CHALLENGES IN GENERATION AT NATHPA JHAKRI POWER STATION (1500 MW) DUE TO HEAVY SILT IN RIVER SATLUJ

A PRESENTATION
AT
POWER-GEN INDIA & CENTRAL ASIA 2006
(International Conference)

26th Oct, 2006
New Delhi

By
H.K. SHARMA
CMD, SJVNL. SHIMLA
BRIEF DESCRIPTION OF NATHPA JHAKRI PROJECT

LAYOUT PLAN

DAM. INTAKE & DESILTING COMPLEX
(CONTRACT 1.0)

SHOLDING

NUGALSARI

MANGLAD

RATTANPUR

HRT VI FACE

POWER HOUSE COMPLEX
(CONTRACT 3.0)

SATLUJ RIVER

WADHAL

NH-22

NATHPA

CONTRACT 2.1
(Total Length: 16,062 M)

CONTRACT 2.2
(Total Length: 11,332 M)
DIVERSION DAM

TYPE - CONCRETE GRAVITY
HEIGHT - 62.5 M, LENGTH - 185.45 M
DESIGN FLOOD - 5660 CUM
BRIEF DESCRIPTION OF NATHPA JHAKRI PROJECT - CONTD.

NATHPA RESERVOIR

LIVE STORAGE - 303 HAM (at EL 1495.5m), AREA = 23.45 HA
RESERVOIR LENGTH = 2.5 KM

LIVE STORAGE - 111 HAM (at EL 1485.0m), AREA = 14.22 HA
RESERVOIR LENGTH = 1.1 KM
BRIEF DESCRIPTION OF NATHPA JHAKRI PROJECT-CONTD.

INTAKE STRUCTURE

NUMBER - FOUR NUMBER,
OPENING SIZE - 6.0 M X 5.25 M
FOUR NUMBER UNDER GROUND EGG SHAPED, EACH 525 M LONG, 16.31 M WIDE & 27.5 M HIGH

{One of the largest Desilting Chambers in the World}
HEAD RACE TUNNEL

CROSS SECTION - 10.15 M CIRCULAR, CONC. LINED
LENGTH - 27.4 KM.
LOW COVER REACHES - STEEL LINED 8.5 M DIA
NEAR MANGLAD & DAJ CREEKS
**BRIEF DESCRIPTION OF NATHPA JHAKRI PROJECT-CONT'D.**

**SURGE SHAFT**

<table>
<thead>
<tr>
<th><strong>TYPE</strong></th>
<th>RESTRICTED ORIFICE WITH POND AT TOP AND A LOWER EXPANSION GALLERY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEIGHT</strong></td>
<td>301 M</td>
</tr>
<tr>
<td><strong>DIAMETER</strong></td>
<td>21.6 M FOR 210 M HEIGHT</td>
</tr>
<tr>
<td></td>
<td>10.2 M FOR CONNECTING SHAFT 86 M HIGH</td>
</tr>
</tbody>
</table>

![Surge Shaft Image]
**POWER HOUSE-MACHINE HALL**

**TYPE** - UNDERGROUND  
**SIZE** - 222 M (L) X 20 M (W) X 49 M (H)  
**TYPE** - VERTICAL AXIS FRANCIS TURBINE  
**NO. & CAPACITY** - 6 X 250 MW  

**DESIGN ENERGY**  
50% MEAN YEAR - 7351 GWH  
90% DEPENDABLE YEAR - 6951 GWH
BRIEF DESCRIPTION OF NATHPA JHAKRI PROJECT-CONTD.

TRANSFORMER HALL & SWITCHGEAR

EQUIPMENT HOUSED – UNIT TRANSFORMERS,
SWITCHGEAR & DRAFT TUBE GATES
CAVITY SIZE – 196 M X 17.5 M X 27.4 M
TAIL RACE - 10.15 M DIA CIRCULAR, CONC. LINED TUNNEL, 982 M LONG
SPECIAL FEATURE- HELPFUL IN OVERCOMING SILT DAMAGES

- **TURBINES :-**
  - THE DESIGN OF TURBINES PERMIT RUNNER REPLACEMENT FROM BOTTOM BY REMOVAL OF DRAFT TUBE CONES.
  - UNDERWATER PARTS LIKE RUNNERS, GUIDE VANES, CHEEKPLATES, LYBRINTH SEALS CAN BE REPLACED FROM BOTTOM ITSELF.

- **COOLING SYSTEM :-**
  - COOLING SYSTEM, USING PORTABLE WATER IS CLOSE CIRCUIT. ONLY THE WATER IN HEAT EXCHANGES IS TAPPED FROM TAILRACE AND DRAINED BACK TO TAILRACE.
NATHPA JHAKRI PROJECT HYDRO ELECTRIC PROJECT

BENEFITS

- GENERATION OF ABOUT 6924 MU OF ELECTRICAL ENERGY ANNUALLY.

- 1500 MW VALUABLE PEAKING POWER TO ENERGY STARVED NORTHERN GRID.

- 12% FREE POWER TO HIMACHAL PRADESH AND 25% OF BALANCE AT BUS BAR RATES TO HP.

- ALLOCATION OF POWER BY MOP, GOI TO THE STATES OF HARYANA, HP, J&K, PUNJAB, RAJASTHAN, UP, UTTARANCHAL, DELHI AND U.T. OF CHANDIGARH.

- TOTAL REVENUE EXPECTED RS. 1415 CRORES ANNUALLY {NEARLY 308 MILLION US DOLLARS}. 
### NATHPA JHAKRI PROJECT
#### DISTRIBUTION / ALLOCATION OF POWER

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>State</th>
<th>Allocation (in MW)</th>
<th>Percentage of the installed capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Haryana</td>
<td>64</td>
<td>4.27</td>
</tr>
<tr>
<td>2</td>
<td>Himachal Pradesh*</td>
<td>547</td>
<td>36.47</td>
</tr>
<tr>
<td>3</td>
<td>Jammu &amp; Kashmir</td>
<td>105</td>
<td>7.00</td>
</tr>
<tr>
<td>4</td>
<td>Punjab</td>
<td>114</td>
<td>7.60</td>
</tr>
<tr>
<td>5</td>
<td>Rajasthan</td>
<td>112</td>
<td>7.47</td>
</tr>
<tr>
<td>6</td>
<td>Uttar Pradesh</td>
<td>221</td>
<td>14.73</td>
</tr>
<tr>
<td>7</td>
<td>Uttarakhand</td>
<td>38</td>
<td>2.53</td>
</tr>
<tr>
<td>8</td>
<td>Chandigarh</td>
<td>08</td>
<td>0.53</td>
</tr>
<tr>
<td>9</td>
<td>Delhi</td>
<td>142</td>
<td>9.47</td>
</tr>
<tr>
<td>10</td>
<td>Unallocated quota at the disposal of the Central Govt.**</td>
<td>149</td>
<td>9.93</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1500</td>
<td>100</td>
</tr>
</tbody>
</table>

Presently, the percentage allocation is as under:-

- Haryana – 15.67%, HPSEB – 2.47%, Punjab – 21.43%,
- Rajasthan – 7.47%, Chandigarh – 0.53%, Delhi – 20.77%,
- U.P. – 14.73%, J&K – 7.00% and Unallocated – 9.93%. 
NATHPA JHAKRI HYDRO ELECTRIC PROJECT

NET PROFIT

Rs. in Crores

YEAR

2004-05 2005-06

298.42 495.18

YEAR

NET PROFIT

2004-05

2005-06
SATLUJ BASIN - SILT DATA
SILT LOAD IN RIVER SATLUJ
CATCHMENT AREA CHARACTERISTICS

- RIVER SATLUJ HAS A CATCHMENT OF 49,820 SQ. KM AT NATHPA
- 12,920 SQ. KM IS IN INDIA AND 36,900 SQ. KM IN TIBET/CHINA
- BECAUSE OF FRAGILE GEOLOGY AND STEEP SLOPES, SOIL EROSION RATE IS HIGH DURING SNOWMELT
- RIVER BLOCKADE ON ACCOUNT OF AVALANCHEs AND LANDSLIDES ARE COMMON BECAUSE OF STEEP BANKS
- WHEN THESE BLOCKADES GIVE WAY FLASH FLOODS ARE CAUSED AND SILT CONCENTRATION INCREASES BECAUSE OF INCREASED EROSION
SILT LOAD IN RIVER SATLUJ- CONTD.
VIEW OF SLOPE DEPOSITS ON RIGHT BANK OF SPITI RIVER BETWEEN LOSAR & PIN-SPITI CONFLUENCE
SILT LOAD IN RIVER SATLUJ- CONTD.
VIEW OF DEPOSITS ON LEFT BANK OF SPITI RIVER BETWEEN LOSAR & PIN-SPITI CONFLUENCE
A view of lake formation due to Maling slide (80 km u/s Nathpa Dam)
A view of wide valley & fan deposits of Spiti river, d/s of Pooh village near Khab.
A view of glacial deposits on left bank of Satluj river, d/s of Morang (67 km u/s of Nathpa Dam)
A view of river terrace deposits along Satluj river between Jangi & Akpa (located at 58km & 70 km u/s of Nathpa Dam)
Satellite Imagery of Satluj Catchment Area (Parechu lake)

(Source: Hindustan Times 19.8.2004)
Satluj Catchment topography in Tibet region
Satluj Catchment topography in Tibet region
Satluj Catchment topography in Tibet region
Satluj Catchment topography in Tibet region
Satluj Catchment topography in Tibet region
<table>
<thead>
<tr>
<th>S. NO.</th>
<th>YEAR</th>
<th>PPM &lt;1000</th>
<th>PPM 1000 To 2000</th>
<th>PPM 2001 TO 4000</th>
<th>PPM 4001 TO 5000</th>
<th>PPM &gt;5000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1971</td>
<td>279</td>
<td>45</td>
<td>40</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1972</td>
<td>292</td>
<td>67</td>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1973</td>
<td>214</td>
<td>48</td>
<td>82</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>1974</td>
<td>303</td>
<td>56</td>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1975</td>
<td>251</td>
<td>58</td>
<td>45</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>1976</td>
<td>305</td>
<td>39</td>
<td>19</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1977</td>
<td>320</td>
<td>25</td>
<td>15</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>1978</td>
<td>313</td>
<td>41</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>1979</td>
<td>306</td>
<td>27</td>
<td>19</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1980</td>
<td>305</td>
<td>29</td>
<td>20</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>1981</td>
<td>312</td>
<td>33</td>
<td>14</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>1982</td>
<td>285</td>
<td>2</td>
<td>27</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>13</td>
<td>1983</td>
<td>261</td>
<td>36</td>
<td>64</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>1984</td>
<td>315</td>
<td>49</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
## SUSPENDED SEDIMENT LOAD
**PPM RANGE FOR THE NUMBER OF DAYS**

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>YEAR</th>
<th>PPM &lt;1000</th>
<th>PPM 1000 To 2000</th>
<th>PPM 2001 TO 4000</th>
<th>PPM 4001 TO 5000</th>
<th>PPM &gt;5000</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>1985</td>
<td>315</td>
<td>43</td>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>1986</td>
<td>282</td>
<td>47</td>
<td>17</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>17</td>
<td>1987</td>
<td>339</td>
<td>21</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>1988</td>
<td>341</td>
<td>20</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>1989</td>
<td>301</td>
<td>38</td>
<td>25</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>1990</td>
<td>304</td>
<td>51</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>21</td>
<td>1991</td>
<td>263</td>
<td>58</td>
<td>37</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>1992</td>
<td>322</td>
<td>38</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>23</td>
<td>1993</td>
<td>336</td>
<td>23</td>
<td>5</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>1994</td>
<td>246</td>
<td>45</td>
<td>54</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>25</td>
<td>1995</td>
<td>283</td>
<td>69</td>
<td>11</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>26</td>
<td>1996</td>
<td>267</td>
<td>67</td>
<td>28</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Average Days</strong></td>
<td></td>
<td><strong>293.58</strong></td>
<td><strong>42.23</strong></td>
<td><strong>22.33</strong></td>
<td><strong>3.81</strong></td>
<td><strong>3.43</strong></td>
</tr>
<tr>
<td>S.NO.</td>
<td>YEAR</td>
<td>PPM 2001 TO 4000</td>
<td>PPM 4001 TO 5000</td>
<td>PPM &gt;5000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>------------------</td>
<td>------------------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1997</td>
<td>29</td>
<td>10</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1998</td>
<td>33</td>
<td>12</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1999</td>
<td>43</td>
<td>9</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2000</td>
<td>64</td>
<td>21</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2001</td>
<td>39</td>
<td>8</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2002</td>
<td>35</td>
<td>7</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2003</td>
<td>22</td>
<td>11</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>37.85</td>
<td>11.14</td>
<td>16.14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SILT LOAD DATA OF RIVER SATLUJ OBSERVED AT WANGTU BRIDGE (2004 TO 2006)

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>YEAR</th>
<th>PPM 2001 TO 4000</th>
<th>PPM 4001 TO 5000</th>
<th>PPM &gt;5000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2004</td>
<td>17</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>2005</td>
<td>23</td>
<td>8</td>
<td>53</td>
</tr>
<tr>
<td>3</td>
<td>2006</td>
<td>43</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>27.66</strong></td>
<td><strong>6.00</strong></td>
<td><strong>31.00</strong></td>
</tr>
</tbody>
</table>
The maximum and minimum range of fractions for the years 1970 to 1996 is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Coarse %</th>
<th>Medium %</th>
<th>Fine %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max.</td>
<td>28.00</td>
<td>36.67</td>
<td>85.00</td>
</tr>
<tr>
<td>Min.</td>
<td>5.00</td>
<td>10.00</td>
<td>42.00</td>
</tr>
<tr>
<td>Average</td>
<td>15.72</td>
<td>22.36</td>
<td>61.92</td>
</tr>
</tbody>
</table>

However, during the recent period there is considerable increase in coarse fraction as can be seen from the data prior to and after the Parechu flood of 26th June, 2005 shown in next Slide.
### SILT LOAD IN RIVER SATLUJ- CONTD.

**GRADATION OF SUSPENDED SILT LOAD**

**PERCENTAGE OF COARSE, MEDIUM AND FINE FRACTIONS IN SUSPENDED SEDEMENTS- AS OBSERVED RECENTLY IN SATLUJ AT NATHPA**

<table>
<thead>
<tr>
<th>DATE</th>
<th>COARSE</th>
<th>MEDIUM</th>
<th>FINE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.06.05 TO</td>
<td>21.9%</td>
<td>33.5%</td>
<td>44.6%</td>
<td>BEFORE FLOOD</td>
</tr>
<tr>
<td>22.06.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.06.05 TO</td>
<td>32.7%</td>
<td>25.1%</td>
<td>42.2%</td>
<td>IMMEDIATE AFTER FLOOD</td>
</tr>
<tr>
<td>30.06.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.07.05</td>
<td>23%</td>
<td>33%</td>
<td>44%</td>
<td>20 DAYS AFTER FLOOD</td>
</tr>
<tr>
<td>08.08.06</td>
<td>20%</td>
<td>35%</td>
<td>45%</td>
<td>--</td>
</tr>
</tbody>
</table>
CHANGING TREND OF SILT INFLOW - SOME DATA

YEAR 2005 (AFTER PARECHU BREACH)

<table>
<thead>
<tr>
<th>DATE</th>
<th>KHAB</th>
<th>POWARI</th>
<th>NATHPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.07.05</td>
<td>7,214</td>
<td>-</td>
<td>25,416</td>
</tr>
<tr>
<td>05.07.05</td>
<td>4,171</td>
<td>9,186</td>
<td>10,456</td>
</tr>
<tr>
<td>11.07.05</td>
<td>-</td>
<td>9,597</td>
<td>8,822</td>
</tr>
<tr>
<td>13.07.05</td>
<td>4,643</td>
<td>10,800</td>
<td>9,085</td>
</tr>
<tr>
<td>21.07.05</td>
<td>2,143</td>
<td>4,119</td>
<td>5,747</td>
</tr>
<tr>
<td>27.07.05</td>
<td>1,357</td>
<td>3,995</td>
<td>4,647</td>
</tr>
<tr>
<td>30.07.05</td>
<td>2,500</td>
<td>4,989</td>
<td>5,210</td>
</tr>
</tbody>
</table>

GENERAL TREND WAS INCREASING SILT LOAD FROM KHAB TO NATHPA, BECAUSE OF DISTABILISATION OF BANKS AND RECONSTRUCTION OF ROAD ACTIVITY
### YEAR 2006

<table>
<thead>
<tr>
<th>YEAR 2006</th>
<th>KHAB</th>
<th>POWARI</th>
<th>NATHPA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SATLUJ</td>
<td>SPITI</td>
<td>TOTAL</td>
</tr>
<tr>
<td>31.7.06</td>
<td>14,686</td>
<td>3,252</td>
<td>9,374</td>
</tr>
<tr>
<td>01.8.06</td>
<td>24,843</td>
<td>2,776</td>
<td>15,368</td>
</tr>
<tr>
<td>02.8.06</td>
<td>13,695</td>
<td>2,662</td>
<td>8,948</td>
</tr>
<tr>
<td>03.8.06</td>
<td>30,804</td>
<td>3,781</td>
<td>19,126</td>
</tr>
<tr>
<td>04.8.06</td>
<td>26,641</td>
<td>8,175</td>
<td>18,792</td>
</tr>
<tr>
<td>05.8.06</td>
<td>23,790</td>
<td>7,328</td>
<td>16,610</td>
</tr>
</tbody>
</table>

**GENERAL TREND WAS THAT MOST SILT CAME AT KHAB FROM SATLUJ (TIBET SIDE) AND CONCENTRATIC REDUCED TOWARDS NATHPA**
## SILT LOAD IN RIVER SATLUJ- CONTD.

### PETROGRAPHIC ANALYSIS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Constituent</th>
<th>Hardness</th>
<th>Operation stage</th>
<th>Average %</th>
<th>Average %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>On Mohr’s Scale</td>
<td>July - August ,04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Quartz</td>
<td>7</td>
<td>Angular to Subangular</td>
<td>68.94</td>
<td>53.81</td>
</tr>
<tr>
<td>2.</td>
<td>Feldspar</td>
<td>6</td>
<td>Prismatic</td>
<td>0.78</td>
<td>6.70</td>
</tr>
<tr>
<td>3.</td>
<td>Muscovite</td>
<td>2.2 .5</td>
<td>Elongated Flaky</td>
<td>9.06</td>
<td>5.53</td>
</tr>
<tr>
<td>4.</td>
<td>Biotite</td>
<td>2.5 -3</td>
<td>Elongated Flaky</td>
<td>8.52</td>
<td>16.37</td>
</tr>
<tr>
<td>5.</td>
<td>Hornblende</td>
<td>5.6</td>
<td>Subangular to subrounded</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Tourmaline</td>
<td>7 -7.5</td>
<td>Angular to Subangular</td>
<td>3.88</td>
<td>2.89</td>
</tr>
<tr>
<td>7.</td>
<td>Chlorite</td>
<td>1.5 –2.5</td>
<td>Angular to subangular</td>
<td>2.18</td>
<td>4.63</td>
</tr>
<tr>
<td>8.</td>
<td>Garnet/ Augite Garnet</td>
<td>6.5 –7.5</td>
<td>Subangular to subrounded</td>
<td>1.26</td>
<td>3.28</td>
</tr>
<tr>
<td>9.</td>
<td>Zircon</td>
<td>7.5</td>
<td>Angular to subangular</td>
<td>2.16</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Ruttle</td>
<td>6 – 6.5</td>
<td>Subangular to subrounded</td>
<td>0.90</td>
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<tr>
<td>11.</td>
<td>Opaques</td>
<td></td>
<td>Angular to subangular</td>
<td>1.06</td>
<td>3.97</td>
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<tr>
<td>12.</td>
<td>Rock Fragments</td>
<td></td>
<td>Angular to subangular</td>
<td>0.94</td>
<td>2.82</td>
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</table>
# PROJECT FACING REGULAR DAMAGE DUE TO EXCESSIVE SILT

<table>
<thead>
<tr>
<th>Project</th>
<th>Capacity (MW)</th>
<th>Head (M)</th>
<th>Speed (RPM)</th>
<th>Turbine</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baira Siul</td>
<td>3 X 60</td>
<td>240</td>
<td>375</td>
<td>Francis</td>
<td>A</td>
</tr>
<tr>
<td>Maneri Bhali I</td>
<td>3 X 30</td>
<td>180</td>
<td>428.6</td>
<td>Francis</td>
<td>A</td>
</tr>
<tr>
<td>Chilla</td>
<td>4 X 36</td>
<td>32.5</td>
<td>187.5</td>
<td>Kaplan</td>
<td>B</td>
</tr>
<tr>
<td>Dehar</td>
<td>6 X 165</td>
<td>282</td>
<td>300</td>
<td>Francis</td>
<td>B</td>
</tr>
<tr>
<td>Giri</td>
<td>2 X 30</td>
<td>147.5</td>
<td>428.6</td>
<td>Francis</td>
<td>B</td>
</tr>
<tr>
<td>Lower Lagyap</td>
<td>2 X 6.3</td>
<td>530.5</td>
<td>1000</td>
<td>Pelton</td>
<td>B</td>
</tr>
<tr>
<td>Kosi</td>
<td>4 X 4.8</td>
<td>6.1</td>
<td>93.8</td>
<td>Bulb</td>
<td>B</td>
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</table>
### Project Capacity

<table>
<thead>
<tr>
<th>Project</th>
<th>Capacity (MW)</th>
<th>Head (Mtrs.)</th>
<th>Speed (RPM)</th>
<th>Turbine</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chibro</td>
<td>4 X 60</td>
<td>110</td>
<td>250</td>
<td>Francis</td>
<td>B</td>
</tr>
<tr>
<td>Dhakrani</td>
<td>3 X 11.25</td>
<td>19.8</td>
<td>187.5</td>
<td>Kaplan</td>
<td>B</td>
</tr>
<tr>
<td>Salal</td>
<td>6 X 115</td>
<td>102</td>
<td></td>
<td>Francis</td>
<td>A</td>
</tr>
<tr>
<td>Nathpa Jhakhri</td>
<td>6 X 250</td>
<td>493</td>
<td>300</td>
<td>Francis</td>
<td>A</td>
</tr>
</tbody>
</table>

PROJECT FACING REGULAR DAMAGE DUE TO EXCESSIVE SILT
MEASURES FOR SILT EXCLUSION
MEASURES FOR SILT EXCLUSION ADOPTED AT NATHPA

DESILTING ARRANGEMENT

CHECKED FOR REMOVAL OF PARTICLE 0.2 MM AND ABOVE

SILT LOAD AT INLET CHECKED : 5000 PPM

FLOW THROUGH VELOCITY : 0.3 M/SEC

FLUSHING CONDUITS IN EACH CHAMBER -

- 3 NOS. FOR COARSE, MEDIUM AND FINE SEDIMENT VELOCITY - 3 - 3.75 M/SEC

SILT FLUSHING TUNNEL AND BRANCHES :

FREE FLOW

VELOCITY 30 -3.5 M/SEC

SIZE OF SFT : 5.88 X 7.44 M, D-SHAPED

1.66 KM LONG CUT AND COVER

1.5 KM LONG
MEASURES FOR SILT EXCLUSION ADOPTED AT NATHPA

DE SILTING ARRANGEMENT

FIG. 2— LAYOUT PLAN OF DESILTING COMPLEX
MEASURES FOR SILT EXCLUSION ADOPTED AT NATHPA

EFFICIENCY OF DESILTING ARRANGEMENT

HYDRAULIC MODEL STUDIES AT CWPRS

<table>
<thead>
<tr>
<th>SIZE OF PARTICLES</th>
<th>SETTLING EFFICIENCY ON MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>COARSE (&gt; 0.2 MM)</td>
<td>90%</td>
</tr>
<tr>
<td>MEDIUM (0.075 TO 0.2 MM)</td>
<td>32%</td>
</tr>
<tr>
<td>FINE (&lt; 0.075MM)</td>
<td>22%</td>
</tr>
</tbody>
</table>

OVERALL EFFICIENCY: ON MODEL 37%
ON PROTOTYPE 40%

CONDUITS CAN FLUSH PARTICLE UPTO 60 MM SIZE

SILT CONCENTRATION IN MODEL

<table>
<thead>
<tr>
<th>AT INLET</th>
<th>1ST CONDUIT</th>
<th>2ND CONDUIT</th>
<th>3 CONDUIT</th>
<th>IN HRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>18.500</td>
<td>8,500</td>
<td>5,700</td>
<td>3,100</td>
</tr>
</tbody>
</table>
### NECESSITY OF FLUSHING

- To prevent siltation of live and dead storage of reservoir and to restrict entry of sediments into intake.

### PROVISION MADE

- Low level spillway with 5 radial gates. River is allowed in free flow conditions once or more each year. During past 2006 season weekly flushings were carried out.

### EFFECTIVENESS

- Effectiveness being a short reservoir with narrow valley, sediments flushing is very effective. As per hydraulic model, 2.5 MCM of sediments can be flushed out in one day with 1500 cumec discharge.
SILT PROBLEM EXPERIENCED
(Performance of generating units under high silt load)

First year of operation

- Upper Limit for power generation - 5000 PPM
- All runner (except 2, with plasma nitriding) and all other under water parts were uncoated
- Heavy damage at the end of monsoon season to all runners, guide vanes, cheek plates and labyrinth seals regardless of plasma coating

Second year of operation

- All units refurbished (during Sep-2004 to April-2005)
- In view of failure of plasma coating, HVOF type tungsten carbide coating provided to some components in unit 4, 5 & 6
- Performance of unit 5 and 6 with reference to silt load was much better because the upper and lower cheek plates, guide vanes, sealing ring were either coated or new. The performance of HVOF coated parts improved by 80-90%.
### SILT PROBLEM EXPERIENCED - CONTD.

**(PERFORMANCE OF GENERATING UNITS UNDER HIGH SILT LOAD)**

#### SILT PASSING THROUGH UNITS

<table>
<thead>
<tr>
<th></th>
<th>AVERAGE PPM IN A MONTH (JUN- AUG)</th>
<th>AVERAGE SILT LOAD IN A MONTH (JUN-AUG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>As per data supplied to manufacturer</td>
<td>932</td>
<td>2.13 MT</td>
</tr>
<tr>
<td>In actual operation</td>
<td>838</td>
<td>1.92 MT</td>
</tr>
<tr>
<td>Yr 2004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yr 2005</td>
<td>2035</td>
<td>4.65 MT</td>
</tr>
</tbody>
</table>

#### QUARTZ CONTENT IN SILT

<table>
<thead>
<tr>
<th></th>
<th>As per historical data</th>
<th>As per latest observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38 %</td>
<td>52 - 65 %</td>
</tr>
</tbody>
</table>

As against the originally anticipated amount of 4.5 lacs MT of silt load in 3312 hours of operation. Silt load upto 5.3 MT and 8.5 MT has passed the turbines in year 2004 and 2005 respectively in lesser number of operation hours.
DAMAGES TO UNDER WATER PARTS
EROSION AFTER 1492 HOURS OF OPERATION,
SILT LOAD PASSED THROUGH RUNNER 6.1 LAC TONS
UNIT NO. 6

EROSION AFTER 1692 HOURS OF OPERATION, SILT LOAD PASSED THROUGH TURBINE 8.1 LAC TONS
DAMAGES BY SILT - EXPERIENCED AT NJPS

NEW RUNNER
DAMAGES BY SILT - EXPERIENCED AT NJPS

RUNNER WITH CRACKED VANES AT OUTLET 2004

ERODED RUNNER 2005
DAMAGES BY SILT - EXPERIENCED AT NJPS

UNCOATED REPAIRED RUNNERS 2005
DAMAGES BY SILT - EXPERIENCED AT NJPS

Soft Coated Runner
2005

Eroded soft coated runner after high silt season
DAMAGES BY SILT - EXPERIENCED AT NJPS

Hard coated Guide Vane
DAMAGES BY SILT - EXPERIENCED AT NJPS

Coated Guide apparatus after erosion Nov. 2005 (Guide Vane, Cheek Plate & Wear Ring)

Coated Guide apparatus (new) being assembled at site Oct. 2006 (Guide Vane, Cheek Plate & Wear Ring)
DAMAGES BY SILT - EXPERIENCED AT NJPS

Coated guide vane after erosion

Coated guide vane after erosion
DAMAGES BY SILT- EXPERIENCED AT NJPS

Cheek plate GV Bush & Turbine cover sleeve after erosion Dec. 2005

Cheek plate GV Bush & Turbine cover sleeve (new) being assembled at site Oct. 2006
New Uncoated upper labyrinth seals Oct. 2005

New Hard Coated Upper Labyrinth Seal Oct. 2006
DAMAGES BY SILT - EXPERIENCED AT NJPS

Hard Coated Upper Labyrinth seal after erosion Oct. 2006

Uncoated Upper Labyrinth seal after erosion Nov. 2005
New Guide vane Bushes (Lower)

Eroded Guide Vane Bushes (Lower)
DAMAGES BY SILT - EXPERIENCED AT NJPS

New coated cheek plate  
Oct. 2006

Uncoated cheek plate after erosion Dec. 2005
Coated lower labyrinth seal after erosion Oct. 2006

Coated lower labyrinth seal after erosion Dec. 2005

DAMAGES BY SILT-EXPERIENCED AT NJPS
DURING HIGH FLOOD SEASON OF 2005, HIGH SILT CONCENTRATION IN RIVER PERSISTED FOR LONG TIME.

WHEN SILT LOAD IN RIVER WAS 7000 PPM, 1 OR 2 UNITS WERE RUN WITH 4 CHAMBERS TO ACHIEVE HIGHER SETTLING EFFICIENCY OF CHAMBERS ON TRIAL BASIS.

BECAUSE OF LOW VELOCITIES IN THE INTAKE AREA AND CONSEQUENTIAL SILT DEPOSITION, THERE WAS PROBLEM IN INTAKE GATE OPERATION. ALSO THERE WAS DEPOSITION IN HRT WHICH CAME INTO SUSPENSION ONCE MORE UNITS CAME INTO OPERATION.

THEREFORE GENERALLY NOT LESS THAN THE 4 UNITS SHOULD BE RUN DURING HIGH FLOW SEASON.
PARAMETERS FOR THE LIMITS FOR SAFE RUNNING OF POWER PLANT

- ORIGINALLY AN UPPER LIMIT OF 5000 PPM AT INTAKE WAS ADOPTED FOR DESIGN OF DESILTING CHAMBERS
- KEEPING IN VIEW THE SILT DAMAGE AND THE PERFORMANCE OF UNITS THE FOLLOWING LIMITS HAVE NOW BEEN PROPOSED/DECIDED
  i. AN UPPER LIMIT OF 2000 PPM IN THE DRAFT TUBE (BASED UPON THE RECOMMENDATION OF TEAM OF CEA)
  ii. AN UPPER LIMIT OF 3500 PPM. FOR WATER DRAWN AT INTAKE. CORRESPONDING SILT LEVEL IN RIVER WOULD BE 4000 PPM.
  iii. AN UPPER LIMIT OF 600 PPM OF COARSE PARTICLES OF SIZE 0.2 mm AND ABOVE AT INTAKE
PARAMETERS FOR THE LIMITS FOR SAFE RUNNING OF POWER PLANT- CONT'D.

- The limit for total silt load passing through a coated runner has been fixed at 7 LAC. tonnes, which would be reviewed after one year of actual performance.

  (This limit for uncoated runner was 4 LAC. tonnes.)

- Parent material used in turbine components is 13/4 & 16/5 nickel-chromium steel. A new material 21-4 Nitronic steel (C-0.5, Cr- 0.21, Ni- 4, N-0.4%) developed by IIT Roorkee, has higher hardness and UTS & better erosion resistance is being tried on one cheek plate on trial basis.
MAJOR IMPROVEMENT IN CONTROLLING WEAR OF UNDER WATER TURBINE PARTS ACHIEVED BY PROVIDING HVOF COATING.

DURING 2005-2006 SEASON 7.5-8.0 LAC MT OF SILT HAS SAFELY PASSED THROUGH TURBINES WITH 300 MICRONS HVOF COATING INSTEAD OF ABOUT 3.5 LAC MT FOR UNCOATED PARTS.

FOR NEXT SEASON 500 MICRON COATING IS PLANNED TO HANDLE SILT UPTO 10 LAC MT OR MORE.

POSSIBILITY OF PROVIDING COATING UP TO 1 MM IN FUTURE IS ALSO BEING EXPLORED.

FACILITY FOR HP HVOF COATING IS BEING SET UP AT SITE.
DUE TO HEAVY SILT LOAD IN RIVER SATLUJ AFTER PARECHU LAKE BREACH ON 26.06.2005, SJVNL IS CONSTANTLY EXPERIMENTING AND EXPLORING ADDITIONAL MEASURES FOR SILT MANAGEMENT ON SHORT MEDIUM AND LONG TERM BASIS

OPINION OF MANY EXPERTS HAVE BEEN OBTAINED ON THIS SUBJECT.
COMMITTEE OF EXPERTS ON SILT MANAGEMENT

CONSTITUTED BY SJVNL (AS PER THE DECISION TAKEN DURING THE MEETING HELD WITH SECRETARY (POWER), GOI ON JULY 15, 2005

MEMBERS

- DR. P R RAO, RETD. CHIEF ENGINEER (CWC)
- PROF. R.J. GARDE, RETD. PROFESSOR CIVIL ENGINEER (IIT, ROORKEE)
- DR M S REDDY, EX-SECY, WATER RESOURCES, GOI.
- SH. V K KULKARNI, RETD. JOINT DIRECTOR, CWPRS, PUNE.
- DR M K MITTAL, PROFESSOR, CIVIL ENGINEERING DEPTT, IIT, ROORKEE.
- SH. P B DEOLALIKAR, JOINT DIRECTOR, CWPRS, PUNE.
- SH. RANJODH SINGH, EXECUTIVE DIRECTOR, SJVNL (RETD.)
SHORT TERM
- EXPERIMENT WITH RESERVOIR OPERATION- OPTIMISATION OF GATE OPERATION ADVISED BY STUDY ON MODEL AND PROTOTYPE.

MEDIUM TERM
- BLANK PANEL- PROVISION OF BLANK PANEL OF HEIGHT 3.2M BY WELDING STEEL PLATE TO BOTTOM WITH TRASHRACK PANEL
- DREDGING PUMPS AT INTAKE- RECOMMENDED FOR SILT REMOVAL NEAR INTAKE GATE

LONG TERM
- STORAGE DAMS- USEFULNESS OF STORAGE DAM AT KHAB AND OTHER PLACES HAS BEEN HIGHLIGHTED
- CATHEMEMENT AREA TREATMENT- TO REDUCE BANK EROSION
- NEW DIVERSION TUNNEL- PRELIMINARY STUDY INDICATES IT IS BENEFICIAL, FURTHER MODEL STUDIES & DETALING OF PROPOSAL HAS BEEN ADVISED.
MULTI-DISCIPLINARY TASK FORCE (MDTF) ON PROBLEMS OF SILT EROSION & REMEDIAL MEASURES FOR NATHPA JHAKRI POWER STATION

CONSTITUTED BY MINISTRY OF POWER (VIDE O/O NO. 13/31/2002-H-II DATED 5.11.2004)

CHAIRMAN -- MEMBER (HYDRO), CEA

MEMBERS

1. CHIEF ENGINEER (CENTRAL WATER COMMISSION)
2. EXECUTIVE DIRECTOR (BHARAT HEAVY ELECTRICALS LTD.)
3. SCIENTIST – G& HEAD, MATERIAL S&T DIVISION, NATIONAL METALLURGICAL LAB. (NML)
4. DIRECTOR (GEOLOGICAL SURVEY OF INDIA)
5. GENERAL MANAGER (PROJECT), SJVNL
REMEDIAL MEASURES SUGGESTED BY MDTF FOR NJHEP

SHORT TERM

1. HARD COATING ON UNDERWATER PARTS.
2. MODIFICATION IN PROFILE OF RUNNER AT INLET
3. MAINTAINING ADEQUATE INVENTORY OF TURBINE COMPONENTS PRONE TO EROSION.
4. DEVELOPMENT OF NEW SILT EROSION RESISTANT MATERIALS.
5. RESERVOIR FLUSING IN VERY HIGH SILT CONDITION.
6. REGULAR ECO SOUNDING AT THE INTAKE.
7. TO STOP THE MACHINES WHEN THE SILT IN RIVER WATER EXCEED 4000 PPM OR 2000 PPM LEAVING DRAFT TUBE.
8. OPERATION OF COATED MACHINE DURING THE SUMMER AND MONSOON MONTHS MAY BE PLANNED IN A MANNER THAT SILT LOAD OF 6.5 LAKH MT DOES NOT EXCEED IN ANY OF THE MACHINES DURING THE PERIOD FROM MAY TO SEPTEMBER.
9. COMMISSIONING OF ON-LINE SILT MONITORING SYSTEM.
**LONG TERM**

a) PROCUREMENT OF COATED SPARES RUNNERS WITH LATEST COATING (SXH 70) WITH EROSION GUARANTEES FROM THE SUPPLIER.

b) RAISING OF DAM HEIGHT.

c) TO CARRY OUT HYDRAULIC MODEL STUDY TO ASSERTAIN THE IMPROVEMENT IN PERFORMANCE BY PROVIDING A NEW DIVERSION TUNNEL/U/S OF NATHPA DAM.

d) CONSTRUCTION OF STORAGE DAM AT KHAB & JANGI ON MAIN SATLUJ RIVER U/S OF NATHPA DAM.

e) CATCHMENT AREA TREATMENT OF THREE TRIBUTARIES ALREADY IDENTIFIED BY SJVN MAY BE COMPLETED AT THE EARLIEST.

f) NALLAHS CONTRIBUTING MAJOR QUARTZIT SILT CONTENT MAY BE IDENTIFIED & CONSTRUCT CHECK DAMS AFTER FEASIBILITY STUDIES.

g) SETING UP SMALL PROTO-TYPE FRANCIS TURBINE FUTURE HYDRO STATION HAVING HIGH SILT. FUNDS CAN BE ARRANGED BY GOVT OF INDIA UNDER R&R
ADDITIONAL MEASURES FOR SILT CONTROL – CONTD.
UNDER CONSIDERATION

OPINION OF EXPERTS

JOINT RECOMMENDATIONS OF CEA, BBMB & SJVN

THE PROBLEM HAS BEEN DELIBRATED JOINTLY BY SJVNL, BBMB AND CEA AND PROPOSAL PUT UP TO MOP i.e.

1) DEFINING UPPER LIMITS OF SILT FOR POWER GENERATION

2) WEEKLY FLUSHING OF RESERVOIR FOR MINIMISING SILT ENTRY INTO POWER INTAKES

3) OPTIMISING OF GATE/RESERVOIR OPERATION
ADDITIONAL MEASURES FOR SILT CONTROL – CONTD.

UNDER CONSIDERATION

OPINION OF WORLD BANK EXPERT

MR. DENIEL J. GUNARATNAM VISITED NJHEP AND SUBMITTED A REPORT DATED 2.01.2006

RECOMMENDATIONS ARE AS FOLLOW :-

1) THE WEAR VULNERABLE PARTS BE COATED WITH WEAR RESISTANT COATINGS

2) CATCHEMENT AREA TREATMENT TO PREVENT SILT LOADING WHEREVER POSSIBLE
ADDITIONAL MEASURES FOR SILT CONTROL – CONTD.
UNDER CONSIDERATION

FORUM OF HYDRO POWER PRODUCERS OF SATLUJ BASIN

• INITIATED BY SJVNL

MEMBER ORGANISATION

1. NATIONAL THERMAL POWER CORPORATION
2. BHAKRA BEAS MANAGEMENT BOARD
3. HIMACHAL PRADESH STATE ELECTRICITY BOARD
4. JAIPRAKASH HYDRO POWER LTD.
5. NUZIVEEDU SEEDS LTD.
6. HIMACHAL SORANG PVT. LTD.
7. SATLUJ JAL VIDYUT NIGAM LTD.
ADDITIONAL MEASURES FOR SILT CONTROL – CONTD.
UNDER CONSIDERATION
FORUM OF HYDRO POWER PRODUCERS OF SATLUJ BASIN

OBJECTIVES:

1. ENVIRONMENT - TO EVOLVE INTEGRATED CATCHMENT AREA TREATMENT PLAN

2. OPERATION OF POWER STATIONS & SHARING OF TECHNICAL EXPERTISE AND EXPERIENCE.

3. DATA SHARING – SHARE FACILITIES TO GENERATE INPUT DATA I.E. DISCHARGE DATA, SILT DATA ETC.

4. DISASTER MANAGEMENT AND PLANNING – TO DEVELOP AND IMPLEMENT EFFECTIVE FLOOD FOREWARNING AND DISASTER MANAGEMENT SYSTEMS.

5. COMMON ISSUES WITH STATE GOVERNMENT AND GOVERNMENT OF INDIA.
OBJECTIVES IS TO MINIMIZE SILT ENTRY INTO INTAKES AND ALSO MINIMIZE THE NO. OF RESERVOIR FLUSHING OPERATION BY SUITABLE GATE OPERATION

THE FOLLOWING IS ADOPTED

i. WHEN INFLOW IS MARGINALLY IN EXCESS OF DESIGN DISCHARGE OPERATE GATES CLOSE TO INTAKE TO KEEP AREA FREE FROM SILT DEPOSITION

ii. WHEN INFLOW IS HIGH, EXCESS WATER BE RELEASED UNIFORMLY THROUGH ALL SLUICES

iii. WHEN INFLOW IN RIVER IS NOT VERY HIGH AND SILT CONCENTRATION IS ALSO LOW (UPTO 3000 ppm.) RESERVOIR LEVEL WILL BE MAINTAINED CLOSE TO MDDL TO MINIMISE RESERVOIR FLUSHINGS
ANOTHER ALTERNATIVE TO OPERATE GATES FURTHEST FROM INTAKE VIZ-A-VIZ (i) ABOVE SHALL ALSO BE STUDIED

THE FINAL SELECTION WOULD BE TRADE OFF BETWEEN THE SILT DRAWN INTO INTAKE AND NO. OF RESERVOIR FLUSHING REQUIRED

THE TRIAL IS BEING CARRIED OUT ON HYDRAULIC MODEL UNDER PREPARATION AT CWPRS, PUNE AND ON PROTOTYPE.
SJVNL PLANS TO CONSTRUCT A DIVERSION TUNNEL FROM 750 M U/S OF NATHPA DAM AXIS TO D/S OF DAM

OBJECTIVES IS TO DIVERT EXCESS WATER UPTO 1000 CUMECS, WITHOUT OPERATING SLUICE GATES, SO THAT TRANQUIL CONDITIONS ARE CREATED IN FRONT OF INTAKE

SO THAT:
(a) SILT ENTERING INTAKE IS MINIMUM
(b) RESERVOIR FLUSHING ARE LESS FREQUENT

( MODEL STUDIES ARE IN PROGRESS)
STORAGE DAM PROPOSED
i. AT KHAB (2 KM D/S OF CONFLUENCE OF SATLUJ AND SPITI)
ii. AT RIBBA DOWNSTREAM OF JANGI ON SATLUJ
iii. TWO STORAGE DAMS ON SPITI NEAR ‘RANGRIK’ AND ‘POOH’ VILLAGES

KHAB DAM (PREFEASIBILITY REPORT PREPARED FOR 1020 MW PROJECT)

i. HEIGHT OF DAM: 275 METERS
ii. GROSS STORAGE: 625 MCM
iii. LIVE STORAGE: 264 MCM
iv. SILT STORAGE: 340 MCM (FOR 28 YEARS)
v. DEDICATED CAPACITY FOR FLOODS 95 MCM

BENEFITS:
- POWER GENERATION, FLOOD CONTROL
- REDUCTION TO SILT DAMAGES
- INCREASE OF GENERATION AND LIFE OF ALL PROJECTS DOWNSTREAM OF KHAB

ADDITIONAL MEASURES FOR SILT CONTROL UNDER CONSIDERATION – CONT'D.
(STORAGE DAM ON RIVER SATLUJ AND SPITI)
\[\text{(CATCHMENT AREA TREATMENT)}\]

- CATCHMENT AREA TREATMENT INCLUDING VEGITATION COVER AND SOIL CONSERVATION WHICH IS ALSO OTHERWISE NEEDED FOR SUSTAINABLE DEVELOPMENT OF REGION, WOULD GREATELY RESULT IN REDUCTION OF SILT LOAD

- SJVNL’S FIRST CONCERN IS ABOUT THE BANK EROSION TAKING PLACE UPSTREAM OF NATHPA AND IS FIRMING UP PROPOSALS

- CATCHMENT AREA TREATMENT PLAN INITIATED WITH HP FOREST DEPARTMENT AND WORK AT SOME SITES STARTED

- SITES HAVE BEEN IDENTIFIED FOR PROTECTION WORKS, RETAINING WALLS TO PREVENT BANKS EROSION WITH BRO

- MATTER REGARDING CHECK DAMS ON TRIBUTERIES INITIATED WITH HP GOVERNMENT
i. AS MOST HIMALAYAN RIVERS, LIKE SATLUJ CARRYING HEAVY SILT LOAD, THIS PROBLEM HAS TO BE ADDRESSED MOST EFFECTIVELY IN DESIGN STAGE OF ALL FUTURE PROJECTS

ii. HVOF COATING OF UNDER WATER PARTS HAVE GIVEN GOOD RESULTS AT NJHEP AND COULD BE TRIED ON OTHER PROJECTS WITH SIMILAR PROBLEMS

iii. AN UPPER LIMIT OF 2000 PPM PASSING THROUGH DRAFT TUBES AND A TOTAL QUANTUM OF 7 LAC TONNES OF SILT LOAD, APPEARS TO BE REASONABLE IN CASE OF NJHEP, AT THIS STAGE.

iv. FOR MAXIMISING GENERATION AND MINIMISING SILT DAMAGE IN ANY RIVER BASIN, A JUDICIOUS COMBINATION OF STORAGE AND RUN-OFF THE RIVER PROJECT IS ESSENTIAL. MOTHER STORAGE AT KHAB IS IDEAL FOR SUCCESS OF ALL D/S PROJECTS.

v. THE SHORT AND LONG TERMS MEASURES OUTLINED IN THE PAPER, WHEN FULLY IMPLEMENTED, WILL GREATLY ENHANCE POWER GENERATION AND MINIMISE DAMAGE IN ALL PROJECTS D/S OF KHAB
Thank you