

# HP TURBINE BREECH NUT REPLACEMENT-JHAJJAR EXPERIENCE

## (500 MW BHEL KWU)

**Vikram Jeet Saini, Manager (TMD), NTPC Jhajjar**  
**Sanjay Nandal, Manager (TMD), NTPC Jhajjar**

**ABSTRACT:** NTPC Jhajjar has 3 x 500 MW BHEL KWU design turbines. All units are operational since 2012. Unit # 1 was taken for scheduled overhaul of boiler and overhauling of TG valves from 20.02.2016 for 25 days. On 02.03.2016 (11th day from zero date) during dismantling of strainers, MS strainer – RHS found severely damaged, 30% element strips were found missing. Pieces of MS strainer element also found in the HRH strainers.

Hence it was suspected that MS strainer element is passed through HP turbine. To examine suspected damage, internal inspection of HP turbine was carried out by Boroscopic videography on 08.03.2016 (17<sup>th</sup> day from zero date). Few pieces of elements found lying near first stage guide blades. It was decided to dismantle HP turbine and IP turbine for internal inspection for suspected damage & repair. After awarding the contract on urgency basis dismantling of HP turbine & IP turbine work started on 16.03.2016 (25<sup>th</sup> Day from zero date).

During HP Turbine dismantling, LHS side Breech nut (inlet pipe connection) got stuck up after loosening the few threads. Despite repeated attempt of loosening the nut by gas & induction heating up to 400 degree from outside and quenching by dry ice from inside, the nut didn't get loosened. After lot of deliberation at site and corporate OS, decision for cutting of breech nut was taken on 28.03.2016 (37<sup>th</sup> day from zero date). Breech nut has been removed by gauging on 30.03.2016 and HP turbine shifted for dismantling.

Breech nut re-installation for 500 MW design was a typical job. For re-installation, we have to remove inlet insert first which is of 150 mm thickness and 650 mm outer diameter, with taking care of control valve seat below inlet insert with 02 mm clearance diametrically. This kind of job was never attempted at site for 500MW design in anywhere in India. Even OEM also has refused to attempt this work at site and not given the offer for repair. We were having two options for re-installation of breech nut  
1) Complete valve body has to be removed by cutting MS line and sent to BHEL Haridwar works for re-installation of breech nut with welding of inlet insert. Expected work execution period: 50 days(min).  
2) Replacement of breech nut at site. Work execution period:20 days

Considering the Longer execution period at BHEL works after lot of deliberation at project and corporate level, it has been decided to replace the Breech nut at site

After awarding the contract on urgency basis Breech nut re-installation work started on 08.04.2016 (48<sup>th</sup> day from zero date) and completed on 27.04.2016 (68<sup>th</sup> day from zero date).

The paper gives the details of the unique jobs of “breech nut replacement” without support of OEM by the Jhajjar team with the full support from the OS-turbine group. After completion of the overhaul activity unit put on barring gear on 04.05.2016 (75<sup>th</sup>day from zero date).

**INTRODUCTION:** Following work were planned in TG side during the overhaul of unit#1:

- a. Servicing of HP & IP stop & control valves with servomotors
- b. Servicing of governing system
- c. Servicing of HP & LP Bypass valves including spray valves
- d. Inspection of MS & HRH Strainers

**OBSERVATIONS AND EXCEPTIONS :**



**Damaged MS Strainers-RHS**

The jobs were going on smoothly, but on the 11<sup>th</sup> day while dismantling the MS strainer – RHS found severely damaged, 30% element strips were missing. Total one third portion of element was damaged. Some unidentified pieces also found inside MS strainer. Subsequently the other strainers of HP & IP turbine were also opened and inspected. These strainers were found intact however with some more foreign materials. Hence it was suspected that portion of MS strainer element is passed through HP turbine.



**MS valve stellite liner pieces in**

Unidentified pieces found inside MS strainers were look like seat of stop valve hence inspection of both main steam stop valve carried out by the BMD group. It was found that the stellite liner of MS valve (LHS) on the upstream side was found in damaged condition



**Damaged valve wedge of MS valve**

### **BOROSCOPIC INSPECTION OF HP TURBINE:-**

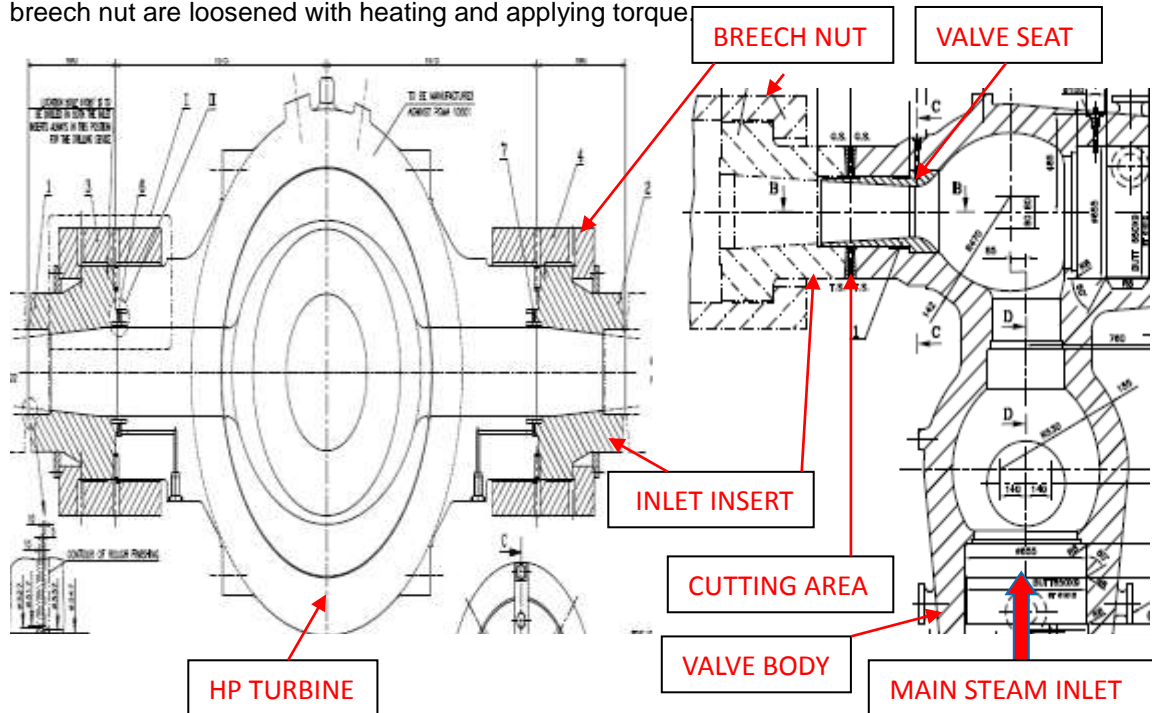
To examine suspected damage, internal inspection of HP turbine was carried out by Boroscopic videography. Few pieces of elements of upto 100 mm length found lying near first stage guide blades.

It was decided to dismantle HP turbine and IP turbine for internal inspection for suspected damage & repair. Contract was to be awarded on urgent basis for the overhaul of HP & IP turbines on the working agency



## OVERHAULING OF HP TURBINE:-

Steam pipes carrying main steam are connected to valve bodies in both side of HP turbine. Valve bodies are mounted over HP turbine with breech nut connections. For removal of HP module for inspection, both breech nut are loosened with heating and applying torque



During HP Turbine dismantling LHS Breech Nut jammed after loosening the few threads. Despite repeated attempt of loosening the nut by gas & induction heating up to 400 degree from outside and quenching by dry ice from inside, the nut didn't get loosened. A **C-type clamp** was fabricated for applying torque force on breech nut, but could not be succeed, after the effort of about 8 days. So it was decided to cut the breech nut in consultation with the TG-OS group.

After cutting of breech nut with gauging for 2 days, HP module removed from position and shifted to zero meter for dismantling work.

## BREECH NUT RE-INSTALLATION:-

OEM was contacted about the problem. OEM requested APCPL to dispatch the whole valve body to Haridwar works as this job cannot be carried out at site. It was also found that one such incidence occurred earlier in SEB and were rectified by sending the valve body to OEM works and rectified after approx.. 2 months. BHEL failed to submit the offer for the job also.

Breech nut re-installation for 500 MW design was a typical job. For re-installation, we have to cut & remove inlet insert first which has 150 mm thickness and 650 mm outer diameter with taking care of control valve seat below inlet insert with 02 mm clearance diametrically. After removal of inlet insert, new breech nut and inlet insert are to be fitted within 2 mm clearance with valve seat. After proper fitment, welding of 150 mm thick joint to be done. This kind of job was never attempted at site for 500MW design in anywhere in India. even OEM also has refused to attempt this work at site.

We were having **two options** for re installation of breech nut:-

- 1) **Option – I** :Complete valve body has to be removed by cutting MS line and send to BHEL Haridwar works for re-installation of breech nut with welding of inlet insert.
- 2) **Option-2**: Replacement of breech nut at site.

## TIME & COST ANALYSIS:-

Description	Option-1 : Work at BHEL works, Haridwar	Option-2 : In-situ replacement
Expected work execution period	50-60 days	20 days
Repair cost (Expected)	77 lacs	18 lacs
Material Cost ( v/v seat)	9 lacs	Nil
Transportation Cost	3 lacs	Nil

Considering the Longer execution at BHEL works it has been decide to replace the Breech nut in situ.

For in-situ cutting of inlet insert with care of valve seat beneath it, Following reputed parties were contacted:-

1) M/s Metalock 2) M/s Siemens 3) M/s Presstool industries 4) M/s Fabmax india

But No-one including OEM ( M/S BHEL) agreed to carry out this kind of job at site on such short notice.

### IN-SITU CUTTING OF INLET INSERT:-

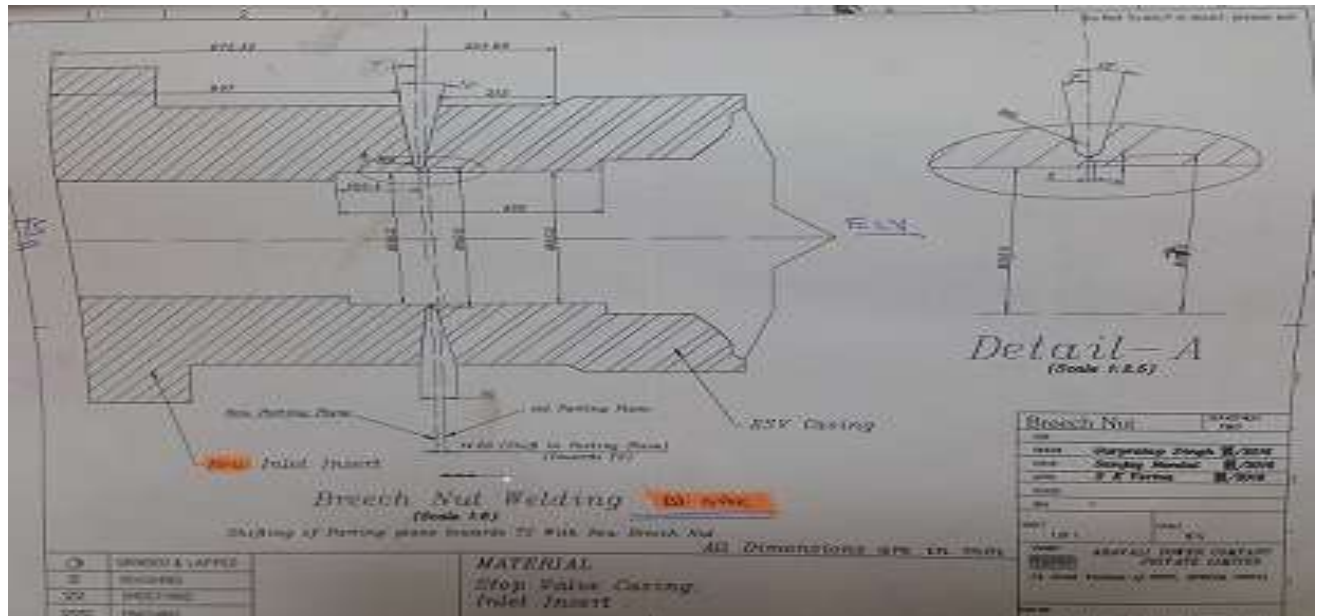
The spare breech nut & the valve inserts were available at site. Search of local agencies was started near delhi and matter was discussed with detailed drawing. Local workshop vendor visited site for understanding the job requirement. A detailed discussion for design and manufacturing of cutting device for inlet insert was carried out and work awarded.

A rotating gear supported over a roller bearing (similar to stacker reclaimer slewing bearing) having ID 850 mm more than OD of inlet insert was arranged by the agency (as shown in the photograph below). The gears was inserted near cutting area (OD: 650 mm). For mounting of bearing , a fixture was fabricated in two halves and mounted near cutting area. Than rotating gear assemble with bearing was seated over the insert.mounted over that fixture. Cutting tool carrier was than fixed on this fixture and exactness was confirmed . The drive pinion was fitted subsequently and trial operation done. Intially the parting of the insert was carried out with a width of approx. 10-12 mm. After the removal of the insert, beveling of the parting area was carried out as per the drawing with taking care of the root weld base.



## FIT-UP OF INLET INSERT WITH VALVE BODY:

The new inlet insert was machined at APCPL workshop in the CNC vertical turret lathe (VTL) as per dimension. Edge preparation was carried out at valve body by same cutting arrangement. Fit-up of new insert with valve body was a critical job as it should be inserted with total 02 mm clearance diametrically.



## The sequence for the breach nut assembly is as follows:-

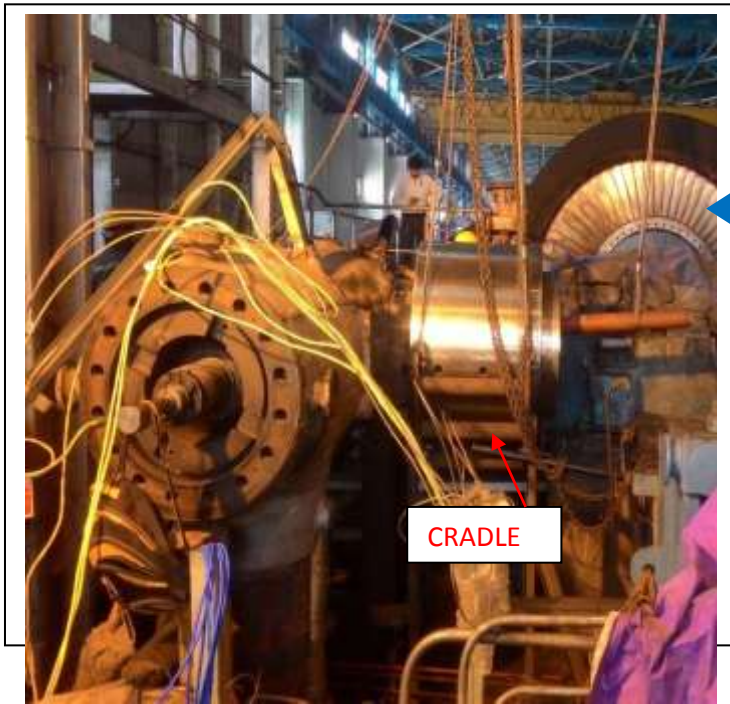
1. Mount the new breach nut over the new insert and position close to the beveled valve body.
2. Position the HPT casing in position.
3. Tighten the breach nut over the HPT casing on side
4. Fit-up the insert with the valve body using a specially prepared fixture(As shown in photograph)



FIXTURE USED FOR FIT-UP



FINAL FIT-UP



Inlet insert with valve body was loaded over cradle and hanged with help of EOT crane and slided with help of fixture to fit with valve body. Than breech nut was tightened with HP turbine outer casing.

#### **WELDING OF INLET INSERT WITH VALVE BODY:-**

The material of valve body was checked from drawing as well as through XRF machine. The detail is as below:-

#### **A) MATERIAL IDENTIFICATION:-**

Material of valve body: Cr-1.18, Mo- 0.88 - P11

Material of new insert: Cr-1.51, Mo-0.86

Old weld joint composition: Cr-2.62, Mo-1.1

Filler wire used : ER90S B3 Electrode used : E9018 B3

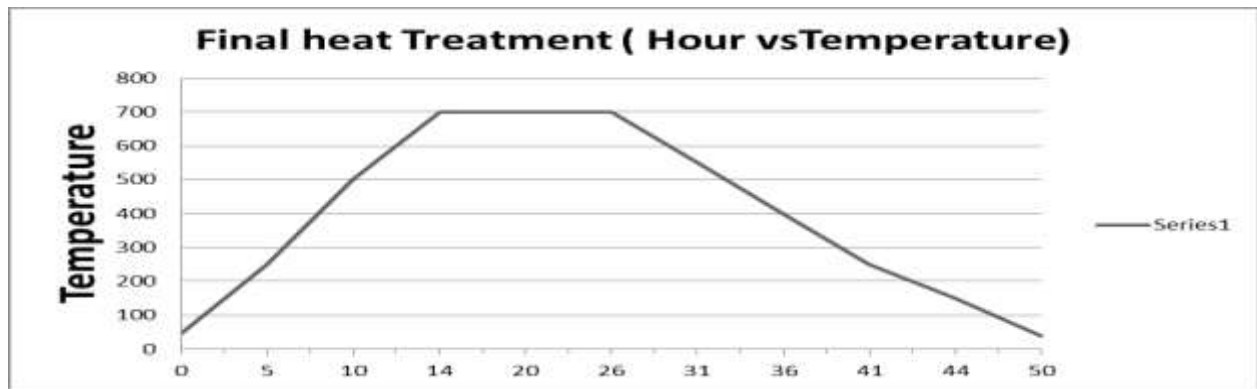
## B) WELDING PROCEDURE:-

The WPS was collected for this thickness, material and high pressure. Welders were arranged and welding experts was hired. The welding process given in table-I

**TABLE: I**

<b>Base Material: P11</b>	<b>Base Material Thickness: 150 mm</b>
<b>1. Edge preparation</b>	
<ul style="list-style-type: none"><li>• Overlap Joint<ul style="list-style-type: none"><li>✓ Thickness: 02 mm</li><li>✓ Length: 02 mm</li></ul></li><li>• DPT of Edges</li></ul>	
<b>2. Root Joint</b>	
<ul style="list-style-type: none"><li>• Preheat Temperature: 300 -350 Degree C</li><li>• Thickness: up to 8-9 mm<ul style="list-style-type: none"><li>✓ Welding Type: GTAW Inert gas: Argon Thickness : 2 TO 3 mm</li><li>✓ Welding type : SMAW Thickness : 6 TO 7 mm</li></ul></li><li>• DPT &amp; RT of Root Joint at Ambient Temperature**</li></ul>	
<b>3. Inter-pass Joints</b>	
<ul style="list-style-type: none"><li>• Preheat Temperature : 300-350 Degree C</li><li>• 1<sup>st</sup> stage joints (up to 25-30 mm)</li><li>• DPT &amp; RT of weld joint at Ambient Temperature**</li><li>• Preheat Temperature : 300-350 Degree C</li><li>• 2<sup>nd</sup> stage joints (up to 80 mm)</li><li>• UT of weld joint at Ambient Temperature**</li><li>• Preheat Temperature : 300-350 Degree C</li><li>• 3<sup>rd</sup> stage joints (up to 120 mm)</li><li>• RT by Cobalt source of weld joint at Ambient Temperature**</li></ul>	
<b>4. Final Weld pass Joint</b>	
<ul style="list-style-type: none"><li>• Preheat Temperature : 300-350 Degree C</li><li>• Final Pass Joint (up to 150 mm)</li><li>• Final UT of weld joint at Ambient Temperature**</li><li>• MPI and DPT</li></ul>	
<b>5. Post Weld Heat Treatment</b>	
<ul style="list-style-type: none"><li>• Heating rate: 50 Degree C/ HR</li><li>• Soaking Temperature: 680-700 Degree C</li><li>• Soaking Period: 12 Hrs.</li><li>• Controlled Cooling rate: 30 Degree C /hr (upto 150 Degree C)</li><li>• Further Cooling (from &amp; below 150 Degree C): Ambient Cooling</li><li>• UT, MPI and DPT after SR</li></ul>	
<b>Note:</b> * Preheat Temperature : 300-350 Degree C	
Interpass Temperature (max.): 350 Degree C	
** Controlled Cooling up to 150 Degree C & further Cooling in ambient conditions.	





**\*\* Cobalt source is used for RT at 120 mm weld thickness. Special agency has been mobilised from Mumbai for this work. Extreme care was taken at site as cobalt is highly radioactive material.**

After completion of welding & heat treatment, the breech nut were loosened , HPT casing moved from position. The HP rotor positioned with inner casing and casing was put back in positioned and casing was put back in position and breech nut were tightens again.

#### ACTIVITY BAR CHART:-

The various activities of breech nut replacement is given in the bar chart as below:-

U#1 TG overhaul : BREECH NUT REPLACEMENT		08.04.16	09.04.16	10.04.16	11.04.16	12.04.16	13.04.16	14.04.16	15.04.16	16.04.16	17.04.16	18.04.16	19.04.16	20.04.16	21.04.16	22.04.16	23.04.16	24.04.16	25.04.16	26.04.16	27.04.16	
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**HP TURBINE OBSERVATION ;** No damage observed in Turbine however few pieces of strainer element were found stuck up in between inter stage fixed blades . After completion of the overhaul activity unit re commissioned on 08.05.2017

#### LEARINGS:-

1. The HP strainers were inspected on the 6<sup>th</sup> day, had it been done earlier we would has saved some time.
2. Potential is available locally for carrying out critical jobs when the not available.

**OVERHAUL COMPLETION PERIOD:** 75 days

**CONCLUSION:** The overhaul of unit was planned without any major jobs in TG area. Due to surprise found during overhaul, the overhaul was extended from 25 to 75 days. Thanks to the contracts & finance department for arranging the overhaul contracts in short span. There was further surprise of breach nut jamming and few more contracts were required for insert machining, cobalt radiography etc. which was again facilitated by these departments.

All the departments like central workshop, FQA, Operation and other maintenance groups have supported in the successful execution of the job. Thanks for unprecedented support given by the TG-OS group and GM(OS) & GM(BOP) and thanks to the Jhajjar management for keeping confidence on the turbine department.

The unit has comeback with the best vibration parameters. The time and money saved during the overhaul is a bonus and the confidence generated in the TG Maintenance group is immense.