Renovation & Modernisation of Kopili Hydro Electric Plant; NEEPCO

The Background, Execution, hurdles and Performance

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SCOPE COMPLEX : New Delhi
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Kopili Hydro Electric Plant
A Brief Introduction

- First Ever Plant of NEEPCO
- Total Installed Capacity 275 MW
- Located in Meghalaya & Assam
- This plant contributes approx. 20% of Peak Hours requirement of NER Grid
- One of the Cheapest Power (Rs. 1.71 per unit at present)
- Major Industrial venture in one of the remotest corners of India
- Total Project Cost (Revised Initial) = 473.32 Crores
NEEPCO has to go for a Before Time R&M because of Acidic Mine Discharge Issue.

- Since 2006, the reservoir water was found to be highly acidic, with pH Value ranging from 2.8 to 3.5
- Machines are not designed to handle this!
- All components in contact with water were subjected to severe Acidic Corrosion
- Plant almost became non-viable because of Very Low PAF & Generation
- Honourable CERC and the Constituents agreed to premature Renovation & Modernisation
- NEEPCO has no control over the causes of Acidification

**Why Renovation & Modernisation?**

- Problem is Unique in nature
- Threat to human life in case of catastrophic ruptures
- No standard solution available
- Rate of deterioration was very fast
- Loss of Revenue
- Power Scarcity in the region
The Issue of Acidity in KHEP

- CORROSIVE ACTION OF THE ACIDIC WATER OF UNDERWATER METAL PARTS, COOLING SYSTEM HAS LED TO THE INCREASE IN THE NUMBER OF BREAKDOWNS
- CIRCUMSTANCES WARRANT PUTTING THE PLANT IN PART OR FULL HYBERNATION
- EXTENSIVE MODIFICATIONS TO METALLURGY, RE-ENGINEERING OF EQUIPMENT FOR A PERMANENT SOLUTION TO WITHSTAND THE ACIDIC WATER AS RECOMMENDED BY EXPERTS IS A LONG DRAWN PROCESS INVOLVING HUGE DISPROPORTIONATE FINANCIAL AMOUNT
- PROACTIVE ACTION REQD FOR SURVIVAL OF THE UNITS THROUGH MASSIVE REPAIR WORKS OF THE UNDERWATER PARTS WHICH INVOLVED EXPERTS FROM DIFFERENT FIELD, SKILLED MANPOWER & MATERIALS.
- NOT A ROUTINE JOB, MAKESHIFT WORKSHOP TO BE MADE.

Affects of Acidic water

Most Affected Components

1. GUIDE VANES
2. GV BUSHING & BUSH HOUSING
3. STAY VANES & STAY RING
4. TOP COVER
5. PIVOT RING
6. MIV & BY PASS VALVE
7. COOLER TUBES
8. VH BUTTERFLY VALVES & PIPES
9. COOLING WATER PIPES & VALVES
10. ALL DRAIN LINES
11. SPIRAL CASING
12. DRAFT TUBE LINER & CONES
13. PENSTOCK
14. TUNNEL LINING
15. ALL EMBEDDED PIPES, ETC.

Corrosion in penstock near butterfly valve
Effects

- SPIRAL DRAIN PIPE
- GUIDE VANES
- STAY VANES
- LEAKAGE THRU’ ANCHOR BLOCK
- CORROSION IN STEEL LINER
- VALVES
- TURBINE SHAFT
DEFLECTOR PIPE

LEAKAGE IN VALVE HOUSE

LOWER GV HOUSING

LEAKAGE FROM PIVOT RING
GSI STUDY REVEALS THAT THE SUB-WATER SHEDS ON WESTERN SIDE OF THE KOPILI CATCHMENT AT UPSTREAM OF THE KHANDONG DAM IS THE AREA CONTRIBUTING MOST IN CONTAMINATING WATER IN THE AREA AND MAKING IT ACIDIC.

THUS THE AFORESAID SUB-WATER SHEDS APPEAR TO HAVE ALREADY BECOME ENVIRONMENTAL HOT SPOT OVER AN UNKNOWN PERIOD.

GSI HAS IDENTIFIED UNSCIENTIFIC EXTRACTION OF COAL IN THE CATCHMENT AREA AS PRIMARY REASON FOR ACIDITY.

Here is the link to some further studies !!

http://www.ipublishing.co.in/jesvol1no12010/EIJES2078.pdf
Constraints

- GEOGRAPHICAL REMOTENESS RESULTING IN POOR LOGISTIC SUPPORT.
- ADVERSE LAW & ORDER SITUATION OF THE REGION POSING THREAT & CHALLENGES IN EXECUTION & OPERATION.
- NON AVAILABILITY OF ADEQUATELY SKILLED MAN POWER
- REMOTENESS AND SECURITY RELATED ISSUES ACCOUNTS FOR POOR RESPONSE FROM RESOURCEFUL CONTRACTORS.
- PROLONGED MONSOON IN THE REGION REDUCES NET WORKING TIME.
- SCARCE INDUSTRIAL SUPPORT
R&M of all seven units of KHEP were taken up in phases during 2014-15.

Supply & Erection, Commissioning of R&M was outsourced primarily to BHEL and some other private companies.

However, NEEPCO kept the conceptual designing & planning part of the R&M to itself.

Done under different heads like R&M, Additional Capitalisation, etc.
✓ All Dismantle-able under water parts were converted to Stainless Steel (Primarily ASTM 304 grade)
✓ Stay Ring, Stay Vane, guard Pipe etc. was ‘TILED’ with 3 mm SS Sheets
✓ Draft Tube liner converted to SS
✓ All Cooling water piping and Valves were also converted to SS
✓ Eroded Turbine Shafts were built up with 309L electrode, and then machined to size.
✓ MIV doors were tiled with SS plate
✓ Wherever Possible, slightly smaller size pipes were inserted into embedded pipes
Few Repaired components

Repaired Turbine Shaft

Repairing of Top Cover Sitting Area

Pivot Ring Sitting Area of Stay Ring
Coating of Spiral & Runner

- **HVOF**
- **Locktite Nordbak**
  - brush able ceramic (2 coats of 500-600 micron)

**Inspection of Spiral After One Year of Application of Locktite Coating**
Tunnels

- Tunnels were taken under shutdown for several times
- Localised weld repair and Grouting was tried, but solution was not permanent
- Finally, new ferrules are inserted in vulnerable places and the lining was re-done.
- Slight loss of discharge is anticipated, however, generation is not affected
### Cost due to Acidic Nature of Reservoir Water

<table>
<thead>
<tr>
<th>Power Station</th>
<th>Expenditure in lakhs</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 x 50 MW KOPILI PS</td>
<td>9517.07</td>
<td>Expenditures in O&amp;M nature are not calculated such as procurement of consumables, increase in manpower expenditure, Over time expenditure, rubber goods, generation loss etc.</td>
</tr>
<tr>
<td>2x25 MW KHANDONG PS</td>
<td>2240.78</td>
<td></td>
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<tr>
<td>1X25 MW STAGE II PS</td>
<td>803.33</td>
<td></td>
</tr>
<tr>
<td>HYDRO-MECHANICAL</td>
<td>692.70</td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>13,253.88</strong></td>
<td></td>
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Performance of R&M Activities

- YES- The plant has survived
- Achieved MOU Outstanding generation target in the next year that is 2015-16
- Should achieve outstanding target by January 2017 this year
- Forced Outage due to acidic failures dramatically reduced
- Few more issues still remaining

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<tr>
<th>PARAMETER</th>
<th>BEFORE</th>
<th>AFTER</th>
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<tr>
<td>Average monthly outage due to acidic failures</td>
<td>149:58:38 hours</td>
<td>6:15:00 hrs</td>
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<tr>
<td>Yearly MoU performance</td>
<td>Average to Good (mostly)</td>
<td>Outstanding</td>
</tr>
<tr>
<td>Machine availability</td>
<td>50% - 70%</td>
<td>90 % and above (Excluding Planned Shutdowns)</td>
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Issues remaining after R&M

Cooler Tube failure
- Converting to Closed Loop cooling
- Changing the cooler tube material & Cooling technology

Penstock failures
- Going for major replacement of all critical areas
- Coating

MIV & Turbine Shaft
- New MIVs of suitable grade of SS are being procured
- Specifications are being finalised for Stainless Steel Turbine Shaft

Non-Accessible Embedded parts
- Coating
- Re-routing of Pipes
Other aspects of R&M

- Replacement of Stator
- Up-gradation to Numeric protection system
- Up-gradation of EHG
- Converting MOCB to SF6
- Up-gradation of Battery Bank to Plante type batteries
- Installation of Turbine discharge measurement device, online vibration monitor, brake dust collector, carbon dust collector, online cooling water flow meter, MIV electrical control panel
Proposed R&M, LE & U of Khandong PS

- 2X25 MW Khandong Power House, NEEPCO’s First Commissioned Power Station is going to complete its Service Life in 2019
- A Comprehensive Planning for Renovation, Modernisation, Life Extension and Up-rating is being executed
- CPRI has been given the contract to carry out RLA and prepare DPR
- The Dam height is being increased by 5 meters
- Expected to increase the service life by another 10 years, despite of the affect of Acidic Water
- Will be up-graded with all the latest automation and control technology available in the international level
- NEEPCO will be the principal concept designer for this R&M, LE & U
“CHALLENGES ARE WHAT MAKE LIFE INTERESTING AND OVERCOMING THEM IS WHAT MAKES LIFE MEANINGFUL.”

- Joshua J. Marine