRUCTURE & BYEPASS CHANNEL**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Location</td>
<td>RD 900 m</td>
</tr>
<tr>
<td>Crest Length &amp; level</td>
<td>4.0 m at 1825.70</td>
</tr>
<tr>
<td>Depth of flow above crest</td>
<td>0.40 m</td>
</tr>
<tr>
<td>Shape of Byepass channel</td>
<td>Rectangular</td>
</tr>
<tr>
<td>Size of Bye pass channel</td>
<td>1.5m x 1.0 m</td>
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**FOREBAY**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Width</td>
<td>6.0m</td>
</tr>
<tr>
<td>Water Depth</td>
<td>3.0m</td>
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<tr>
<td>Free Board</td>
<td>1.0m</td>
</tr>
<tr>
<td>Length</td>
<td>30m</td>
</tr>
<tr>
<td>Full Reservoir Elevation</td>
<td>1825.70 m</td>
</tr>
<tr>
<td>MDDL</td>
<td>1823.60 m</td>
</tr>
<tr>
<td>Storage Capacity</td>
<td>540 cu m (2 min. storage)</td>
</tr>
<tr>
<td>Trash Rack (1 Nos.)</td>
<td>1200 mm wide X 1200mm high</td>
</tr>
<tr>
<td>Penstock Gate (1 Nos.)</td>
<td>1200 mm wide X 1200 mm high</td>
</tr>
</tbody>
</table>

**PENSTOCK**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Center-line El. at fore-bay</td>
<td>1823.30 m</td>
</tr>
<tr>
<td>Diameter of Main Penstock</td>
<td>770 mm OD</td>
</tr>
<tr>
<td>Diameter of Unit Penstock</td>
<td>600 mm OD</td>
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<tr>
<td>Number of Main Penstock</td>
<td>1 Nos.</td>
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<tr>
<td>Flow Through Velocity</td>
<td>3.98 m/sec.</td>
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<tr>
<td>Plate Thickness</td>
<td>Varies from 8 to 10 mm</td>
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<tr>
<td>Penstock Plate</td>
<td>Material Confirming to IS 2002 Gr. B or</td>
</tr>
<tr>
<td></td>
<td>ASTM 285 Gr. C</td>
</tr>
<tr>
<td>Anchor Blocks</td>
<td>8 Nos.</td>
</tr>
<tr>
<td>Saddle Supports</td>
<td>40 Nos.</td>
</tr>
<tr>
<td>Saddle Plate material</td>
<td>Confirming to IS 2062</td>
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</tbody>
</table>
Expansion Joints per Penstock: 8 Nos.
Manhole (500 mm Diameter): Not Required
Y – Pieces: 1 Nos. made from 25 mm thick plates
Length of Penstock:
(a) 770mm OD – (i) 8 mm thick – 200m
(ii) 10 mm thick – 100m
(b) 600mm OD - 10mm thick 30 m

**POWERHOUSE**
- Length: 35 m
- Width: 8 m
- Height: 8 m
- Max. TWL: 1675.00 m
- Min. TWL: 1675.00 m

**SWITCHYARD**
- Size: 30 m X 36 m
- Elevation: 1678 m

**ELECTRO-MECHANICAL EQUIPMENT**

**Turbine**
- Type of Turbine: Horizontal Francis
- Capacity of each turbine: 1500 MHP
- Number: 2 Nos.
- Rated Head: 145.00 m

**Generator**
- Type of Generator: Synchronous
- Capacity of each Generator: 1000 KW
- Voltage, number of phases: 3.3 KV (three phase, 50 Hz)
- Frequency
- Number: 2 Nos.
- Type of excitation: Brushless

**TAILRACE**
- Shape: Rectangular Channel
- Size: Width 1.5 m, depth 1 m, length 30 m

**POWER AND ENERGY**
- Installed Capacity: 2x1.0 MW
- Annual energy: 11.06 million kwh
- Energy available for sale: 10.90 million kwh
- Plant load factor: 62.2%

**FINANCIAL**
- Estimated cost of Project: Rs. 1550 lakhs
- Cost of civil works: Rs. 757.38 lakhs
- Cost of Electro-mechanical works: Rs. 714.50 lakhs
- Others: Rs 78.12 Lacs
- CDM Benefits: Rs 54.48 Lacs
- Levelised cost of generation with CDM benefits: Rs. 2.5 per Kwhr
- Levelised cost of generation without CDM benefits: Rs. 2.67 per Kwhr
LIMCHAGAD SHP
(2x1750 Kw)
(UNDER CONSTRUCTION)
Limchagad Small Hydro Project; (2 X 1750 Kw) Under Construction

- Eco-Sensitive Zone within the Project's status: Undefined
- Type of Project (Proposed / Operation/ Under Construction): Under Construction
- Geographical Co-ordinates
  - Tranch Wier - 78° 41' 28" East 30° 55' 31" North
  - Power House - 78° 40' 55' East 38° 55' 13" North

- River on which the Project is located – Limchagad
- Trench Weir river water catchment area – 14.75 sq km
- Area & Type of the land required for Construction of Project – Reserve Forest Land -4.275 Ha. (Formal approval of 0.9875 Ha. Land has been obtained on dated 13.04.2006 and the land case of additional 3.288 Ha. Land is still awaited form the Nodal office, Dehradun since 16.03.2013)
- Water conductor system type and length - Surface channel 450m.

**Project description:**

The Limchagad SMALL HYDRO PROJECT (3500 KW) is located on the right bank of the tributary Limchagad of the Bhagirathi River in the mid from 2378.50 m to 1960 m. The provision shall be made for continuous flow in river, 20 percent water of minimum flow of the river flows continuously.

The brief descriptions of proposed Hydraulic Structures are given hereunder:

(A) **Trench Weir:**

To acquire an adequate discharge for generation of the power, the construction of Diversion Structure 12 M Width (Equals to River width) shall be constructed in such a manner that neither any reservoir shall be formed nor any displacement or position of the sinking of the vegetative resources involved due to constructed structures to be constructed. The river flow will be sustained and it will always be ensured that the flow in the river will be minimum 0.08 cumec i.e 20% of the minimum flow of river. Natural boundaries of the river shall not affected due to construction of Trench Weir.

(B) **Water Conductor System:**

The Total length of Water Conductor System will be 1383 m. In Water Conductor System, surface Channel (450 m X 1.0 m), Disilting Tank (28.4 m X 5.0 m), Power duct (35 m X 2.5 m) Pipe Channel (1.0 m dia as per requirement), Forebay Tank (20 X 5.0 m) and Penstock Pipe (850 X 0.80 m) etc. are proposed.

The minimum cutting shall be done as per width of Proposed Hydraulic structures viz Power Pipes and Penstock Pipe whose length are 450 m and 850 m respectively. A steel Power Pipe of 1.00 m diameter is proposed to be laid in 1.0 m wide strip land. The surface of hill is proposed to be laid according to natural slope of the hill in width strip of 1.00 m. Due to which Cutting of hill
will be minimal. No tunnel is proposed in the Project. Surface channel & Power pipe are the main structures in the Water Conductor System.

(C) Land requirement for the construction of project: -

For the construction of the project Total 4.275 Ha Reserve Forest land is required. Formal approval of 0.9875 Ha. Land has been obtained on dated 13.04.2006 and the land case of additional 3.288 Ha. Reserve forest Land has been submitted to additional chief conservator Forest, Ministry of Forest, F.R.I, Dehradun office since 16.03.2013.

The suitable land have been identified and included in the proposal for the proper muck disposal excavated from construction. During Construction of the Project Provisions of task force and Indian Forest Conservation Act would be strictly followed.

(D) Switchyard and Power House : -

The construction of a Surface Power House of Size 30x20 m & Switchyard is of Size 30x20 m is proposed. Construction of Power House is proposed on a sloping terrace on the right bank of the river of Limchagad about 500 meters from Uttarkashi-Gangotri National highway. Because of Power House is proposed on the terrace having gradient (5°-10°). So no hill cutting is required for the construction of Power House. Only small excavation shall be needed for leveling and foundation of the Terrace.

(E) Residential colony: -

Residential colony for the Project shall not be required. During the Project construction and operation the officers & officials of the project shall reside in Pre constructed residential colony in Bhatwari against the Pala Maneri Hydro Project. During the Project's operation personnel posted in shifts, shall go from Pala Maneri colony to Power House through vehicle.

(F) Technology to be adopted in the construction of Project: -

Detailed Project Report was prepared by the Technical experts of the IIT Roorkee after the Detail investigation, survey and study of site. The design of hydraulic structures was done after finding site suitability with the conformity of the site by site survey, detail investigation of the Technical and Geological experts of the IIT Roorkee prior to preparing the detailed Project report.

(G) COST BENEFIT ANALYSIS:

i. Total cost of the project Rs 2571.70 lac (without interest during construction) Rs 2646.00 lac (with interest during construction)

ii. Debt Equity Ratio 70:30

iii. Loan Repayment Period 07 years

iv. Financing Institution NABARD

v. Expenditure till date Rs 223.00 lac

vi. Net Saleable energy 20.124 Million Unit

vii. Levelized cost of generation Rs 1.95 per unit

viii. Annual Revenue from sale of energy Rs 704.00 lac
➢ No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

The following standards shall be followed strictly during Project construction:

1. Heavy explosives as well as heavy machinery shall be prohibited during Project construction and all the construction work shall be done through labours and small machinery only.

2. Material excavated from construction and unused material/Debris shall be dumped only at the places indentified by the forest department.

3. Construction material required for construction work such as stone, sand and aggregate etc shall be used by transport only from pre-approved mines, No Excavation/mining shall be done for the requirement of the above material on the site. Construction material required for Remaining works shall also be transported only from pre-approved mines.

4. The natural boundaries of the Limchagad River shall not be changed due to construction of Trench Weir and even after completion of Remaining works; natural boundaries of the river shall not change.

5. A minimum 0.14 Cumec i.e. 20% of minimum water flow in river flows shall be continuously for the environmental point of view.

6. It shall be ensured that Monthly inspection report of the experts on the environment and pollution control board shall be forwarded to Environment and Pollution control board.

7. The treatment for slopes of the hills from erosion in the Project Area shall be carried out for stability through protection works and bio-engineering techniques shall be used in protection works.

8. Treatment of debris/Muck and landscaping shall be done through Bio Engineering & Suggestions received from technical experts shall be incorporated therein.

9. In Project area construction of drains shall be made for prevention of seepage and these shall have obstacle-free flow. Flow resulting from the drains will be connected with natural drainage flow/River flow.

10. In the design for construction of hydraulic structures, the Indian standards & specifications shall be followed.

11. Appropriate design standards for the construction of hydraulic structures will be followed so that the hill is not eroded.

12. There is no landslide and fault zone in the Project area.

13. There is no any irrigation or water supply scheme proposed in the upstream of the project & Project area on Suwarigad River. Hence any other scheme will not be affected due to construction of the project.

14. In the Project area there is no population and agriculture land. So there shall be no need to change agriculture land use and due to small structures of the project, no Reservoir shall be formed and hence no population shall be rehabilitated.

15. The rights and Privileges of the residents of the Project area shall not be affected with the construction of the Project and construction shall be started only after obtaining formal approvals from the residents as per rules.

16. The priority in employment shall be given to the local residents according to their qualifications during Project construction or operation.
17. The alignment of the structures of the Project shall be marked such that Loss of vegetative cover shall be minimal.

18. Construction of the Project will not affect any natural heritage site built in the Project area and pedestrian routes will be protected in its natural state.

(H) Clarification for the “Undefined” category of the project under the Gazette notification of the Eco-Sensitive Zone:

1. Formal approval of 0.9875 Ha. Reserve forest land was obtained before the declaration of partial area into Eco-Sensitive Zone in district Uttarkashi and construction of the project had been started in year 2010. Under construction projects are also not prohibited in the above Gazette.

2. As per Government Gazette Notification No. 2429 dated 18.12.2012 Page No.- 31 following activities shall be prohibited within the Eco-sensitive Zone:

   3(a)(i) River Valley projects: Setting up of new hydro-electric power plants (dams, tunneling, and construction of reservoir) and expansion of existing plants on the river Bhagirathi and all its tributaries from Gaumukh to Uttarkashi except micro or mini hydel power projects, which would serve the energy needs of the local communities, subject to consent of the gram sabha and all other requisite clearances;

3. In reference to the project, it is to apprise that the estimated annual Power Generation of the project shall be 20.12 MU from which state government shall receive annual revenue of Rs 7.04 Crore per year. The above Electricity shall be consumed by the villegers & state residents as per government policies of the Uttarakhand.
The Salient features of the Project are given as below:

**SALIENT FEATURES**

**LOCATION:**
I. **State:** Uttarakhand
II. **District:** Uttarkashi
III. **Village:** Gangnani
IV. **Nearest Town:** Bhatwari, Uttarkashi
V. **Geographical Coordinates**
   - **Longitude:** 78°41’28”
   - **Latitude:** 30°55’31”

**HYDROLOGY:**
I. **Name of stream:** Limcha-Gad
II. **Catchment Area:** 14.75 sq. km. upto diversion weir site
III. **50% dependable flow:** 1.1 cumec
IV. **Minimum flow:** 0.4 cumec
V. **Maximum flow (Flood):** 105 cumec

**DIVERSION WORK:**
I. **Weir:** Trench type intake
II. **Weir Elevation (Top):** 2378.5 m
III. **H.F.L.:** 2381.5 m
IV. **Design Discharge for 1.1 Cumec:****
   - Size of Weir: Width 1.5 m
   - Depth Varies from 0.6 m to 1.20 m
   - Length: 12 m
   - Intake Bulk Head Gate: 1.8 m x 1.5 m
   - Intake Service Gate: 2.8 m x 1.0 m

**INTAKE WELL, INTAKE CHANNEL AND SHINGLE FLUSHING CHANNEL**
I. **Shape:** Rectangular
II. **Size:**
   - **Width:** 5.0 m
   - **Height:** 6.0 m
   - **Length (parallel to river):** 8.0 m

**POWER DUCT**
Size : 2.5 m mm X 0.6 m / 2.1 m (in box section slab)
Length : 35 m
Type : RCC Rectangular Channel/box section

**SINGLE FLUSHING CHANNEL**
Size : 1.0 m X 0.3 m (B=1.0 m, FSD = 0.3 m)
Length : 120 m
Type : RCC Rectangular Channel/covered with removable slabs
Mode of operation of : Electrically Manually operated Gates
Power duct and shingle excluder

**DESILTING TANK**
I. **Full Supply Elevation:** 2377.0 m
II. **Length:** 28.4 m (Including splay & Fluming)
III. Width 5.0 m
IV. Nos. of hoppers 4
V. Depth 1.3+2.7 = 4.0 m
VI. Average Design Discharge 2.2 Cumec
VII. Discharge for flushing 0.5 Cumec
VIII. Flow through Velocity 0.35 m/sec.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>I. Width</td>
<td>1.0 m</td>
<td>1.0 m dia</td>
</tr>
<tr>
<td>II. Depth (FSD)</td>
<td>1.8 m</td>
<td>0.85 m</td>
</tr>
<tr>
<td>III. Bed Elevation at beginning</td>
<td>2375.1</td>
<td></td>
</tr>
<tr>
<td>IV. Slope</td>
<td>1 in 700</td>
<td>1 in 260</td>
</tr>
<tr>
<td>V. Flow velocity</td>
<td>1.11 m/sec.</td>
<td>2. m/sec.</td>
</tr>
<tr>
<td>VI. Total length of power</td>
<td>450 m</td>
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</tbody>
</table>

Channel including free flow
MS pipe in short pieces as and
Where required

BYPASS SPILLWAY STRUCTURE & ESCAPE CHANNEL

I. Location Just before forebay
II. Crest Length & level 5.0 m at RL 2376.3 m
III. Depth of flow above crest 0.40 m
IV. Shape of Bypass channel Rectangular
V. Size of Bye pass channel 1.5m X1.0 m, stepped spillway

FOREBAY

I. Width: 5.0m
II. Water Depth: 6.5 m
III. Free Board: 1.0 (+0.4)=1.4 m
IV. Length 20m
V. Full Reservoir Elevation: 2376.3 m
VI. MDDL: 2373.8 m
VII. Storage Capacity: 240 cu m. (2 min. storage)
VIII. Trash Rack (1 Nos.) 3.0 m wide X 2.55 m high
IX Gate on power channel before forebay 1.4 m wide x 3.2 m height

PENSTOCK

I. Center-line El. at fore-bay 2372.04 m
II. Diameter of Main Penstock 0.8 m
III. Diameter of Unit Penstock 0.6 m
IV. Number of Main Penstock 1 Nos.
V. Flow Through Velocity 3.8 m/sec
VI. Plate Thickness 8 to mm to 20 mm
VII. Penstock Plate Material Confirming to IS 2002 Gr. B
VIII. Anchor Blocks 40 Nos.
IX. Saddle Supports 100 Nos.
X. Saddle plate material Confirming to IS 2062
XI. Expansion joints per penstock 40 Nos.
XII.  Y- Pieces 01 No made form 25 mm thick plates

XIII. Length of main penstock 800 metres (thickness8 to 20 mm)
     Length of unit penstock 50 metres (plate thickness-16 mm)

POWERHOUSE
I.  Length 30 m
II.  Width 20 m
III. Height 8 m
IV.  Max. TWL 1960.00 m
V.  Min. TWL 1958.5 m

SWITCHYARD
I.  Size 30 m X 20 m
II.  Elevation 1962 m

ELECTRO-MECHANICAL EQUIPMENT
A. TURBINE
   I.  Type of Turbine Horizontal pelton-2 jet
   II. Capacity of each turbine 1750 KW
   III. Number 2 Nos.
   IV. Rated Head 400 m
B. GENERATOR
   I.  Type of Generator Synchronous
   II. Capacity of each Generator 1750 KW
   III. Voltage, number of phase, Frequency 3.3 KV (Three phase, 50 HZ)
   IV. Rated RPM 1000
   V.  Number 2 Nos.
   VI. Type of excitation Brushless

TAILRACE
I.  Shape Rectangular Channel
II. Size Width 2.5 m, FSD 0.6 m,
     Length 100 m, bed slope 1in 500

POWER AND ENERGY
   I. Installed Capacity 2x 1.75 MW (3500 KW)
   II. Annual energy 20.644 million kwh
   III. Energy available for sale 20.124 million kwh
   IV. Plant load factor 67.32% million kwh

FINANCIAL
I. Estimated cost of project Rs. 2571.70 Lacs
II. Cost of Civil works Rs. 1508.26 Lacs
III. Cost of Electro-mechanical works Rs. 958.43 Lacs
IV. Cost of Transmission works: Rs. 75 Lacs
V.  Cost of Land and other preliminary works Rs. 30.00 Lacs
VI. Total CDM Benefit Rs. 79.69 Lacs
VII. Levelised cost of generation
     Over a 30 year period
     Benefit for 10 yrs & Rs. 2.08 per kwhr without CDM Benefit
     Rs. 1.95 per Kwhr with CDM
     Rs. 642.18 lacs

VIII. Equity (30% of project cost)
IX. Levelised return on equity (with Rs. 2.80 per kwhr as sale price over the 30 year period) Rs. 14.00 %
ASIGANGA-I SHP

(2x2250 Kw)

(UNDER CONSTRUCTION)
Asiganga-I Hydro Electric Project (2X2250KW)

- Status of the Project as per Eco Sensitive Zone Gazette notification – Undefined.
- Actual Status of the Project- Under construction.
- Geographical Coordinates-
  - Trench weir -30° 48’ 37’’ North, 78° 27’05’’ East
- Name of the River on which project is situated- Asiganga
- Water catchment area of the River on Trench Weir – 147 Sq Km
- Type & Area of the Land for the project- 2.162 Ha Reserve forest Land
- Type & Length of water conductor system –
  - Open channel - 1410 m
  - Pressure free Tunnel - 800 m

Detail of the Asiganga-I Project :-

Project is situated on the left bank of the river Asiganga from the base of the river from 1496.00m to 1394.25 m. Provision is made for release of Minimum 20% (0.81 cumec) water continuously in the downstream of project to maintain the continuous flow of water in the river. This projected was started in 2004-05. Now 70% Construction work of the project has been completed Before the flash flood of 03.08.2012.

Detail of the various component of the project is as followings-

1) **Trench Weir**-
   22 m wide Trench weir has been constructed before the flash flood 03.08.2013 but due to flash flood of 03.08.2013 flash flood, the trench weir has been completely damaged hence the restoration work of the trench weir is proposed in the revised DPR. Due to restoration of the trench weir natural boundaries of the river will not be affected. Hence no rehabilitation of the population shall be required and life of flora and fauna will not be disturbed.

2) **Water Conductor System**-
   Proposed component of the water conductor system as per DPR-
   - Length of Water Conductor System- 2552m
   - Open Channel- 1410 x 2.1 m
   - Desilting Tank- 70 x 8m
   - Pressure free Tunnel- 800x2.1m
   - Forebay- 32x10m
   - Penstock- 150 x 1.3m
   - Tail Race Channel- 90m

The construction work of the above said various component of the water conductor system has been completed before flash flood of June 2013. But due to the flash flood all the component of the water conductor system have been damaged partially. The restoration work of the above will not disturb the life of nearby population & surroundings of the Asiganga river.

3) **Land Details of the Project**-
Total 2.162 ha Reserve forest land is required for completion of the project. In which formal approval of 0.923 ha reserve forest land has been approved on dated – 26.06.2001 & formal approval of remaining 1.239 ha reserve forest land has been approved on dated-31.08.2010. The lease deed of the 2.162 ha Reserve forest land has been done on dated-14.06.2012. There is no requirement of any additional land for restoration of the project. The provision will be made to strict compliance of rules & regulation of Indian forest conservation act & Task force during the restoration of the Project.

4) **Switchyard and Power House:**
The construction of 30X18 m size surface Power House and 30x20m size Switch Yard are proposed in this project. In which the construction of Power House has been completed before the flash flood of August 2012 but due to flash flood Power House building has been damaged. Now the construction of New Power House is proposed on the left bank of the river Asiganga on Gangori-SangamChatti Road. The provision shall be made for the stabilization & protection of hill slopes during the leveling of Terrace and excavation of Foundation of Power House building as per Bio Engineering & Views of the Experts.

5) **Residential building**
The construction of residential building for the project has been completed in 2010 at Gangori.

6) **Cost Benefit Analysis:**
ix. Total cost of the project
   - Rs 5360.81 lac (without interest during construction)
   - Rs 6361.47 lac (with interest during construction)

   x. Debt Equity Ration
   - 70:30

   xi. Loan Repayment Period
   - 12 Years

   xii. Financing Institution
   - NABRAD

   xiii. Expenditure till date
   - Rs 3274 lac

   xiv. Net Saleable energy
   - 26.33 Million Unit

   xv. Levelized cost of generation
   - Rs 3.89 per unit

   xvi. Annual Revenue from sale of energy
   - Rs 921.00 lac

   ➢ No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

7) **Technology used in the Restoration of the Project:**
The DPR of the project has been prepared by the technical experts of Indian Institute of Technology, Roorkee. After the flash flood, the revised DPR has been prepared incorporating the views of technical Experts of IIT Roorkee, UJVNL & other departments which has been approved by the BoD of UJVNL.

The following parameters will be considered during the restoration & construction of balance work of the Project-

a) Maximum work, as far as possible shall be carried out by labour in place of heavy machinery.

b) There is no need of any kind of blasting in this project. but Controlled blasting will be done if required.
c) Muck produced during the restoration of the project will be disposed off on demarcated lands as per instruction of Forest department.
d) RBM used in the project will be carted from the government approved quarries. RBM will not be taken from the river at project site.
e) Natural boundaries of the river will not be disturbed due to restoration of the project.
f) To maintain the environmental discharge minimum 20% (0.81 cumec) water will be released continuously in downstream of the project in the river Asiganga.
g) The monthly inspection report of the project construction will be sent to the Environment pollution control board and construction work will be carried out as per instruction of Environment pollution control board.
h) The hilly slopes will be maintained & protected by using latest bio engineering technologies.
i) Treatment of produced muck & land scaping will be done with the help of bio engineering & according to the views of experts.
j) Systematic Drainage system will constructed to avoid the unnecessary storage of the water with in the project & surroundings and the drainage system will be connected to the natural drainage.
k) The various component of the project will be construct as per suitable design parameter to avoid the decay of the slopes.
l) The project is not situated in sliding zone & fault zone.
m) The flow of the Asiganga river will not be disturbed due to project restoration.
n) Irrigation & water supply projects are not proposed in this area and no other project will be affected by the restoration of this project.
o) Habitation & Agricultural land is not situated in the project area hence there is no need to rehabilitation of population & conversion of Land.
p) Priority will be made for the employment of the people of the project affected area according to their qualification.
q) Suitable alignment of the various component of the project will be adopted to maintain the forest/vegetal cover.
r) Heritage of state/country will not be affected due to restoration of the project. Roads situated in the project will be conserved in their natural condition.
s) 70% Restoration work of the project and remaining 30% balance construction work will be done as per gazette notification of Eco Sensetive Zone.

8) **Recommendation of the gazette notification of Eco Sencetive Zone for this project**-

- Construction of Asiganga-I (4.5 MW) SMALL HYDRO PROJECT has been started in 2004. This project is not defined in the Eco sensitive zone gazette notification.
- According to Eco sensitive zone gazette notification GOI point no-03 para(1) the following activities are prohibited for the river velly projects-
  “Setting up of new hydro-electric power plants(dams, tunneling, and construction of reservoir) and expansion of existing plants on the river Bhagirathi and all its tributaries from Gaumukh to Uttarkashi except micro or mini hydel power projects, which would serve the energy needs of the local communities, subject to consent of the gram sabha and all other requisite clearances”.

9) **Conclusion**-
The status of this project is not defined in the Gazette notification. This is an under construction project. In addition to this, this project does not included in the 24 projects which were prohibited by the Honorable Supermecourt of India. 70% construction work of
this project has already been completed which requires only restoration & maintenance and remaining 30% balance construction work is still to be carried out. The above said restoration work (70%) & balance construction work (30%) will be done as per provision made in Eco Sensitive Zone gazette notification Hence there is no harm to the Eco sensitive zone form this project.
Layout of Asiganga-I SHP (2x2.25 MW)

- **Design discharge**: 5.63 Cumec
- **Net Head**: 94 m
- **Total Energy Generation**: 26.33 MU
- **Total cost**: Rs. 6361.47

**Intake Structure**
- L = 135 m
- H = 63.95 m

**Power Duct**
- 05 Hoppers @ 9 m x 8 m
- L = 70 m

**De-silting tank**
- L (Channel): 14.10 m
- Size: 2.0 x 2.0 m
- L (Tunnel): 980 m
- Size: 2.0 x 3.0 m (D)

**Power Channel/Tunnel**
- L = 32 m
- B = 10 m
- FSL = 1480.70 m

**Forebay**
- Proposed Escape
- L = 160 m
- Existing Penstock
- 1000 mm D & 1230 m

Legend:
- Work Executed
- Work to be done again
- Work yet to be done

- Existing Switchyard
- Existing Powerhouse
- Proposed Powerhouse

L = 55 m
B = 40 m
2 trenches @ 1.5 m
(Only temporary diversion structure is to be constructed)
**Salient features of the Project**

1- **LOCATION**

- **State**: Uttarakhand
- **District**: Uttarkashi
- **Taluka**: Bhatwari
- **Access:**
  - i. Road: Uttarkashi-Sangamchatti
  - ii. Rail head: Rishikesh (174km)

- **Geographical coordinates** (Diversion site)
  - Latitude: 30°48’37”N
  - Longitude: 78°27’05”E

2- **RIVER CATCHMENT:**

- **Catchment**: Ganga
- **River**: Ganga
- **Tributary**: Bhagirathi
- **Sub-tributary**: Asiganga

3- **HYDROLOGY:**

- **Catchment area at the diversion site.**
  - Gross: 147sq km

- **Intercepted in the scheme, if any**: Nil

- **Snow bound catchment area**: Negligible

- **Precipitation**
  - **Average rainfall (mm)**: 1630mm

- **Dependable yield**
  - 50%: 5.63 cumec
  - 75%: 4.09 cumec

- **Climate data**
  - **Normal**
    - Atmospheric temperature: 20°C - 32°C
    - Humidity: 60% - 85%
  - **Max**
    - Below 0°C
    - 85%
  - **Min**
    - 30%

- **Floods**
  - **Historical**
    - Maximum discharge estimated: NA
    - Date of occurrence: NA
    - Max. Design flood discharge: 594 cumec
    - Month of nil flows: Nil

4- **MEDIUM/HIGH HEAD PROJECTS:**

A. **Diversion structure**

- **Type of structure**: Trench type weir with trash rack
- **Length**: 22M
- **Overflow section**: 33M
- **Non-overflow section NIL**
- **Shingle excluder duct**
  - **Length (approx.)**: 140 M
Size 1MX1M
Material RCC
Maximum discharging Capacity (Cumec) 594cumec

B. **Intake structure**

Shape and size Rect. 8MX6M
Height above deepest foundation 6.79M
Number of gates Two
Size of gates 3.6 MX 2.4M & 2.5X2.15M

**Power Duct:**

(a) Length 110M
(b) Size 3.00MX 2.00M

C. **Desilting tank**

Type Hopper Type
Material of construction RCC
Size 70MX 8M
Particle size to be removed 0.2mm
Size of silt flushing pipe 450mm dia (05nos)

D. **Water conductor system**

Open Power channel

Length (approx.) 1700M
Shape Rectangular
Size 2.10MX2.30M
supply depth 2.00M
MaterialFull RCC
Design discharge 5.63cumec

Free flow head race Tunnel

Length (approx.) 700M
Shape D-Shaped
Size 2.10MX3.00M
Full supply depth 1.70M
Material RCC
Design discharge 5.63cumec

E. **Forebay**

Size 32MX7M
Full supply level RL1490.38M

F. **Penstock**

(I) **Main penstock**

Number with bifurcation at ends
Diameter and Thickness 1321mm(10mm)
Length 175M
Design discharge 5.63cumec

(II) **Branch Main penstock (after bifurcation)**

Number Two
Diameter and Thickness 938mm (10mm)
Length 20M each
Design discharge 2.815 cumec for each branch

5- **POWER HOUSE**

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<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Surface</td>
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<tr>
<td><strong>Head</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td><strong>Gross</strong> 96.60M</td>
</tr>
<tr>
<td></td>
<td><strong>Net</strong> 94.03M</td>
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<tr>
<td><strong>Size of power house</strong></td>
<td>29.00 MX 14.90MX8.5M</td>
</tr>
<tr>
<td><strong>Installed capacity</strong></td>
<td>2X2250KW</td>
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<tr>
<td><strong>Turbines:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Type</strong></td>
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</tr>
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<td><strong>Type of generator</strong></td>
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</tr>
<tr>
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<td>Static Brushless excitation</td>
</tr>
<tr>
<td><strong>Regulation system</strong></td>
<td>AVR</td>
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<tr>
<td><strong>Power house crane</strong></td>
<td>HOT</td>
</tr>
<tr>
<td><strong>Lifting tackle capacity</strong></td>
<td>18MT</td>
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6- **POWER HOUSE**

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</table>
View of Trench Weir location after flash flood in the River Asiganga on 03.08.2012.
View of RCC Power duct before flood.
View of damaged Power duct after flood.
A View of Completed RCC De-silting chamber before flood.
View of damaged De-Silting Tank after flood.
View of RCC Silt Flushing channel before and after flood.
View of RCC Power channel after flood.
View of Powerhouse Building before flood
Inside view of Powerhouse Building before flood
View of Powerhouse Building after flood
View of machine hall & Control Room before flood
View of machine hall & Control Room after flood
ASIGANGA-II SHP

(2x2250 Kw)

(UNDER CONSTRUCTION)
Asiganga-II Hydro Electric Project (2X2250KW)

- Status of the Project as per Eco Sensitive Zone Gazette notification – Undefined.
- Actual Status of the Project- Under construction.
- Geographical Coordinates-
  - Trench weir -78° 26’ 40’’ North, 30° 47’40’’ East
- Name of the River on which project is situated- Asiganga
- Water catchment area of the River on Trench Weir – 167 Sq Km
- Type & Area of the Land for the project- (Total Land Required- 3.405 ha Reserve Forest Land)
  - 2.302 Ha Reserve forest Land
  - Additional Land Required -1.103 Ha Reserve forest Land
- Type & Length of water conductor system –
  - Open channel -271m
  - Free Flow Tunnel -1604m

Detail of the Asiganga-I Project :-

Project is situated on the right bank of the river Asiganga from the base of the river from 1378.42m to 1306.00 m. Provision is made for release of Minimum 20% (0.50 cumec) water continuously in the downstream of project to maintain the continuous flow of water in the river. This projected was started in 2008-09. Now 41% Construction work of the project has been completed before the flash flood of 03.08.2012 & June-2013. After the flash flood on dated 03.08.2012 some land of the project has been washed away in the flood. Hence for further construction of the project additional land was required. Therefore land case for additional land of 1.103 ha reserve forest land has been submitted to the Nodal officer Dehradun in march 2013 which is pending in the nodal office Dehradun till date. The status of the under construction project is not defined in the Eco Sensitive Zone gazette notification of GOI.

Detail of the various component of the project is as followings-

10) Trench Weir-
32 m wide Trench weir has been constructed before the flash flood 03.08.2013 but due to flash flood of 03.08.2013, the trench weir has been completely damaged hence the restoration work of the trench weir is proposed in the revised DPR. Due to restoration of the trench weir natural boundaries of the river will not be affected. Hence no rehabilitation of the population shall be required and life of flora and fauna will not be disturbed.

11) Water Conductor System-
Propose component of the water conductor system as per DPR-
Length of Water Conductor System- 2228m
Open Channel- 271 x 2.0 m
Desilting Tank- 78 x 10m
Tunnel- 1604 x 2.0m
Forebay- 40x9.0m
Penstock- 135 x1.6m
Tail Race Channel-100m
The construction work of the above said various component of the water conductor system has been completed before flash flood of June 2013 except 728m free flow tunnel. But due to flash flood all the component of the water conductor system have been damaged partially. The restoration work of the above component and construction of 878m tunnel will not disturb the life of nearby population & surroundings of the Asiganga river.

12) Land Details of the Project-
According to the revised DPR the total 3.405 ha Reserve forest land is required for the restoration of the project in which 1.103 ha additional Reserve forest land is required for completion of the project. Formal approval of 2.302 ha reserve forest land has been approved & case for the formal approval of remaining 1.103 ha reserve forest land is pending in the nodal office Dehradun. The lease deed of the 2.302 ha Reserve forest land has been done for mutation & transfer of land. The provision will be made to strict compliance of rules & regulation of Indian forest conservation act & Task force during the restoration & balance construction of the Project.

13) Switchyard & Power house-
For the construction of the project 30x15m size Power House Building is proposed on the right bank of the river Asiganga which is located 400m away from the bridge situated on Gangori-Sangamchatti road for Uttrown village.

14) Transmission Line-
Every year 20.38 MU electricity generation is proposed in DPR from this project. The 12 .00Km 33KV transmission line is under construction from Kaldigad Power House to Tiloth Power House sub-station(220KV). The land case of 20.25 ha reserve forest land for the construction of transmission line has been approve by the MoEF.

15) Residential building
The construction of residential building for the project has been completed in 2010 at Gangori, Uttarkashi.

16) Cost Benefit Analysis:

- xvii. Total cost of the project: Rs 5360.81 lac (without interest during construction)
- xviii. Total cost of the project: Rs 6361.47 lac (with interest during construction)
- xix. Debt Equity Ration: 70:30
- xx. Loan Repayment Period: 25 years
- xx. Financing Institution: NABRAD
- xxii. Expenditure till date: Rs 3274 lac
- xxii. Net Saleable energy: 26.33 Million Unit
- xxiii. Levelized cost of generation: Rs 3.89 per unit
- xxiv. Annual Revenue from sale of energy: Rs 921.00 lac
- xxv. Internal Rate of Return (IRR): 11.92%
- xxvi. Benefit cost Ratio: 1.06
No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

17) Technology used in the Restoration and construction of balance work of the Project-
The DPR of the project has been prepared by the technical experts of Indian Institute of Technology, Roorkee. After the flash flood, the revised DPR has been prepared incorporating the views of technical Experts of IIT Roorkee, UJVNL & other departments which have been approved by the BoD of UJVNL.

The following parameters will be considered during the restoration of the Project :-
t) Maximum work, as far as possible shall be carried out by labour in place of heavy machinery.
u) For the construction of remaining tunnel Controlled blasting will be done.
v) Muck produced during the restoration of the project will be disposed off on demarcated lands as per instruction of Forest department.
w) RBM used in the project will be carted from the government approved quarries. RBM will not be taken from the river at project site.
x) Natural boundaries of the river will not be disturbed due to restoration of the project.
y) To maintain the environmental discharge minimum 20% (0.50 cumec) water will be released continuously in downstream of the project in the river Asiganga.
z) The monthly inspection report of the project construction will be sent to the Environment pollution control board and restoration & construction work will be done as per instruction of Environment pollution control board.

aa) The hilly slopes will be maintained & protected by using latest bio engineering technologies.
bb) Treatment of produced muck & land scaping will be done with the help of bio engineering & according to the views of experts.
cc) Systematic Drainage system will constructed to avoid the unnecessary storage of the water with in the project & surroundings and the drainage system will be connected to the natural drainage.

dd) The various component of the project will be constructed as per suitable design parameter to avoid the decay of the slopes.

ee) The project is not situated in sliding zone & fault zone.
ff) The flow of the Asiganga River will not be disturbed due to project restoration & construction.

Irrigation & water supply projects are not proposed in this area and no other project will be affected by the restoration & construction of this project.

hh) Habitation & Agricultural land is not situated in the project area hence there is no need to rehabilitation of population & conversion of Land.

ii) Priority will be made for the employment of the people of the project affected area according to their qualification.

jj) Suitable alignment of the various component of the project will be adopted to maintain the forest/vegetal cover.

kk) Heritage of state/country will not be affected due to restoration of the project. Roads situated in the project area will be conserved in their natural condition.
ll) 41% Restoration work of the project and remaining 59% balance construction work will be done as per gazette notification of Eco Sensetive Zone.

18) **Recommendation of the gazette notification of Eco Sensetive Zone for this project**-

✓ Construction of Asiganga-II (4.5 MW) SMALL HYDRO PROJECT has been started in 2008. This project is not defined in the Eco sensitive zone gazette notification.

✓ According to Eco sensitive zone gazette notification GOI point no-03 para (1) the following activities are prohibited for the river valley projects-

“Setting up of new hydro-electric power plants (dams, tunneling, and construction of reservoir) and expansion of existing plants on the river Bhagirathi and all its tributaries from Gaumukh to Uttarkashi except micro or mini hydel power projects, which would serve the energy needs of the local communities, subject to consent of the gram sabha and all other requisite clearances”.

19) **Conclusion**-

The status of this project is not defined in the Gazette notification. This is an under construction project. In addition to this, this project does not included in the 24 projects which were prohibited by the Honorable Supreme Court of India. 41% construction work of this project has already been completed which requires only restoration & maintenance and 59% balance construction work will be done as per provision mention in the Eco Sensetive Zone gazette notification. Hence there is no harm to the Eco sensitive zone form the restoration and construction of balance work of this project.
SALIENT FEATURES ASIGANGA-II SMALL HYDRO PROJECT

LOCATION
State: Uttarakhand
District: Uttarkashi
Taluka: Bhatwari
Access Road: Uttarkashi-Sangamchatti
Rail head: Rishikesh (185 km)
Geographical coordinates
(Diversion site)
Latitude: 30°47’40”N
Longitude: 78°26’40”E

3- HYDROLOGY
Catchment area at the diversion site.
Gross: 167 sq km
Intercepted in the scheme, if any: Nil
Snow bound catchment area: Negligible
Precipitation
Average rainfall (mm): 1620 mm
Dependable yield
50%: 5.63 cumec
75%: 4.09 cumec
100% (minimum discharge): 2.14 cumec
Climate data
Atmospheric temperature
Normal: 20° C
Max: 30° C
Min: 5° C
Humidity
60% 85% 30%
e. Floods
Historical
Maximum discharge estimated: NA
Date of occurrence: NA
Max. Design flood discharge: 650 cumec
Month of nil flows: Nil

4- MEDIUM/HIGH HEAD PROJECTS
A Diversion structure
Type of structure: Trench type weir with trash rack
Length 32 M
ductOverflow section 22 M
Non-overflow section 10 M
Shingle excluder
Length (approx.) 180 m
Size 1 m x 1 m
Material RCC
Maximum discharging Capacity (Cumec) 650 cumec

B. Intake structure
Shape and size Rect. 8 m x 6 m
Height above deepest foundation 6.79 m
Number of gates Two
Size of gates 3.6 m x 2.4 m & 2.5 m x 2.15 m

Power Duct:
Length 180 m
Size 3.00 m x 2.30 m

2- RIVER CATCHMENT
Catchment Ganga
River Ganga
Tributary Bhagirathi
Sub-tributary Asiganga

D. Desilting tank
Type Hopper Type
Material of construction RCC
Size 70 m x 8.5 m
Particle size to be removed 0.2 mm
Size of silt flushing pipe 450 mm dia (04 nos.) 600 mm dia (02 Nos)

E. Water conductor system
(I) Open Power channel
Length (approx.) 91 m
Shape Rectangular
Size 2.5 m x 2.3 m
Full supply depth 2.00 m
Material RCC

(II) Free flow head race Tunnel
Length (approx.) 1604 m
Shape D-Shaped
Size 2.10 m x 3.00 m
Full supply depth 1.70 m
Material RCC

F. Forebay
Size 40 m x 8.5 m
Full supply level RL 1374.44 m
G. Penstock

(I) Main penstock
- Number: One with bifurcation at ends
- Diameter and Thickness: 1600 mm ID & 10 mm
- Length: 110 m

(II) Branch Main penstock (after bifurcation)
- Number: Two
- Diameter and Thickness: 1250 mm ID & 10 mm
- Length: 20 m each

5- POWER HOUSE
- Type: Surface
- Head
  - Design - Gross: 56.63 m
  - Net: 55.33 m
- Size of power house: 30.00 m x 15 m x 8.5 m
- Installed capacity: 2x2250 kW

Turbines:
- Type: Horizontal Francis
- Number: Two
- Capacity: 2x2250 kW
- Type of generator: Synchronous
- Excitation system: Static Brushless excitation
- Regulation system: AVR
- Power house crane: HOT
- Lifting tackle capacity: 18MT

6- TAIL RACE
- Shape: Rectangular
- No.: One
- Length: 100 m
Tunnel Outlet portal
BEFORE FLOOD
POWER HOUSE BEFORE FLOOD
View of Power House, TRC & Switchyard site After Flood of 03/08/2012
KALDIGAD SHP
(2x4500 Kw)
(UNDER CONSTRUCTION)
KALDIGAD SMALL HYDRO PROJECT (2x4500KW) UNDER CONSTRUCTION

1- Category of Project under Eco –Sensitive Zone - Undefined

2- Condition of Project (Proposed/Commissioned/Under Construction) – Under Construction

   Geographical Coordinates

   A – Trench Weir  
   B – Power House

3- Name of River  
Kaldigad (a trutnary of Asiganga River)

4- Catchment area
111.46 SqKm

5- Type & requirement of land for the project
4.036 Ha; Reserve Forest land
0.66 Ha Civil Soyam Land

6- Type of water conductor system and length
Contour channel 100 m & free flow tunnel, length – 2386 m

7- Brief description of the project

Kaldigad Small Hydroelectric Project (2X4500 kW) is situated on the left bank of Kaldigad River between El 1785 m – 1505 m. A provision of 20% of the minimum flow of river i.e. 0.50 cumec has been made for environmental release continuously in the River. This project is under construction prior to decleration of Eco-Sensitive Zone in District Uttarkashi. About 21% works of the project were completed up to occurrence of flash flood in Asiganga Valley. Due to flash flood in Asiganga Valley, some part of of Project’s land was washed away, therefore; case for transfer of additional land was submitted in the office of Nodal Officer, Forest Department, Dehradun, which is still pending at their level. The category of under constructiuon hydro electric projects is not defined in GoI Gazette Notification of Eco-Sensitive Zone. The brief description of under construction / proposed hydraulic structures of the project are hereunder:

(A) TRENCH WEIR

A trench weir having 52 m span (equal to the width of River) has been proposed to divert the required discharge from the River, out of which approximate 40% works has been completed. Due to construction of Trench Weir, neither any reservoir will form nor any displacement or any situation of drown of vegetation will occur. The natural boundary of River will also not be affected due to construction of Trench weir.

(B) WATER CONDUCTOR SYSTEM

The total length of water conductor system is 2531 m. Water conductor system having, contour channel (100.0 X 2.0 m), Desilting Tank (45.0X10.0 m), Free flow tunnel (2386.0X2.0 m), Forebay (28.0X7.0 m), Penstock (590.0X1.10 m) & Tail Race Channel 228.0 m are under construction. According to the width of hydraulic structures, the minimum hill cutting has been done and minimum cutting will be done for remaining structures. The length of contour channel and penstock is 100 m and 590 m respectively.
The contour channel is proposed to be constructed on 3.00 m wide strip/patra. The penstock will be laid on 1.10 m wide strip along the hill slope. The minimum hill cutting will be required for construction of these structures. Approximate 740 m free flow tunnel of the project is completed and 1646 m is yet to be completed.

(C) REQUIREMENT OF LAND

For construction of project, total 5.506 Ha reserve forest land and 0.66 Ha Civil Soyam land shall be required, out of which 4.036 Ha reserve forest land has been sanctioned under the provision of Forest Conservation Act, whose lease deed has also been executed in favour of UJVNL. Tha land case for construction of the project for 1.147 Ha reserve forest land and 0.66 Ha Civil Soyam land is pending in the office of Nodal Officer, Dehradun since June 2013. A provision for proper disposal of unutilized muck at appropriate low land has been made in the sanctioned land. The muck generated from the construction of structures has been disposed off at pre demarcated dumping yard. The proper protection work has been made, to avoid the spilling of muck from the dumping yard. Land scaping of the filled dumping yard is proposed to be done by bio engineering as per suggestion of the experts. The provision of Forest Conservation Act and Task Force has been strictly complied during construction and its compliance shall be ensured during construction of remaining structures.

(D) POWER HOUSE & SWITCH YARD

A surface power house having size 36X23 m is proposed to be constructed in the project. Power House is proposed on the left bank of Asiganga River at 400 m down stream from the bridge, constructed on Asiganga River for travelling from Gangori – Sangamchatti Motor Road to Seku Village. The hill slopes is proposed to be stabilized by bio engineering as per consultation of experts after excavation and leveling of the terrace.

(E) ELECTRIC TRANSMISSION LINE

Kaldigad Small Hydro Electric Project will generate 56.30 MU electricity per year. For transmission of generated electricity, 12 km long, 33 kV double circuit transmission line from power house to Tiloth 220 kV switch yard is under construction. An approval from MOEF for 20.25 Ha reserve forest land for construction of 33 kV, double circuit transmission line has been obtained. The conditioned laid down in the approval letter and Forest Conservation Act is being complied strictly and shall also be complied during construction of remaining works. The generated electricity from the project shall be fed to the Uttarakahdn grid which shall be consumed as per the policy of Uttarakahnd.

(F) RESEDENTIAL COLONY

The residential colony for the project has been constructed in 2011 on the land of Gangori Power House. The staff posted on the project during operation will reside in the Gangori Colony and during operation they will be transported to and fro from Gangori Colony to Power House by shift bus.

(G) TECHNIQUE IMPLEMENTED IN PROJECT CONSTRUCTION

The Detailed Project Report of the project was prepared by Indian Institute of Technology, Roorkee after detailed investigation and surveying of the site. Revised Detailed Project
Report has been prepared incorporating the suggestions of technical experts and Geologist after flash flood occurred on 03.08.2012. The Revised Detailed Project Report has been approved by the Board of Director of UJVNL. The hydraulic structures have been designed after surveying, site inspection and detailed investigation by a team of Technical Experts & Geologist of IIT, Roorkee after establishing the suitability of the site before preparation of the Detailed Project Report.

**H) COST BENEFIT ANALYSIS**

i. Total cost of the project  
   Rs 9955.37 lac (without interest during construction)  
   Rs 10366.00 lac (with interest during construction)

ii. Debt Equity Ratio  
   70:30

iii. Loan Repayment Period  
   25 years

iv. Financing Institution  
   Asian Development Bank

v. Expenditure till date  
   Rs 2100.00 lac

vi. Net Saleable energy  
   56.30 Million Unit

vii. Levelized cost of generation  
   Rs 3.59 per unit

viii. Annual Revenue from sale of energy  
   Rs 2094.36 lac

ix. Internal Rate of Return (IRR)  
   11.92%

x. Benefit cost Ratio  
   1.06

➢ No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

The following standard shall be followed strictly during construction of the project:

1- The earth moving and heavy equipments are not used at site but all works has been carried out through labour and small equipments. Controlled blasting shall be used in construction of free flow tunnel.

2- The unutilized muck, generated from construction is being disposing at demarcated and sanctioned place by the forest department.

3- The construction material such as stone, sand and aggregate has been brought from approved quarries and same has been used in construction. No mining and quarrying has been done at site for construction material. The construction material shall be brought from approved quarries for remaining works.

4- The natural boundary of Kaldigad remained unchanged during construction of Trench Weir and no change will occur in the natural boundary of river due to construction of remaining works of Trench Weir.

5- A 0.50 cumec environmental water discharge will be release always to keep the river flow continuous.

6- The monthly report of experts of environment & pollution control unit shall be ensured to submit to Environment and Pollution Control Board
7- The hill slopes shall be stabilized by appropriate protection works to avoid erosion of hills in the project area and the technique of bio-engineering shall be used in slope stabilization.

8- The treatment of construction generated muck shall be done as per suggestion of experts by using bio engineering.

9- The proper drains shall be constructed in project area for disposal of seepage or runoff and shall be kept free from blockage. These drains shall be connected with the natural drainage system.

10- The appropriate design standard shall be followed in design of hydraulic structures so that hill erosion could be avoided.

11- There is no any fault zone in the project area.

12- The flow of Kaldigad / Asiganga River shall remain undisturbed during construction of project.

13- There is no irrigation or water supply scheme on the Kaldigad in project area or in upstream of the project therefore; no other project shall be affected due to construction this project.

14- There is no habitation and agricultural land in the project area, therefore conversion of land use shall not be required. Rehabilitation shall not be required due to non formation of reservoir in the project.

15- The rights of villagers in the vicinity of the project area shall not be affected due to construction of the project.

16- The priority in employement during construction and operation of the project shall be given to local villagers as per their eligibility.

17- The alignment of the project shall be done such that loss of vegetal cover could be minimized.

18- No natural heritage shall be affected due to construction of the project and the old foot path lies in the project area shall be maintained in its natural state.
The Salient Features of the Project are hereunder:

<table>
<thead>
<tr>
<th>1.</th>
<th><strong>Location</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>State</td>
</tr>
<tr>
<td>(ii)</td>
<td>District</td>
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<tr>
<td>(iii)</td>
<td>Tehsil</td>
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<tr>
<td>(iv)</td>
<td>Village</td>
</tr>
<tr>
<td>(v)</td>
<td>Access-road</td>
</tr>
<tr>
<td>(vi)</td>
<td>Reference of topo sheet</td>
</tr>
<tr>
<td></td>
<td>Geographical coordinator</td>
</tr>
<tr>
<td></td>
<td>Latitude Longitude</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(vii)</td>
<td>Altitude</td>
</tr>
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</tr>
</tbody>
</table>

2(a) **River Catchment**

| (i) | Catchment | : 111.46 sq. km. (Snow catchment 33.82 sq.km.) |
| (ii) | River     | : Kaldigad (a major tributary of Asiganga River) |
| (iii) | Max flood discharge | : 872 cumecs |

3. **Medium / High Head Projects:**

(a) **Diversion Structure (Head works)**

<p>| (i) | Type of structure (Weir/barrage) | : Trench type Weir of RCC |
| (ii) | Length (a) Trench | : 22 m |
| | Length (b) Solid crest (over flow section) | : 30 m |
| (iii) | C.L. of Penstock | : 1512.70 |</p>
<table>
<thead>
<tr>
<th>(iv)</th>
<th><strong>Maximum discharge capacity of trench weir</strong></th>
<th>: 6.25 cumecs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(v)</td>
<td><strong>Gates on entry to intake chamber</strong></td>
<td>: 1 no.</td>
</tr>
<tr>
<td>(b)</td>
<td><strong>Desilting Tank (Gutter type)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Length (including transition)</strong></td>
<td>: 44.0 m</td>
</tr>
<tr>
<td></td>
<td><strong>Size of gutter</strong></td>
<td>: 28m x8m</td>
</tr>
<tr>
<td></td>
<td><strong>Depth of water above Gutter</strong></td>
<td>: 2.0 m</td>
</tr>
<tr>
<td></td>
<td><strong>Proposed particle size to be removed</strong></td>
<td>: 0.2 mm and above</td>
</tr>
<tr>
<td>(c)</td>
<td><strong>Water Conductor System</strong></td>
<td>: 630 m Tunnel before Desilting Tank, 100m Power Channel &amp; 1756m Tunnel</td>
</tr>
<tr>
<td>(i)</td>
<td><strong>Length (m)</strong></td>
<td>: 630 m Tunnel from intake to Desilting Tank &amp; 30 m Power Channel from Desilting Tank to Inlet portal of Tunnel followed by unpressurised free flow 1756 m long Tunnel followed by 70 m long Power Channel upto Forebay</td>
</tr>
<tr>
<td>(ii)</td>
<td><strong>Slope</strong></td>
<td>: (a) in Power Duct/Tunnel : 1 in 350 (b) in Tunnel &amp; Power Channel 1 in 1000</td>
</tr>
<tr>
<td>(iii)</td>
<td><strong>Size (a) Power Duct</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Open channel - rectangular</td>
<td>Width 1.75m, Total Depth 1.55 m</td>
</tr>
<tr>
<td></td>
<td>(c) Tunnel – D-shaped</td>
<td>Width 2.30m, Total Depth 1.55 m Width 2.30m, total height upto crown 3.015 m</td>
</tr>
<tr>
<td>(iv)</td>
<td><strong>Thickness of lining of Tunnel</strong></td>
<td>: 0.225 m thick, CC M-20</td>
</tr>
<tr>
<td></td>
<td><strong>Thickness of wall of rectangular channel</strong></td>
<td>: 0.200 m thick, RCC M-20</td>
</tr>
<tr>
<td>(v)</td>
<td><strong>Design discharge</strong></td>
<td>: 4.12 cumecs</td>
</tr>
<tr>
<td>(c)</td>
<td><strong>Forebay:</strong></td>
<td>: 2 minutes storage capacity</td>
</tr>
<tr>
<td>(i)</td>
<td><strong>Size of forebay (upto MDDL)</strong></td>
<td>: L=27.4 m; B = 6.8, D = 4.8m</td>
</tr>
<tr>
<td></td>
<td><strong>Maximum depth near penstock</strong></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td><strong>Full forebay level (FSL)</strong></td>
<td>: 1777.20 m</td>
</tr>
<tr>
<td>(d)</td>
<td><strong>Penstocks</strong></td>
<td></td>
</tr>
</tbody>
</table>
### 4. Power House

#### (i) Type
- Type: Over ground surface type Power House
- E.L. at Power House: 1511.26 m

#### (ii) HFL of Asiganga River at Power House site
- HFL: 1509.500 m on 03.08.2012

#### (iii) Head
- Gross Head: 264.50 m
- Net head: 255.94 m
- Design: 255.94 m

#### (iv) Turbine
- Type: Pelton horizontal shaft
- Number: Two
- Output (Kw/Hp): 4500 KW

#### (v) Size of Power House:
- Length: 36.00 m
- Width: 23.00 m
- Height: 12.85 m
- Machine hall floor: 1511.26 m

#### (vi) Installed capacity (KW)
- Installed capacity: 2 x 4500 KW (Machine of 2 x 4500 kW)
<table>
<thead>
<tr>
<th>(vii)</th>
<th>Type of generator</th>
<th>kW already procured)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Generator specification</td>
<td>: Synchronous salient pole type</td>
</tr>
<tr>
<td></td>
<td>Excitation system</td>
<td>: 4500 Kw, 11 KV, 600 rpm, 0.85</td>
</tr>
<tr>
<td></td>
<td>Regulation system</td>
<td>: power factor Brush-less</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AVR type</td>
</tr>
<tr>
<td>(viii)</td>
<td>Power House crane/lifting tackle capacity</td>
<td>: 25 tonnes</td>
</tr>
</tbody>
</table>

5. **Power**

| (i)    | Installed capacity | : 9000 Kw (Machine of 2X4500 kW already procured) |
| (ii)   | Plant Load Factor | : 74.58 % |
| (iii)  | Seasonal (max) Power (KW) | : 8800 Kw |
| (iv)   | Annual energy (KWH) for sale | : 56.30 mkwh |
|        | After accounting for machine outages and auxiliary consumption on 50% dependability |

6. **Switchyard:**

| (i)    | Voltage level / basic insulation level | : 33 kV |
| (ii)   | No. of bays | : 2 bays |
| (iii)  | Size: Length and Width h | : 30 x 20 m |
TRENCH WEIR
POWER CHANNEL
PILANGAD – I SHP
(2x1125 Kw)
(EXISTING)
PILANGAD – I SMALL HYDRO ELECTRIC PROJECT (2x1125 Kw) (EXISTING)

1- Category of Project under Eco –Sensitive Zone - Regulated
2- Condition of Project (Proposed/Commissioned/Under Construction) – Existing Project (Damaged due to flash flood of 15 – 17 June 2013, Works of restoration under progress)

Geographical Coordinates
A – Power House 30° 46' E & 78° 38' N

3- Name of River Pilangad (a trinutary of Bhagirathi River)
4- Catchment area 198.50 SqKm

5- Type & requirement of land for the project Existing Project

6- Type of water conductor system and length Contour channel 1350 m

7- BRIEF DESCRIPTION OF THE PROJECT

Pilangad Small Hydro Electric Project is located in Tehsil Bhatwari, District Uttarkashi in between 30° 46' E & 78° 38' N. The project was commissioned in year 2003-04 and since then the project is generating electricity.

Due to flash flood occurred in 15 – 17 June 2013 in Uttarakhand, the Trench Weir, Desilting Tank and partial Contour channel of the project was got damaged and electricity generation was stopped from the project. The project generated average 10.60 MU per year since its commissioning year 2004 to 2013, upto its damage. The project is connected to Uttarakhand grid, the electricity generated from the project was utilized directly or indirectly by the villagers of Uttarkashi and Uttarkhand. The restoration of the damaged structures of the project is essential for the development of Uttarakhand. Central Govt has sanction central assistance for restoration of the project under disaster packages (SPA – R).

8- RESTORATION WORKS OF DAMAGED STRUCTURES

A – No additional land is required for restoration of the damaged structures of the project.

B – The restoration of the damaged structures of the project shall be done on its original alignment and on earlier sanctioned land similar (without changing the length, breadth and height of earlier structures) to earlier constructed structures as per their earlier design.

C – No excavation shall be required on the hill slopes for restoration of the damaged structures. The treatment to stabilize the eroded hill slopes due to flash flood shall be done.

D – The works are related to maintenance and repair, therefore little muck will generate, and that will be used in filling behind the structures. No heavy equipments and blasting will be used during restoration works therefore no possibility of noise and air pollution. The natural boundary of the Pilangad shall remain unchanged despite of restoration of damaged structures, and the flow of River shall remain as it is. Any type of expansion in
the installed capacity of the projected shall not occur after completion of the restoration works.

No adverse effect shall occur on the environment of the area due to restoration of damaged structures and the provision of Forest Conservation Act 1986 shall be strictly followed.

9- ECO SENSITIVE ZONE
As per sub para XIII of para 3 (b) of MOEF Notification No. 24291 dated 18.12.2012 “The existing hydro-electric power projects shall continue to operate with strict environmental compliance and social audit”, Pilinagad – I Small Hydro Electric Project lies under “Regulated Activities under Eco Sensitive Zone”.

10- COST BENEFIT ANALYSIS
i. Total cost of the project
   Rs 904.93 lac (without interest during construction)
   Rs 993.43 lac (with interest during construction)

ii. Financial Assistance
    Central Assistance under disaster package
    (SPA-R) Rs 904.00 lac

iii. Expenditure till date
     Nil

iv. Net Saleable energy
    14.21 Million Unit

v. Levelized cost of generation
    Rs 3.28 per unit

vi. Annual Revenue from sale of energy
    Rs 557.03 lac

vii. Internal Rate of Return (IRR)
    18.29%

viii. Benefit cost Ratio
     1.42

➢ No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

The following standards shall strictly be followed in restoration of damaged structures of the Project:

1- The earth moving and heavy equipments shall not be used at site but all works shall be carried out through labour and small equipment, therefore blasting shall not be required.

2- The unutilized muck, generated from restoration shall be disposed off in the filling behind the structures.

3- The construction material such as stone, sand and aggregate has been brought from approved quarries and same is being used in construction. No mining and quarrying has been done at site for construction material.

4- The natural boundary of Pilangad remained unchanged during construction of Trench Weir and no change will occur in the natural boundary of river due to construction of remaining works of Trench Weir.
5- The hill slopes shall be stabilized by appropriate protection works to avoid erosion of hills in the project area. The technique of bio-engineering shall be used in slope stabilization.

6- The proper drains shall be constructed in project area for disposal of seepage or runoff and shall be kept free from blockage. These drains shall be connected with the natural drainage system.

7- The appropriate design standard shall be followed in design of hydraulic structures so that hill erosion could be avoided.

8- There is no any fault zone in the project area.

9- The flow of Pilangad River shall remain undistrubbed during construction of project.

10- No natural heritage shall be affected due to construction of the project and the old foot path lies in the project area shall be maintained in its natural state.

The Salient Features of the Project are hereunder:

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<th>Location</th>
<th></th>
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<tbody>
<tr>
<td>(i)</td>
<td>State</td>
<td>:         Uttarakhand</td>
</tr>
<tr>
<td>(ii)</td>
<td>District</td>
<td>:         Uttarkashi</td>
</tr>
<tr>
<td>(iii)</td>
<td>Tehsil</td>
<td>:         Bhatwari</td>
</tr>
<tr>
<td>(iv)</td>
<td>Village</td>
<td>:         Malla (Bhela Tepry)</td>
</tr>
<tr>
<td>(v)</td>
<td>Access-road</td>
<td>:         About 26 kms from Uttarkashi on Uttarkashi - Gangotri Route.</td>
</tr>
<tr>
<td>(vi)</td>
<td>Reference of topo sheet</td>
<td>:         53 J/9</td>
</tr>
<tr>
<td></td>
<td>Geographical coordinator</td>
<td>:         Geographical coordinator</td>
</tr>
<tr>
<td></td>
<td>Latitude</td>
<td>:         Latitude</td>
</tr>
<tr>
<td></td>
<td>Longitude</td>
<td>:         Longitude</td>
</tr>
<tr>
<td></td>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>(vii)</td>
<td>Altitude</td>
<td>:         1450 m to 1600 m above mean sea level</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2(a)</th>
<th>River Catchment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Catchment</td>
<td>:         198.5 Sqkm</td>
</tr>
<tr>
<td>(ii)</td>
<td>River</td>
<td>:         Pilangad, a tributary of Bhagirathi River</td>
</tr>
<tr>
<td>(iii)</td>
<td>Max flood discharge</td>
<td>:         825.00 Cumec</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.</th>
<th>Medium / High Head Projects:</th>
<th></th>
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<tbody>
<tr>
<td>(a)</td>
<td>Diversion Structure (Head works)</td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Type of structure (weir/barrage)</td>
<td>:         Trench type weir of RCC</td>
</tr>
<tr>
<td>(ii)</td>
<td>Length (a) Trench</td>
<td>:         22.00 m</td>
</tr>
<tr>
<td></td>
<td>Length (b) Solid crest (over flow section)</td>
<td>:         3.00 m</td>
</tr>
<tr>
<td>(iii)</td>
<td>Min&quot;TWL&quot;</td>
<td>:         1473.00 m</td>
</tr>
</tbody>
</table>
(iv) Maximum discharge capacity of trench weir : 3.50 cumecs  
(v) Gates on entry to intake chamber : 1 no.

(b) **Desilting tank (Hopper type)**
- Length (including transition) : 35.74 m  
- Size of gutter : 27.74m x 4.10m  
- Depth of water above Gutter : Varying from 2.30 to 3.30 m  
- Proposed particle size to be removed : 0.2 mm and above

(c) **Water Conductor System**
- Length : 1350 m
  - (i) Size (a) Power Duct  
    - (b) Open channel - rectangular  
      - Length – 110 m  
        - Width 1.80 m, Total Depth 1.20 m,  
          (FSD – 0.90 m)  
        - Length – 1200 m  
          Width 1.80 m, Total Depth 1.20 m;  
          (FSD – 0.90 m)
  - (ii) Design discharge : 2.75 cumecs

(d) **Forebay:**
- 2 minutes storage capacity
  - (i) Size of forebay (upto MDDL)  
    Maximum depth near penstock : L=18.00 m; B = 12.00, D = 5.5 m

(e) **Penstocks**
- Number : One
  - (ii) Diameter  
    Thickness of steel liner : 900 mm  
    8 to 10 mm
  - (iii) Length : 140 m
  - (iv) Size of gate on penstock at forebay : Sluice vale at penstock of 900 mm dia
  - (v) Bifurcations at lower end : Bifurcation just before PH to two  
    600 mm dia, 10 mm thick to feed two units

4. **Power House**
- Type : Over ground surface type power house E.L. at power house 1475.00 m  
  30 x 11 x 8.5 m  
- (ii) Size  
  - (iii) Head  
    - Gross Head : 105.245 m  
    - Net head : 102.00 m  
    - Design : 102.00 m
  - (iv) Turbine  
    - Type : Francis horizontal shaft
<p>| | | |</p>
<table>
<thead>
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</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Two</td>
</tr>
<tr>
<td></td>
<td>Output (Kw/Hp)</td>
<td>1125 KW</td>
</tr>
<tr>
<td>(v)</td>
<td>Size of power house:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length</td>
<td>30.00 m</td>
</tr>
<tr>
<td></td>
<td>Width</td>
<td>11.00 m</td>
</tr>
<tr>
<td></td>
<td>Height</td>
<td>8.50 m</td>
</tr>
<tr>
<td>(vi)</td>
<td>Installed capacity (KW)</td>
<td>2 x 1125 KW</td>
</tr>
<tr>
<td>(vii)</td>
<td>Type of generator</td>
<td>Synchronous salient pole type</td>
</tr>
<tr>
<td></td>
<td>Generator specification</td>
<td>1250 kVA Kw, 3.3/33 KV, 1000 rpm, 0.9 power factor</td>
</tr>
<tr>
<td></td>
<td>Excitation system</td>
<td>Synchronous</td>
</tr>
<tr>
<td></td>
<td>Regulation system</td>
<td>AVR type</td>
</tr>
<tr>
<td>(viii)</td>
<td>Power house crane/lifting tackle capacity</td>
<td>15 tonnes</td>
</tr>
</tbody>
</table>

5. **Power**

(i) Installed capacity | 2250 KW (2X1125 kW)

(ii) Plant Load Factor | 54 % (As per previous average generation)

**TRC**

(i) Shape | Rectangular RCC

(ii) Size | 1.80x1.20 (internal dimensions)

(iii) Length | 10 mtrs

(iv) Water level (El.M) at PH site Max min | 1475.00 m 1473.80 m

(v) Number of size of draft tubes gates |   |

**Power**

(i) Seasonal (max) Power (KW) | 2250 KW

(ii) Annual energy (KWH) for sale After accounting for machine outages and auxiliary consumption | 14.21 MU

6. **Switchyard:**

(i) Voltage level / basic insulation level | 33 kV

(ii) No. of bays | 2 bays

(iii) Size: Length and Width | 30 x 15 m
DAMAGED DESILTING TANK

TRC PIPE BURIED
TRC PIPE BURIED

TRC PIPE BURIED
SONEGAD SHP
(2\times3500 \text{ Kw})
(PROPOSED)
SONEGAD SMALL HYDRO PROJECT (2x3500KW) PROPOSED

1- Category of Project under Eco –Sensitive Zone - Undefined
2- Condition of Project (Proposed/Commissioned/Under Construction) – Proposed
   (Investigation and Planning completed)

Geographical Cordinates

A – Trench Weir   30°58'27" E & 78°41'11" N
B – Power House   30°58'25" E & 78°41'46" N

3- Name of River   Sonegad (a trinutary of BhagirathiRiver)
4- Catchment area  98.31 SqKm
5- Type & requirement of land for the project  1.47 Ha; Reserve Forest land

   0.33 Ha Barren Nap land

6- Type of water conductor system and length  Contour channel / Pipe Channel length – 730 m.

7- DESCRIPTION OF THE PROJECT

Sonegad Small Hydro Electric Project (installed capacity 7000 kW) is located on the left bank of tributary of Bhagirathi River, Sonegad between 2370 m to 2165 m. A provision to release minimum 20% water discharge of river i.e. 0.30 cumec continuously has been made in the Detailed Project Report of the Project. The brief description of the hydraulic structures of the project is as hereunder:

(A) TRENCH WEIR

A trench weir having 13 m span (equal to the width of River) shall be constructed to divert the required discharge from the River. Due to construction of Trench Weir, neither any reservoir will form nor any displacement or any situation of drown of vegetation will occur. The flow of River will remained continuous and 0.30 cumec flow shall be ensured. The natural boundary of River will also not affect due to construction of Trench weir.

(B) WATER CONDUCTOR SYSTEM

The total length of water conductor system is 1130 m. Water conductor system having, power duct (30.0X3.0 m), vortex tube chamber (25.0X4.50 m), Desilting Tank (48.4X8.7 m), Pipe Channel (600.0X1.65 m), Forebay (26.0X6.0 m), Penstock (400.0X1.20 m) etc are proposed. According to the width of hydraulic structures, the minimum hill cutting shall be done. The length of contour channel and penstock is 234 m and 590 m respectively. The Mild Steel power pipe of 1.65 m diameter is proposed to be laid on 1.65 m wide strip along contour, which shall carry the required water discharge up to Forebay. The penstock will be laid on 1.60 & 1.20 m wide strip along the hill slope to minimize the excavation. There is no tunnel construction in the project. The main structure of water conductor system is power pipe, wherein required water discharge through 1.65 m mild steel pipe shall be carried out up to Forebay in place of
power channel. Therefore; on using of mild steel pipe in place of channel, the requirement of land shall be minimum and hill cutting shall also be minimum.

(C) REQUIREMENT OF LAND

For construction of project and transmission line, 1.47 Ha reserve forest land and 0.33 Ha Barren Nap land shall be required. The approval of Reserve Forest land shall be taken under the provision of Forest Conservation of Act 1986 and Barren Nap land shall be taken from the land owner through mutual negotiation. The provision for proper disposal of unutilized muck at appropriate low land shall be made made in above required Reserve Forest land and the provision of Forest Conservation Act and Task Force shall strictly be complied.

(D) POWER HOUSE & SWITCH YARD

A surface power house having size 32X21 m is proposed to be constructed in the project. Power House is proposed on the right bank of Sonegad River at about 175 m up stream from the bridge, constructed on Sonegad on Uttarkashi - Gangotri highway. Since the Power House is proposed on an inclined terrace ($5^0 – 10^0$), therefore; no hill cutting is required for construction of Power House. The little excavation shall be required for leveling and foundation excavation.

(E) ELECTRIC TRANSMISSION LINE

Sonegad Small Hydro Electric Project will generate 45.43 MU electricity per year. For transmission of generated electricity, 1 km long, 33 kV double circuit transmission line from power house to Lohari 33 kV sub station is proposed to be constructed. The generated electricity from the project shall be fed to the Uttarakahdn grid which shall be consumed as per the policy of Uttarakahnd.

(F) RESIDENTIAL COLONY

The residential colony for the project will not be constructed. The staff posted on the project during construction and operation will reside in the pre-constructed residential colony against Pala Maneri Hydro Electric Project at Bhatwari and staff will be transported through shift bus during operation to and fro from Bhatwari Colony to Power House.

(G) TECHNIQUE IMPLEMENTED IN PROJECT CONSTRUCTION

The Detailed Project Report of the project has been prepared by Indian Institute of Technology, Roorkee after detailed investigation and surveying of the site. The hydraulic structures have been designed after surveying, site inspection and detailed investigation by a team of Technical Experts & Geologist of IIT, Roorkee after establishing the suitability of the site before preparation of the Deatiled Project Report.

(H) COST BENEFIT ANALYSIS

i. Total cost of the project
   - Rs 7633.42 lac (without interest during construction)
   - Rs 9617.55 lac (with interest during construction)

ii. Debt Equity Ration 70:30
iii. Loan Repayment period 12 years
iv. Financing Institution NABARD
v. Expenditure till date NIL
vi. Net Saleable energy 45.43 Million Unit
vii. Levelized cost of generation Rs 3.60 per unit
viii. Annual Revenue from sale of energy Rs 1908.24 lac
ix. Internal Rate of Return (IRR) 11.99%
x. Benefit cost Ratio 1.12

➢ No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

The following standard shall be followed strictly during construction of the project:

1- The earth moving and heavy equipments shall not be used at site but all works shall be carried out through labour and small equipments.

2- The unutilized muck, generated from construction shall be disposed off at approved and demarcated land by forest department.

3- The construction material such as stone, sand and aggregate shall be brought from approved quarries. No mining and quarrying shall be done at site for construction material.

4- The natural boundary of Sonegad remained unchanged during construction of Trench Weir.

5- A 0.30 cumec environmental discharge will be release always to keep the river flow continuous.

6- The monthly report of experts of environment & pollution control unit shall be ensured to submit to Environment and Pollution Control Board.

7- The hill slopes shall be stabilized by appropriate protection works to avoid erosion of hills in the project area. The technique of bio-engineering shall be used in slope stabilization.

8- The treatment of muck generated from construction shall be done as per suggestion of experts by using bio-engineering.

9- The proper drains shall be constructed in project area for disposal of seepage or runoff and shall be kept free from blockage. These drains shall be connected with the natural drainage system.

10- The appropriate design standard shall be followed in design of hydraulic structures so that hill erosion could be avoided.

11- There is no any fault zone in the project area.
12- The flow of Sonengad River shall remain undisturbed during construction of project.

13- Due to provision of power pipe for construction of the project, the excavation works shall be minimum.

14- There is no irrigation or water supply scheme on the Sonegad in project area or in upstream of the project therefore; no other project shall be affected due to construction of this project.

15- There is no habitation and agricultural land in the project area, therefore conversion of land use shall not be required. Rehabilitation shall not be required due to non formation of reservoir in the project.

16- The rights of villagers in the vicinity of the project area shall not be affected due to construction of the project.

17- The priority in employment during construction and operation of the project shall be given to local villagers as per their eligibility.

18- The alignment of the project shall be done such that loss of vegetal cover could be minimized.

19- No natural heritage shall be affected due to construction of the project and the old foot path lies in the project area shall be maintained in its natural state.
PILANGAD-II SHP
(2x2000 Kw)
(PROPOSED)
PILANGAD – II SMALL HYDRO ELECTRIC PROJECT (2x2000 KW)

1- Category of Project under Eco –Sensitive Zone - Undefined

Geographical Cordinates

A – Trench Weir 30° 58’ 27” E & 78° 41’ 11” N
B - Power House 30° 58’ 25” E & 78° 41’ 46” N

Name of River Pilangad (a tributary of Bhagirathi River)
Catchment area 105.00 SqKm

3- DESCRIPTION OF THE PROJECT
Pilangad Small Hydro Electric Project is located on the right bank of the tributary of Bhagirathi River, Pilangad near Pilang village. The work of discharge measurement is being done under investigation and planning of the project. A provision to release minimum 20% discharge of river continuously for environment and ecology shall be made in the Detailed Project Report of the Project and accordingly the installed capacity of the project shall be kept. The Detailed Project Report of the Project shall be prepared after detailed investigation, surveying and inspection of the site by technical experts and geologist ensuring the suitability of the site. The construction works of the projects shall be done as per design and drawing issued by appropriate technical expert and technical specification & standards shall be followed strictly.

(I) COST BENEFIT ANALYSIS
The project is under preliminary investigation and planning stage, therefore cost benefit analysis could not be ascertained at this stage.

- No change in costing shall be occurred due to implementation of Eco-sensitive gazette notification.

The following standard shall be followed strictly during construction of the project:

1- The earth moving and heavy equipments shall not be used at site but all works has been carried out through labour and small equipments.

2- The unutilized muck, generated from construction shall be disposed off at approved and demarcated land by forest department.

3- The construction material such as stone, sand and aggregate shall be brought from approved quarries. No mining and quarrying shall be done at site for construction material.

4- The natural boundary of Pilangad remained unchanged during construction of Trench Weir.

5- A 0.50 cumec environmental discharge will be release always to keep the river flow continuous.
6- The monthly report of experts of environment & pollution control unit shall be ensured to submit to Environment and Pollution Control Board

7- The hill slopes shall be stabilized by appropriate protection works to avoid erosion of hills in the project area. The technique of bio-engineering shall be used in slope stabilization.

8- The treatment of construction generated muck shall be done as per suggestion of experts by using bio engineering.

9- The proper drains shall be constructed in the project area for disposal of seepage or runoff and shall be kept free from blockage. These drains shall be connected with the natural drainage system.

10- The appropriate design standard shall be followed in design of hydraulic structures so that hill erosion could be avoided.

11- There is no any fault zone in the project area.

12- The flow of Pilangad River shall remain undisturbed during construction of project.

13- Power Pipe / Contour Channel shall be provided in the construction of the project to minimize the excavation.

14- There is no irrigation or water supply scheme on the Pilangad in project area or in upstream of the project therefore; no other project shall be affected due to construction of this project.

15- There is no habitation and agricultural land in the project area, therefore conversion of land use shall not be required. Rehabilitation shall not be required due to non formation of reservoir in the project.

16- The rights of villagers in the vicinity of the project area shall not be affected due to construction of the project.

17- The priority in employment during construction and operation of the project shall be given to local villagers as per their eligibility.

18- The alignment of the project shall be done such that loss of vegetal cover could be minimized.

19- No natural heritage shall be affected due to construction of the project and the old foot path lies in the project area shall be maintained in its natural state.
KAKORAGAD SHP
(12.50 MW)
(Under Implementation)
LAYOUT OF KAKORA GAD S.H.P. (2x6.25MW)

DESIGN DISCHARGE: 3.75 m³/s
NET HEAD: 348.47 m
GROSS HEAD: 428.01 m
GROSS ENERGY GENERATION: 96.00 MU

POND
L: 50.0m
W: 40.0m
H: 0.8m

POWER TUNNEL
L: 1350.0m
SIZE: 3.5m x 3.5m

INTAKE TUBE
L: 8.0m
D: 3.0m

INTAKE STRUCTURE
L: 2.5m

DEBRIS RAMP
L: 50.0m
H: 3.0m

ESCAPE CHANNEL
L: 250.0m

KAKORA GAD

FLOODWATER DISPOSAL
Kakoragad SHP (12.50 MW)

1. Name of Project: Kakoragad SHP
2. Type: Run of River Small Hydropower Project, involves No Dam/Barrage/ Reservoir
3. Location: Kakoragad Stream, tributary of River Bhagirathi, Harsil, Distt Uttarkashi.
4. Capacity: 12.5MW
5. Developer: Harsil Hydro Ltd, 24/73 Birhana Road, Kanpur-208001
7. DPR Approved: 2011
8. Project Cost (Including Interest During Construction): Rs 9195.8 Lacs
10. Electricity Generation Yearly: Gross 56.92MU, Nett Saleable (30 yrAvg). 49.75 MU
11. Tariff Assumed (2011): Rs. 3.50/unit. (Actual as applicable on commissioning under Renewable Energy Tariff determined by UERC).
12. Net Saleable Yearly Revenue (30yrs average): Rs 1741.1 lacs
13. Royalty to State-Free Electricity Yearly (30yrs average): 4.92 MU
14. Carbon Emissions Reduction: Yearly 41,000 tonnes
15. Project Land requirement: 4.9675 HA.
17. Consent to Establish from State Pollution Control Board: Obtained dt. 17.7.2012
18. Environmental Clearance: Not applicable for SHPs (below 25MW)
20. Environmental Flow: Presently 0.3 cumecs, as applicable. However, Environmental Flow will be maintained as may be stipulated by State/Central Govt. Authorities, Monitoring Committee, and as may be directed by Hon’ble Courts.

21. STATUS: Under Implementation as per terms of Implementation Agreement signed with Uttarkhand Govt. on 9.9.2011 and Consent to Establish from State Pollution Board dt 17.7.2014. However, matters relating to implementation and Forest Clearance for 24 Hydropower Projects in Alaknanda-Bhagirathi Basin, including above Project, is sub-judice before Hon’ble Supreme Court and halted till further orders in Case no 6736 of
2013 Alaknanda HydroPower Co. Ltd vs Anuj Joshi & Others vide Hon’ble Court order dt 13.8.2013 and subsequent orders. Project to be included in Zonal Masterplan, subject to final orders of Hon’ble Supreme Court.

22. STANDARDS & SAFEGUARDS.- All applicable Rules, Regulation, Conditions, Best Practices, Design Standards will be followed during Construction and Operation as stipulated by State/Central Govt. Authorities, Monitoring Committee, State Pollution Board and as may be directed by Hon’ble Courts. Due expert advice and supervision will be ensured to keep environmental impact to bare minimum and adherence to stipulated conditions. Regular reports, as applicable, will be sent to concerned Authorities as specified.
KAKORAGAD SHP (12.50MW) : MAIN FEATURES

1. Location

State : Uttaranchal
District : Uttarkashi
Tehsil : Bhatwari
Village : Harsil
Access distance from :
  State Capital : Dehradun : 275 km
  District Head Quarter : Uttarkashi : 75 km
  Nearest Road Head : Harsil : 35 km from Bhatwari
                     : 3 km from Powerhouse Site
  Nearest Rail Head : BG – Rishikesh (230 km)

2. Geographical Co-ordinate of project: Approx location

  Diversion weir
  Northing : 31º 03.83' N
  Easting : 078º 46.33’ E
  Altitude : ± 2942 m

3. Details of the Stream

  Name of the stream : Kakora Gad.
  Catchments area at diversion : 86 Sq.Km.
  Lean period discharge : 1.20 cumec
  Status of the stream snow / glacier / rain fed : Glacier, snow and rain fed

4. Meteorological Information

  Annual Rainfall : 1590 mm
  Temperature : Min. -12°C, Max +26°C

5. Availability of Labor

  Availability of Labor in nearby area
  (i) Skilled : Available at Uttarkashi.
  (ii) Unskilled : Available near project site

6. Preliminary Technical Parameters

  6.1 Basic parameters
  Gross Head (Intake to Powerhouse) : 403 m
Gross Head (Forebay to Powerhouse) : 400.3 m  
Net head : 393.47 m  
Design discharge : 3.75 m³/s  
Installed Capacity : 12.5 MW

6.2 Diversion structure & intake

Type : Trench type weir with intake structure made of RCC.
Design discharge for Intake structure : 5.36 m³/s  
Altitude (above MSL) : ± 2942 m  
Size : Width : 2.5  
Depth: 2.0.  
Length : 18 m  
FSL at Diversion/Intake at elevation : ± 2942 m asl

6.3 Intake Pipe up to Desilting Chamber

Type : Steel Pipe of 1400 mm diameter  
Length : 45 m  
Design Discharge in Pipe : 5.16 m³/s

6.4 Desilting chamber

Design Criteria : To remove silt particles of size 0.2mm and above  
Size (With Hopper Shape) : L = 50.00 m  
B = 8.25 m  
D = 3.50 m  
Side Slope of Hopper : 1.H : 1V  
Discharge capacity : 4.69 m³/s  
Flushing Arrangement : Sloping bed, sluice valve at the bottom

6.5 Channel from Desilting Chamber to Tunnel Inlet Portal

Type : RCC Channel  
Length : 5 m  
Design Discharge in Pipe : 3.75 m³/s

6.6 Tunnel

Size : D shaped  
Width : 2.0 m  
Height : 2.5 m  
Length : 1629 m
Discharge Capacity: $3.75 \text{ m}^3/\text{s}$

6.7 Forebay Tank

- Length: 50.0 m
- Width: 6.0 m
- Depth: 2.5 m
- Free Board: 1.0 m
- Type: Rectangular RCC
- Approximate Detention Time: 3 Minute
- No of Gates: 1 no. for penstock intake
  1 no. for sluice valve 300 mm diameter

6.8 Penstock

- Diameter: 1250 mm
- Length: 799.00 m
- Unit Penstock Diameter: 900 mm
- Length: 2 X 10 m
- Type: Fabricated from Steel plate confirming to IS 2002
- Thickness: Varies from 8 mm to 32 mm.
- Design discharge: 3.75 m$^3$/s
- Anchors and Saddle Supports: Anchor block at each vertical & horizontal bend, and supported on saddle support at every 6 m spacing

6.9 Power House

- Type: Surface
- Size of the Power House building: L = 32 m
  W = 13 m
  H = 16.0 m
- Service Bay Elevation: EL ±2540.50 m
- Centre Line of turbine: EL ±2539.0 m
- Installed Capacity: 2 X 6.25 MW
- Power House Crane: 50/10 Pendant Operated EOT

7. E&M Equipment

7.1 Turbines

- Type: Two Jet horizontal Pelton Machine with a directly coupled generator
- No. & Capacity: 2 x 6250 kW
- Design head: 393.47 m
- Speed: 500 rpm
7.2 Generators  
Type: Horizontal shaft alternating current synchronous type.  
No. & Capacity: 2 x 6250 KW  
Power factor: 0.9pf

7.3 Transformer  
Type and Numbers: Two 10MVA, 11/33kV Delta/Star step up transformer of ONAF type

7.4 Tail Race  
Shape: Rectangular  
Size: 2 m wide X 1.5m deep  
Bed Slope: 1 in 600  
Length: 100 m  
FSL at Maximum Tail water level: ± 2535.5m asl (Tail discharge is into Bhagirathi river)

8 Power  
Installed Capacity: 12500 KW  
Average year of 95% plant Availability: 56.92 MU  
Plant Load Factor: 54.72%

9 Transmission Lines  
Voltage: 33 KV Single Circuit  
Length: 3 Km  
Feeding Point into Grid: Harsil Switchyards
# KAKORAGAD SHP (12.5MW) : FINANCIAL ANALYSIS

## FINANCIAL STATEMENTS : (As per DPR2011)

### Assumptions

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<tr>
<td>Construction Period (Yrs)</td>
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<td>Cost per MW (Rs. Lacs)</td>
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<td>RATE OF INTEREST ON LOAN</td>
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<td>Income Tax Rate (%)</td>
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<td>For 10 years</td>
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<td>REPAYMENT OF LOAN</td>
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<td>10</td>
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<td>TARIFF RATE FOR IST 15 YEARS</td>
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<td>ESCALATION ON TARIFF IN 16TH YEAR @ 18%</td>
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<td>GROSS GENERATION(Million Unit)</td>
<td>Average year</td>
<td>56.92</td>
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<td>Free Power</td>
<td>For 1st 15 Years and thereafter</td>
<td>0%</td>
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<tr>
<td>NET SALEABLE ENERGY (Million Unit)</td>
<td>54.67</td>
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<td>Carbon Credits in tonnes = 41000 tonnes</td>
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<td>Revenue from Sale of Energy (Average 30yrs)</td>
<td>Yearly</td>
<td>1741.1 lacs INR</td>
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<td>Revenue from sale of carbon credits</td>
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<td>125.92 lacs INR</td>
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<tr>
<td>NOTE: ACTUAL FINAL TARIFF TO BE AS DETERMINED BY UERC UNDER RENEWABLE ENERGY TARIFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDICATORS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TARIFF COST LEVELISED</td>
<td>Rs/Kwh</td>
<td>2.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVERAGE DSCR</td>
<td></td>
<td>1.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRR(AFTER TAX)</td>
<td></td>
<td>12.96%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

## Cost Details

<table>
<thead>
<tr>
<th>Items</th>
<th>Estimated Cost (Rs. In Lacs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building and Civil Work</td>
<td>4015.2</td>
</tr>
<tr>
<td>Plant &amp; Machinery</td>
<td>2853.7</td>
</tr>
<tr>
<td>Pre Operative Expenses</td>
<td>702.0</td>
</tr>
<tr>
<td>Project Cost ( Excl. Escalation &amp; IDC)</td>
<td>7570.9</td>
</tr>
<tr>
<td>Project Cost ( Incl. Escalation &amp; IDC)</td>
<td>7195.8</td>
</tr>
</tbody>
</table>
SIYANGAD SHP
(11.50MW)
(Under Implementation)
SIYANGAD SHP (11.50MW)

1. Name of Project: Siyangad SHP
2. Type: Run of River Small Hydropower Project, involves No Dam/Barrage/Reservoir
3. Location: Siyangad Stream, tributary of River Bhagirathi, Harsil, Distt Uttarkashi.
4. Capacity: 11.5MW
5. Developer: Harsil Hydro Ltd, 24/73 Birhana Road, Kanpur -208001
7. DPR Approved: 2011
8. Project Cost (Including Interest During Construction): Rs 9361.4Lacs
9. Implementation Agreement: Signed 1.9.2011 (for period 40 years)
10. Electricity Generation Yearly: Gross 53.52MU, Nett Saleable (30 yr Avg), 46.77 MU
11. Tariff Assumed(2011): Rs. 3.50/unit. (Actual as applicable on commissioning under Renewable Energy Tariff determined by UERC).
12. Net Saleable Yearly Revenue (30yrs average): Rs 1637.1 Lacs
13. Royalty to State - Free Electricity Yearly(30yrs average): 4.72 MU
15. Project Land requirement: 4.990 HA.
17. Consent to Establish from State Pollution Control Board: Obtained dt. 12.7.2012
18. Environmental Clearance: Not applicable for SHPs (below 25MW)
20. Environmental Flow: Presently 0.3 cumecs, as applicable. However, Environmental Flow will be maintained as may be stipulated by State/Central Govt. Authorities, Monitoring Committee, and as may be directed by Hon’ble Courts.
21. STATUS: Under Implementation as per terms of Implementation Agreement signed with Uttarkhand Govt. on 1.9.2011 and Consent to Establish from State Pollution Board dt 12.7.2014. However, matters relating to implementation and Forest Clearance for 24 Hydropower Projects in Alaknanda-Bhogirathi Basin, including above Project, is sub-judice before Hon’ble Supreme Court and halted till further orders in Case no 6736 of 2013 Alaknanda HydroPower Co. Ltd vs Anuj Joshi & Others vide Hon’ble Court order dt 13.8.2013 and subsequent orders. Project to be included in Zonal Masterplan, subject to final orders of Hon’ble Supreme Court.

22. STANDARDS & SAFEGUARDS.- All applicable Rules, Regulation, Conditions, Best Practices, Design Standards will be followed during Construction and Operation as stipulated by State/Central Govt. Authorities, Monitoring Committee, State Pollution Board and as may be directed by Hon’ble Courts. Due expert advice and supervision will be ensured to keep environmental impact to bare minimum and adherence to stipulated conditions. Regular reports, as applicable, will be sent to concerned Authorities as specified.
# SIYANGAD SHP (11.50MW) : MAIN FEATURES

1. Location

<table>
<thead>
<tr>
<th>State</th>
<th>: Uttaranchal</th>
</tr>
</thead>
<tbody>
<tr>
<td>District</td>
<td>: Uttarkashi</td>
</tr>
<tr>
<td>Tehsil</td>
<td>: Bhatwari</td>
</tr>
<tr>
<td>Village</td>
<td>: Harsil</td>
</tr>
<tr>
<td>Access distance from</td>
<td></td>
</tr>
<tr>
<td>State Capital</td>
<td>: Dehradun : 275 km</td>
</tr>
<tr>
<td>District Head Quarter</td>
<td>: Uttarkashi : 75 km</td>
</tr>
<tr>
<td>Nearest Road Head</td>
<td>: Harsil : 35 km from Bhatwari : 4 km u/s of PH Site</td>
</tr>
<tr>
<td>Nearest Rail Head</td>
<td>: BG – Rishikesh (230 km)</td>
</tr>
</tbody>
</table>

2. Geographical Co-ordinate of proposed Project Structure: Approx. Location--

| Diversion Weir: Northing | : 31°03.16’ N |
| Easting                  | : 078°41.73'E |
| Altitude                 | : ± 2763 m |

3. Details of the Stream

| Name of the stream       | : Siyan Gad. |
| Catchments area at diversion | : 136.00Sq.Km. |
| Lean period discharge    | : 1.10 cumec |
| Status of the stream snow / glacier / rain fed | : Glacier, snow and rain fed |

4. Meteorological Information

| Annual Rainfall | : 1590 mm |
| Temperature     | : Min. -12°C, Max +26°C |

5. Availability of Labor

| Availability of Labor in nearby area | |
| (i) Skilled | : Available at Uttarkashi. |
| (ii) Unskilled | : Available near project site |

6. Preliminary Technical Parameters

6.1 Basic parameters
<table>
<thead>
<tr>
<th><strong>6.2 Diversion structure &amp; intake</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td><strong>Design discharge for Intake structure</strong></td>
</tr>
<tr>
<td><strong>Altitude (above MSL)</strong></td>
</tr>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Length</strong></td>
</tr>
<tr>
<td><strong>FSL at Diversion/Intake is at elevation</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>6.3 Intake Tunnel</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td><strong>Length</strong></td>
</tr>
<tr>
<td><strong>Height</strong></td>
</tr>
<tr>
<td><strong>Diameter</strong></td>
</tr>
<tr>
<td><strong>Max depth of water</strong></td>
</tr>
<tr>
<td><strong>Design Discharge</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>6.4 Underground Desilting chamber</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Criteria</strong></td>
</tr>
<tr>
<td><strong>Size (With Hopper Shape)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Discharge capacity</strong></td>
</tr>
<tr>
<td><strong>Flushing Arrangement</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>6.5 Head Race Tunnel</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Length</strong></td>
</tr>
<tr>
<td><strong>Discharge capacity</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>6.6 Adit</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Length</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>6.7 Forebay Tank</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>Width</strong></td>
</tr>
<tr>
<td><strong>Depth</strong></td>
</tr>
<tr>
<td><strong>Free Board</strong></td>
</tr>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td><strong>Approximate Detention Time</strong></td>
</tr>
<tr>
<td><strong>Gross Capacity</strong></td>
</tr>
<tr>
<td><strong>No of Gates Valve</strong></td>
</tr>
</tbody>
</table>

### 6.8 Penstock

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diameter</strong></td>
<td>1350 mm</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>637m</td>
</tr>
<tr>
<td><strong>Unit Penstock Diameter</strong></td>
<td>900 mm</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>2 X 10 m</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Fabricated from Steel plate confirming to IS 2002</td>
</tr>
<tr>
<td><strong>Thickness</strong></td>
<td>Varies from 8 mm to 28 mm.</td>
</tr>
<tr>
<td><strong>Design discharge</strong></td>
<td>4.21 m³/s</td>
</tr>
<tr>
<td><strong>Anchors and Saddle Supports</strong></td>
<td>Anchor block at each vertical &amp; horizontal bend, and supported on saddle support at every 6 m spacing</td>
</tr>
</tbody>
</table>

### 6.9 Power House

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Surface</td>
</tr>
<tr>
<td><strong>Size of the Power House building</strong></td>
<td>L = 52 m W = 25.0 m H = 16.0 m</td>
</tr>
<tr>
<td><strong>Service Bay Elevation</strong></td>
<td>EL. ±2436.00 m</td>
</tr>
<tr>
<td><strong>Centre Line of turbine</strong></td>
<td>EL. ±2434.00 m</td>
</tr>
<tr>
<td><strong>Installed Capacity</strong></td>
<td>2 X 5.75 MW</td>
</tr>
<tr>
<td><strong>Power House Crane</strong></td>
<td>50/10 EOT</td>
</tr>
</tbody>
</table>

### 7. E&M Equipment

#### 7.1 Turbines

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Two Jet horizontal Pelton Machine with a directly coupled generator</td>
</tr>
<tr>
<td><strong>No. &amp; Capacity</strong></td>
<td>2 x 5750 kW</td>
</tr>
<tr>
<td><strong>Design head Speed</strong></td>
<td>320.37 m 428 rpm</td>
</tr>
</tbody>
</table>

#### 7.2 Generators

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Horizontal shaft alternating current synchronous type.</td>
</tr>
<tr>
<td><strong>No. &amp; Capacity</strong></td>
<td>2 x 5750 KW</td>
</tr>
<tr>
<td><strong>Power factor</strong></td>
<td>0.9pf</td>
</tr>
</tbody>
</table>

### 7.3 Transformer
<table>
<thead>
<tr>
<th>Type and Numbers</th>
<th>: Twono.7.5MVA,11/33kV Delta/Star step up transformer of ONAF type</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.4 Tail Race</td>
<td>Shape : Rectangular</td>
</tr>
<tr>
<td>Size</td>
<td>: 2 m wide X 1.5m deep</td>
</tr>
<tr>
<td>Bed Slope</td>
<td>: 1 in 600</td>
</tr>
<tr>
<td>Length</td>
<td>FSL at Maximum Tail water level is at elevation</td>
</tr>
<tr>
<td></td>
<td>: 100 m</td>
</tr>
<tr>
<td></td>
<td>: 2430.50 m</td>
</tr>
<tr>
<td>8 Power</td>
<td>Installed Capacity : 11500 KW</td>
</tr>
<tr>
<td></td>
<td>Annual Energy (Gross) : 56.34 MU</td>
</tr>
<tr>
<td></td>
<td>Annual Energy at 95% plant availability in Average Year : 53.52 MU</td>
</tr>
<tr>
<td></td>
<td>Plant Load Factor (Gross) : 55.92%</td>
</tr>
<tr>
<td></td>
<td>Plant Load Factor (95 % plant availability) : 53.12 %</td>
</tr>
<tr>
<td>9 Transmission Lines</td>
<td>Voltage : 33 kV Single Circuit</td>
</tr>
<tr>
<td></td>
<td>Length : 3 km</td>
</tr>
<tr>
<td></td>
<td>Feeding Point into Grid : Harsil Switchyard (Proposed PTCUL/UPCL)</td>
</tr>
</tbody>
</table>
# SIYANGAD SHP (11.50MW): FINANCIAL ANALYSIS

**FINANCIAL STATEMENTS: (As per DPR 2011)**

<table>
<thead>
<tr>
<th>Assumptions</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Construction Period (Yrs)</td>
<td>3.00</td>
</tr>
<tr>
<td>PROJECT COST (Rs. Lacs)</td>
<td>9361.4</td>
</tr>
<tr>
<td>Cost per MW (Rs. Lacs)</td>
<td>814.0</td>
</tr>
<tr>
<td>DEBT/EQUITY RATIO</td>
<td>2.33 :1</td>
</tr>
<tr>
<td>RATE OF INTEREST ON LOAN</td>
<td>12.00%</td>
</tr>
<tr>
<td>Income Tax Rate (%)</td>
<td>33.66%</td>
</tr>
<tr>
<td>Tax Relief</td>
<td>100%</td>
</tr>
<tr>
<td>For 10 years</td>
<td></td>
</tr>
<tr>
<td><strong>REPAYMENT OF LOAN</strong></td>
<td></td>
</tr>
<tr>
<td>Yrs</td>
<td>10</td>
</tr>
<tr>
<td><strong>TARIFF RATE FOR IST 15 YEARS</strong></td>
<td></td>
</tr>
<tr>
<td>Rs/Kwh</td>
<td>3.50</td>
</tr>
<tr>
<td><strong>ESCALATION ON TARIFF IN 16TH YEAR @ 18%</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.50</td>
</tr>
<tr>
<td><strong>GROSS GENERATION(Million Unit)</strong></td>
<td></td>
</tr>
<tr>
<td>Average year</td>
<td>53.52</td>
</tr>
<tr>
<td>Free Power</td>
<td></td>
</tr>
<tr>
<td>For 1st 15 Years and thereafter</td>
<td>0%</td>
</tr>
<tr>
<td>18%</td>
<td></td>
</tr>
<tr>
<td><strong>NET SALEABLE ENERGY (Million Unit)</strong></td>
<td>51.40</td>
</tr>
<tr>
<td>Carbon Credits in tonnes = 38555 tonnes</td>
<td></td>
</tr>
<tr>
<td>Revenue from Sale of Energy</td>
<td></td>
</tr>
<tr>
<td>(Average 30yrs)</td>
<td>Yearly</td>
</tr>
<tr>
<td></td>
<td>1637.1 Lacs INR</td>
</tr>
<tr>
<td>Revenue from sale of carbon credits</td>
<td>Yearly</td>
</tr>
<tr>
<td></td>
<td>118.4 Lacs INR</td>
</tr>
<tr>
<td><strong>NOTE: ACTUAL FINAL TARIFF TO BE AS DETERMINED BY UERC UNDER RENEWABLE ENERGY TARIFF</strong></td>
<td></td>
</tr>
<tr>
<td><strong>INDICATORS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TARIFF COST LEVELISED</strong></td>
<td>Rs/Kwh</td>
</tr>
<tr>
<td></td>
<td>2.46</td>
</tr>
<tr>
<td><strong>AVERAGE DSCR</strong></td>
<td>1.36</td>
</tr>
<tr>
<td><strong>IRR(AFTER TAX)</strong></td>
<td>11.51%</td>
</tr>
</tbody>
</table>

## Cost Details

<table>
<thead>
<tr>
<th>Items</th>
<th>Estimated Cost (Rs. In Lacs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building and Civil Work</td>
<td>4491.80</td>
</tr>
<tr>
<td>Plant &amp; Machinery</td>
<td>2666.10</td>
</tr>
<tr>
<td>Pre Operative Expenses</td>
<td>579.20</td>
</tr>
<tr>
<td>Project Cost Total (excl IDC &amp; Escalation)</td>
<td>7737.10</td>
</tr>
<tr>
<td>Project Cost Total (Incl IDC &amp; Escalation)</td>
<td>9361.40</td>
</tr>
</tbody>
</table>
JALANDHARYGAD SHP
(24MW)
(Under Implementation)
LAYOUT PLAN

LAYOUT OF JALANDHARI S.H.P. (24 MW)
POWER HOUSE-I & POWER HOUSE-II

DESIGN DISCHARGE: 470 m³/s
Net Head: 693.07 m
Gross Energy Generation: 117.45 MW

POWER HOUSE-I
- Penstock-I: L - 180.52 m, Dia - 1.40 m
- Tunnel Discharge: L - 50.52 m, Dia - 1.65 m
- Intake Structure: L - 85.82 m, Dia - 3.285 m
- Tailrace: L - 30.47 m, Dia - 1.40 m

POWER HOUSE-II
- Penstock-II: L - 180.52 m, Dia - 1.40 m
- Tunnel Discharge: L - 50.52 m, Dia - 1.65 m
- Intake Structure: L - 85.82 m, Dia - 3.285 m
- Tailrace: L - 30.47 m, Dia - 1.40 m

POWER CHANNEL
- Length: 3.50 km
- Discharge: 470 m³/s

INTAKE STRUCTURE
- Length: 85.82 m
- Diameter: 3.285 m
- El: 3164.4 m

Penstocks
- Penstock-I: El - 1450.9 m
- Penstock-II: El - 1300 m
JALANDHARYGAD SHP (24MW)

1. Name of Project: Jalandharygad SHP
2. Type: Run of River Small Hydropower Project, involves No Dam/Barrage/ Reservoir. Cascade with single Diversion weir and dual powerhouse.
3. Location: Jalandharygad Stream, tributary of River Bhagirathi, Harsil, Distt Uttarkashi.
4. Capacity: 24 MW
5. Developer: Harsil Hydro Ltd, 24/73 Birhana Road, Kanpur - 208001
7. DPR Approved: 2011
8. Project Cost (Including Interest During Construction): Rs 19715.1 Lacs
9. Implementation Agreement: Signed 2.9.2011 (for period 40 years)
10. Electricity Generation Yearly: Gross 117.87 MU, Nett Saleable (30 yr Avg). 105.12 MU
12. Net Saleable Yearly Revenue (30yrs average): Rs 3679.2 Lacs
13. Royalty to State - Free Electricity Yearly (30yrs average): 10.40 MU
15. Project Land requirement: 13.2175 HA.
17. Consent to Establish from State Pollution Control Board: Obtained dt. 12.7.2012
18. Environmental Clearance: Not applicable for SHPs (below 25MW)
20. Environmental Flow: Presently 0.3 cumecs, as applicable. However, Environmental Flow will be maintained as may be stipulated by State/Central Govt. Authorities, Monitoring Committee, and as may be directed by Hon’ble Courts.

21. STATUS: Under Implementation as per terms of Implementation Agreement signed with Uttarkhand Govt. on 2.9.2011 and Consent to Establish from State Pollution Board dt 17.7.2014. However, matters relating to implementation and Forest Clearance for 24 Hydropower Projects in Alaknanda-Bhagirathi Basin, including above Project, is sub-
judice before Hon’ble Supreme Court and halted till further orders in Case no 6736 of 2013 Alaknanda HydroPower Co. Ltd vs Anuj Joshi & Others vide Hon’ble Court order dt 13.8.2013 and subsequent orders. Project to be included in Zonal Masterplan, subject to final orders of Hon’ble Supreme Court.

22. STANDARDS & SAFEGUARDS.- All applicable Rules, Regulation, Conditions, Best Practices, Design Standards will be followed during Construction and Operation as stipulated by State/Central Govt. Authorities, Monitoring Committee, State Pollution Board and as may be directed by Hon’ble Courts. Due expert advice and supervision will be ensured to keep environmental impact to bare minimum and adherence to stipulated conditions. Regular reports, as applicable, will be sent to concerned Authorities as specified.
JALANDHARYGAD SHP (24.0 MW) : Main Features

1. Location

State : Uttarakhand
District : Uttarkashi
Tehsil : Bhatwari
Village : Harsil
Access distance from : 
   State Capital : Dehradun : 275 km
   District Head Quarter : Uttarkashi : 75 km
   Nearest Road Head : Harsil : 35 km from Bhatwari
   : 3 km from Powerhouse Site
   Nearest Rail Head : BG – Rishikesh (230 km)

2. Geographical Co-ordinate of proposed Project Location: approx location
   Weir site
   Northing : 31° 04.767' '
   Easting : 078° 44.374' '
   Altitude : ± 3105 m

3. Details of the Stream

   Name of the stream : Jalandhary Gad.
   Catchments area at diversion : 157 Sq. Km.
   Lean period discharge : 1.27 cumec
   Status of the stream snow / glacier / rain fed
   glacier / rain fed

4. Meteorological Information
   Annual Rainfall : 1590 mm
   Temperature : Min. -12°C, Max +26°C

5. Availability of Labor
   Availability of Labor in nearby area
   (i) Skilled : Available at Uttarkashi.
   (ii) Unskilled : Available near project site

6. Preliminary Technical Parameters; JG HEP 24MW in cascade design with single intake and dual powerhouse (Stage I - 18.5 MW & Stage II - 5.5 MW)
   Gross Head Total : 642m
   Net Head : 601.07m

6.1 Basic parameters (Stage I)

   Gross Head (Intake to Powerhouse) : 492.00 m
   Gross Head (Forebay to Powerhouse) : 468.70 m
   Net head : 461.50 m
   Design discharge : 4.70 m³/s
   Installed Capacity : 18.5 MW

6.2 Diversion structure & intake

   Type : Trench type weir with intake structure made of RCC.
Design discharge for Intake structure : 6.11 m$^3$/s
Altitude (above MSL) : 3105.0 m
Size : Width : 2.5
       Depth: 2.0.
Length : 29 m
Flushing Arrangement : Gated Channel

6.3 Intake channel up to Desilting Chamber
Type : Rectangular type (cut and cover)
Length : 422 m
Design Discharge in channel : 6.11 m$^3$/s

6.4 Desilting chamber
Design Criteria : To remove silt particles of size
                 0.2 mm and above
Size (With Two Hopper Shape) : L = 35.00 m
                               B = 5.25 m (one hopper)
                               D = 3.85 m
                               Side Slope of Hopper: 1.H: 1V
Discharge capacity : 5.88 m$^3$/s
Flushing Arrangement : Sloping bed, sluice valve at the bottom

6.5 Channel from Desilting Chamber to Tunnel Inlet Portal
Type : RCC Channel (cut and cover)
Length : 60 m
Design Discharge in channel : 4.70 m$^3$/s

6.6 Tunnel
Size : D shaped
       Width : 2.1 m
       Height : 2.5 m
Length : 1915 m
Discharge Capacity : 4.70 m$^3$/s

6.7 Forebay Tank
Length : 60.0 m
Width : 6.0 m
Depth : 3.0 m
Free Board : 1.0 m
Type : Rectangular RCC
Approximate Detention Time : 3 Minute
Gross Capacity : 1080 m$^3$
No of Gates : 1 no. for penstock Intake
             1 no. for sluice valve 500 mm diameter
Valve :

6.8 Penstock
Diameter : 1400 mm
Length : 910.00 m
Unit Penstock Diameter : 900 mm
Length : 2 X 10 m
Type : Fabricated from Steel plate confirming to IS 2002
Thickness : Varies from 8 mm to 32 mm.
Design discharge: 4.70 m$^3$/s
Anchors and Saddle Supports: Anchor block at each vertical & horizontal bend, and supported on saddle support at every 6 m spacing

6.9 Power House-1
Type: Surface
Size of the Power House building:
L = 52 m
W = 27.0 m
H = 16.0 m
Service Bay Elevation: EL. ±2614.00 m
Centre Line of turbine: EL. ±2613.00 m
Installed Capacity: 2 X 9.25 MW
Power House Crane: 80/20 Pendent Operated EOT

6.10 E&M Equipment

6.10.1 Turbines
Type: Two Jet horizontal Pelton Machine with a directly coupled generator
No. & Capacity: 2 x 9250 kW
Design head: 461.50 m
Speed: 500 rpm

6.10.2 Generators
Type: Horizontal shaft alternating current synchronous type.
No. & Capacity: 2 x 9250 KW
Power factor: 0.8 pf

6.10.3 Transformer
Type and Numbers:
Twono.14.5MVA, 11/33kV
Delta/Star step up transformer of ONAF type
Two Nos. UAT 33 KV/433 V

6.11 Tail Race
Shape: Rectangular
Size: 2.1 m wide X 2.5m deep
Bed Slope: 1 in 600
Length: 200 m

6.12 Power
Installed Capacity: 18500 KW
Annual Energy at 95% Plant Availability in average year: 90.69 MU
Plant Load Factor: 58.90 %

6.13 Transmission Lines
Voltage: 33 KV Single Circuit
Length: 2.5 Km

7. Preliminary Technical Parameters for Stage-II
7.1 Basic parameters

- Gross Head (Intake to Powerhouse): 147.00 m
- Gross Head (Forebay to Powerhouse): 144.60 m
- Net head: 139.57 m
- Design discharge: 4.65 m$^3$/s
- Installed Capacity: 5.5 MW

7.2 Channel from intake to Tunnel Inlet Portal

- Type: RCC Channel
- Length: 268 m
- Design Discharge in channel: 4.65 m$^3$/s

7.3 Tunnel

- Size: D shaped
  - Width: 2.1 m
  - Height: 2.5 m
- Length: 1568 m
- Discharge Capacity: 4.65 m$^3$/s

7.4 Forebay Tank

- Length: 62.0 m
- Width: 6.5 m
- Depth: 2.5 m
- Free Board: 1.0 m
- Type: Rectangular RCC
- Approximate Detention Time: 3 Minute
- Gross Capacity: 1008 m$^3$
- No of Gates: 1 no. For penstock Intake, 1 no. For sluice valve 500 mm diameter

7.5 Penstock

- Diameter: 1300 mm
- Length: 230.00 m

- Unit Penstock
  - Diameter: 900 mm
  - Length: 2 X 10 m

- Type: Fabricated from Steel plate confirming to IS 2002
- Thickness: Varies from 8 mm to 16 mm.
- Design discharge: 4.65 m$^3$/s
- Anchors and Saddle Supports: Anchor block at each vertical & horizontal bend, and supported on saddle support at every 6 m spacing

7.6 Power House-II

- Type: Surface
- Size of the Power House building
  - L = 28 m
  - W = 14.8 m
  - H = 13.0 m
Service Bay Elevation : EL. ±2464.00 m
Centre Line of turbine : EL. ±2463.00 m
Installed Capacity : 2 X 2.75 MW
Power House Crane : 25/8 Pendent Operated EOT

7.7 E&M Equipment

7.7.1 Turbines
Type : Two Jet horizontal Francis Machine with a directly coupled generator
No. & Capacity : 2 x 2750 kW
Design head
Speed : 139.57 m : 500 rpm

7.7.2 Generators
Type : Horizontal shaft alternating current synchronous type.
No. & Capacity : 2 x 2750 KW
Power factor : 0.8 pf

7.7.3 Transformer
Type and Numbers : One no. 9.0 MVA, 11/33kV Delta/Star step up transformer of ONAF type

7.8 Tail Race
Shape : Rectangular
Size : 2 m wide X 1.5m deep
Bed Slope : 1 in 600
Length : 200 m

7.9 Power
Installed Capacity : 5500 KW
Annual Energy at 95% Plant Availability in average year : 27.18 MU
Plant Load Factor : 59.39 %

7.10 Transmission Lines
500M 33 KV Directly feeding into Pooling substation at Harsil

Feeding Point
Harsil Substation Pooling substation

8.6 Pooling substation & Power Evacuation:

8.7 Power generated from stage I and stage II power houses will be fed into a pooling substation of appropriate capacity upto 33/220 KV to be located near Harsil village. Power from Kakora SHP (12.5 MW) and Siyan SHP (11.5 MW) will also be fed into this substation. Power beyond the substation will be fed into local/regional grid which will be made available by UPCL/PTCUL.
**JALANDHARYGAD SHP (24.0 MW) : FINANCIAL ANALYSIS**

**FINANCIAL STATEMENTS:** (As per DPR 2011)

<table>
<thead>
<tr>
<th>Assumptions</th>
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<tbody>
<tr>
<td>Construction Period (Yrs)</td>
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<tr>
<td>PROJECT COST (Rs. Lacs)</td>
<td>19715.1</td>
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<tr>
<td>Cost per MW (Rs. Lacs)</td>
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<td>DEBT/EQUITY RATIO</td>
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<tr>
<td>RATE OF INTEREST ON LOAN</td>
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<td>Income Tax Rate (%)</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Tax Relief</td>
<td>100%</td>
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<td>For 10 years</td>
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<tr>
<td>REPAYMENT OF LOAN</td>
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<tr>
<td>Yrs</td>
<td>10</td>
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<tr>
<td>TARIFF RATE FOR IST 15 YEARS</td>
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<tr>
<td>ESCALATION ON TARIFF IN 16TH YEAR @ 18%</td>
<td>3.25</td>
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<tr>
<td>GROSS GENERATION(Million Unit)</td>
<td>Average year</td>
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<tr>
<td>Free Power</td>
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<tr>
<td>For 1st 15 Years and thereafter</td>
<td>0% 18%</td>
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<tr>
<td>NET SALEABLE ENERGY (Million Unit)</td>
<td>115.51</td>
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<tr>
<td>Carbon Credits in tonnes = 88400 tonnes</td>
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<tr>
<td>Revenue from Sale of Energy (Average 30yrs)</td>
<td>Yearly</td>
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<tr>
<td>Revenue from sale of carbon credits</td>
<td>Yearly</td>
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<td>NOTE: ACTUAL FINAL TARIFF TO BE AS DETERMINED BY UERC UNDER RENEWABLE ENERGY TARIFF</td>
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**INDICATORS**

| TARIFF COST LEVELISED | Rs/Kwh | 2.30 |
| AVERAGE DSCR          |        | 1.35 |
| IRR(AFTER TAX)        |        | 11.47% |

<table>
<thead>
<tr>
<th>Cost Details</th>
<th>(In Rs lacs)</th>
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<tr>
<td>Combined cost of Building and Civil Work</td>
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<tr>
<td>Combined cost of E&amp; M Work</td>
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<td>Total Pre Operative Expenses</td>
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<td>Project Cost Total (excluding IDC &amp; Escalation)</td>
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<tr>
<td>Project Cost Total (including IDC &amp; Escalation)</td>
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