LIFE ENHANCEMENT OF E&M EQUIPMENT THROUGH IMPROVISED O&M TECHNIQUES

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PART -A

EXPERIENCES OF SJVN WITH HVOF HARD COATINGS OF UNDERWATER TURBINE PARTS AT NJHPS AND RHPHS: WAY FORWARD
1. HVOF Coating

• Tungsten Carbide
  – Typical Chemical Composition
  – Typical HVOF Parameters
Innovations of SJVN

• Hard coating plant installed at NJHPS which is 1\textsuperscript{st} ever hard coating plant provided at a Hydel Power house in the country
Hard coating workshop

- Robotic arm hard coating the guide vane
- Hard coating workshop with 40T Turn table
• **Following components are under regular coating**
  
  – Guide vanes
  – Cheek plate
  – Labyrinth seal
  – Turbine Wear rings
  – Upper DT cone
  – Silt Flushing gate
  – GV Sealing ring
• MOP has initiated policy interventions for setting up of such Hard Coating facilities by all Hydro Power Developer for their projects.
NJHPS new runners (250 MW each) with coating
Hard coated runners of RHPS (68.67 MW each)
NJHPS runners (coated and uncoated)

Original runner: uncoated 16:5 runner after one year of operation

New Runner: coated 13:4 runner after one year of operation
Runner materials

- Original runners were of 16:5 composition
- 4 new spare runners of 13:4 composition were procured in 2008

<table>
<thead>
<tr>
<th>Material Composition</th>
<th>Original runner</th>
<th>New Runner</th>
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<tbody>
<tr>
<td></td>
<td>X4CrNiMo 16-5-1</td>
<td>X3CrNiMo 13-4</td>
</tr>
<tr>
<td>C max 0.06</td>
<td></td>
<td>C max 0.05</td>
</tr>
<tr>
<td>Cr 15.0-17.0</td>
<td></td>
<td>Cr 12-14</td>
</tr>
<tr>
<td>Ni 4.0-6.0</td>
<td></td>
<td>Ni 3.5-4.5</td>
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<tr>
<td>Mo 0.80-1.50</td>
<td></td>
<td>Mo 0.3-0.7</td>
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Other Innovations In Underwater Components
Innovative Repair Techniques

• Advanced coating in
  – Spiral casing
  – Stay rings and stay vanes

• In-situ Machining in
  – Upper Turbine cover/ top cover
  – Bottom Turbine cover/ Bottom ring
  – Sitting surface of Upper Labyrinth Seal Stationary (ULSS)
Bottom Turbine cover/ Bottom ring
In Situ machining
Sitting surface of Upper Labyrinth Seal Stationary (ULSS)

- Repeated failure of labyrinth was observed
3. Repair and Maintenance

• Regular maintenance and cleaning is done to enhance the lifecycle and availability of the components.

• The welding is done with ESAB 309 Mo electrode.

• The profiles of over dimensional and non-removable components of hydro turbines were re-maintained through In-situ self-leveling machining using laser guidance.

• The repair of runner and guide vanes were carried out using templates to match original profile to the extent possible.
In-situ machining of Silt Flushing gates
What we achieved

• Enhancement in life of components
• Reliable and consistent performance throughout the annual operating cycle
• Less erosion in underwater parts and less maintenance time.
• **Consistent generation both in NJHPS and RHPS above design value**
Challenges ahead:

• To improve the quality of hard coating, its application, and continuous adoption of better materials
• To achieve two year repair cycle in place of one year repair cycle at present
• To achieve most optimal/ suitable combination of HVOF (Hard coating) and Soft Coating (Ceramics based brushable/ epoxy based combination coating) for enhancing the life of underwater components
PART -B

LIFE EXTENSION MEASURES FOR ELECTR-MECHANICAL EQUIPMENT: AN EXPERIENCE OF SJVN
SJVN’S EXPERIENCE OF LIFE EXTENSION MEASURES

AT NJHPS (6X 250MW)

• Retrofit of 400kV GIS

• Modernization of existing Bus Bar Protection scheme
RATIONALE FOR R&M & LIFE EXTENSION

New Plants – costly, having longer gestation period.

Obsolescence due to technology upgradation.

R&M at lower costs and life extension achieved.
OBJECTIVE FOR R&M & LIFE EXTENSION

Exploit the design margins

Better spare management

Ease of operation

Life extension in cost effective manner
CHALLENGES TO R&M IMPLEMENTATION

R&M Solutions are complex and plant specific

Constraints in defining exact scope of work

Limited agencies for R&M implementation (OEM vs Others)

R&M activity to be associated with planned unit shutdown

Loss of Generation/ Availability
Retrofit and Extension of 400kV GIS

NEED

&

BENEFITS
Equipment Failure History at NJHPS due to impact of Overvoltage during off Peak Seasons (Sept. to May)

A. B-Ph CB pole failure of NJ-Rampur (Ex NLG) on 12/07/03.
B. R-ph CB pole failure of NJ-KCW-I (Ex Baspa) on 10/02/05
C. B-Ph CB pole failure of NJ-Panchkula-I (Ex ABD) on 04/04/09
D. R-PH CB pole failure of NJ-Panchkula-I on 19/11/09
E. R-Ph CB pole failure of NJ-KCW-II on 13/12/09
F. - R-Ph CB pole failure of NJ-Panchkula-I on 20/02/11

REMARK SINCE 2011, SJVN HAS MANAGED TO MITIGATE THE FAULTS BY ADOPTING FREQUENT MONITORING OF SF6 ACIDITY LEVELS OVER AND ABOVE THE MANUFACTURER’S RECOMMENDATIONS.
OVER VOLTAGES DURING OFFPEAK HOURS IN LEAN SEASON

NJHPS Typical bus Voltage

Bus Voltage
Abdullapur-1, Pre Fault Voltage 431KV

Fault Started after 200 msec of CB opening during R-phase voltage rising/oscillation. It appears that remote end was not opened for so long.
Fault Developed when Voltage Rises to 368.7KV (Ph-N)
EFFECTS

HIGH FREQUENCY OF BREAKER FAULTS

FASTER RATE OF CONSUMPTION OF INITIAL SPARES

SPARE MANAGEMENT BECAME A BOTTLENECK FOR SJVN
THE NEED

• RECOMMENDATIONS OF NRPC FOR REACTIVE COMPENSATION (80MVar Reactor at both NJHPS & RHPS)
• SPARE MANAGEMENT OF EXISTING OBSOLETE MODEL OF GIS EQUIPMENT

THE PROPOSAL

• EXTENSION OF 01 NEW 420KV GIS BAY FOR SWITCHING OF 80MVAR BUS REACTOR
• RETROFITTING OF EXISTING 01 NO. 420 KV GIS LINE BAY WITH LATEST AVAILABLE GIS CIRCUIT BREAKER.
BENEFIT

ADAPTATION OF NEW TECHNOLOGY

THE SPARE FOR THE NEW MODEL BREAKER WOULD BE EASILY AVAILABLE, WHILE THE THREE POLES OF THE OLD GIS MODEL B-142 DISMANTLED C.B, AS WELL ITS HYDRAULIC OPERATING MECHANISMS, WOULD SERVE AS SPARE FOR THE EXISTING BAYS, LEADING TO SPARE MANAGEMENT IN COST EFFECTIVE MANNER FOR NEXT 5-10 YEARS.
PLANNING

As both 1500MW NJHPS and 412MW RHPS of SJVN are running in tandem, losses associated with the downtime for installation, testing and commissioning had to be kept to minimum.

For retrofit activity of new bays an interface between old equipment and new installation was required, which necessitated complete shutdown of both buses at NJHPS which would mean shutdown of both power houses i.e. NJHPS and RHPS.

The whole activity has been planned in a threadbare manner after which it has been possible to schedule the whole activity in a shutdown of 30HRS.
CONCLUSION

The road to R&M implementation has its own challenges & O&M engineers shall have to take a call to convert the adversities into opportunities.
Modernization is a continuous process and can be part of Renovation Program
THANKS