

Renovation & Modernisation of Kopili Hydro Electric Plant; NEEPCO

The Back ground, Execution, hurdles and Performance



A presentation by

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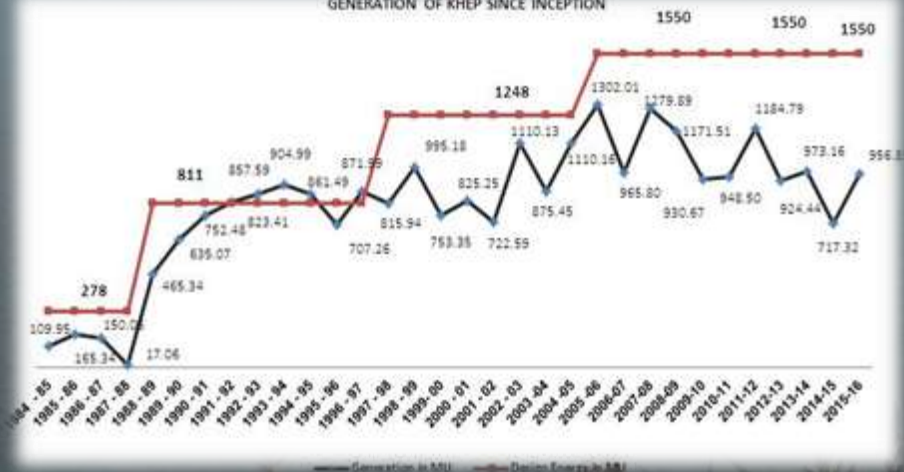
Kopili Hydro Electric Plant

▲ Brief Introduction

- ✓ FIRST EVER PLANT OF NEEPCO
- ✓ TOTAL INSTALLED CAPACITY 275 MW
- ✓ THREE POWER HOUSES COMMISSIONED IN PHASES - 1984, 1988, 1997 AND 2003
- ✓ 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



GENERATION OF KHEP SINCE INCEPTION





Why Renovation & Modernisation ?

- ✓ 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

- **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**

Affects of Acidic water

- ✓ **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.**

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



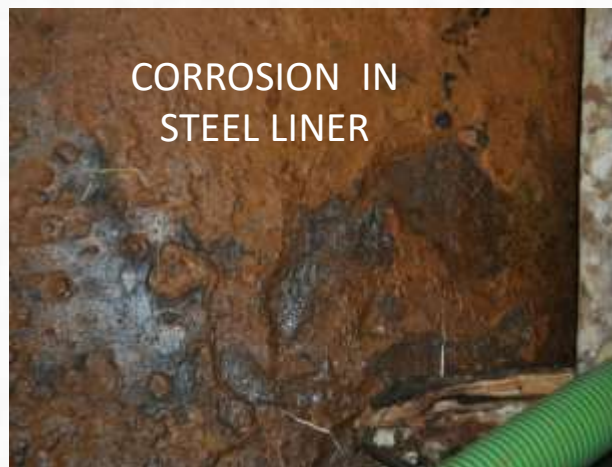
STAY VANES



LEAKAGE THRU' ANCHOR BLOCK



VALVES

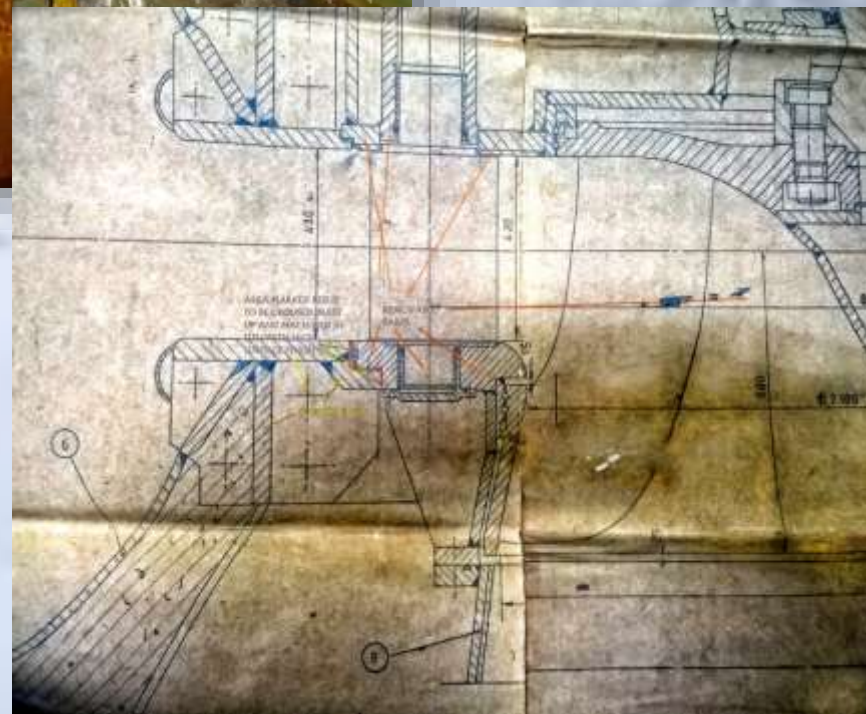


CORROSION IN STEEL LINER



TURBINE SHAFT

More Instances



Investigations

- **ENGINEERING GEOLOGY DIVISION OF GSI, NER, SHILLONG WAS INITIALLY ENTRUSTED TO CONDUCT A STUDY ON THE PROBLEM OF ACIDIC NATURE OF WATER IN THE RESERVOIRS.**
- **FORMATION OF SULPHURIC ACID IN SOME PARTS OF THE UPPER CATCHMENT AREA DUE TO THE OXIDATION AND HYDRATION OF PYRITES THAT ARE EXPOSED TO ATMOSPHERE BY HUMAN ACTIVITIES AND LEACHING OF THE ACID INTO THE SURFACE AND SUB-SURFACE FLOW THAT JOIN THE RESERVOIR WAS INFERRED AS A REASON OF THE ACIDITY.**

Investigations

- **GSI STUDY REVEALS THAT THE SUB-WATER SHEDS ON WESTERN SIDE OF THE KOPLI 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**



EXECUTION OF R&M

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 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.



Major Renovations(Acidic)

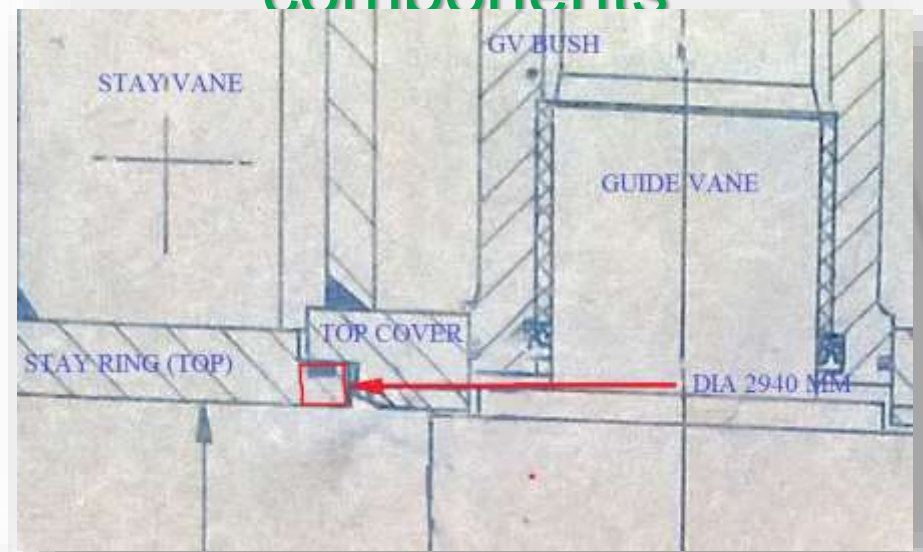
- ✓ *All Dismantle-able under water parts were converted to Stainless Steel (Primarily ASTM 304 grade)*
- ✓ *Stay Ring , Stay Vane, guard Pipe etc. was 'TILED' with 3 mm SS Sheets*
- ✓ *Draft Tube liner converted to SS*
- ✓ *All Cooling water piping and Valves were also converted to SS*
- ✓ *Eroded Turbine 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



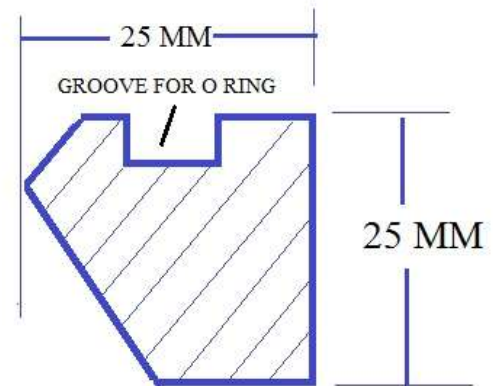
REPAIRED TURBINE SHAFT



REPAIRING OF TOP COVER SITTING AREA



PIVOT RING SITTING AREA OF STAY RING



REPAIR (CONTD.)

Coating of Spiral & Runner

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



HVOF COATING IN RUNNER



INSPECTION OF SPIRAL AFTER ONE YEAR OF APPLICATION OF LOCTITE 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 of R&M

COST DUE TO ACIDIC NATURE OF RESERVOIR WATER

Power Station	Expenditure in lakhs	Remarks
4 x 50 MW KOPILI PS	9517.07	Expenditures in O&M nature are not calculated such as procurement of consumables, increase in manpower expenditure, Over time expenditure, rubber goods, generation loss etc.
2x25 MW KHANDONG PS	2240.78	
1X25 MW STAGE II PS	803.33	
HYDRO-MECHANICAL	692.70	
Total	13,253.88	

Expenditure done under different heads and budget Provisions

- ✓ **R&M**
- ✓ **Additional Capitalisation (CERC)**
- ✓ **Capital Budget (Non- CERC)**
- ✓ **O&M Budget**

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

PARAMETER	BEFORE	AFTER
Average monthly outage due to acidic failures	149:58:38 hours	6:15:00 hrs
Yearly MoU performance	Average to Good (mostly)	Outstanding
Machine availability	50% - 70%	90 % and above (Excluding Planned Shutdowns)



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 it's 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

Thank You

A large dam with multiple spillways is shown against a dramatic sunset sky. The sky is filled with colorful clouds in shades of orange, yellow, and blue. The water is cascading over the spillways, creating a misty spray. The foreground features rocky terrain and a river flowing through it.