RESIDUAL LIFE ASSESSMENT (RLA) BASED RENOVATION & MODERNIZATION (R&M) OF STEAM TURBINES

BY:

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Synopsis:

Today, power availability has become synonymous with quality of life. An increasing human quest to further improve quality of life is resulting in enhancing demand for electrical power. However, at macro level, how the electric power is generated, transmitted and utilized, is also of paramount importance. Aging is an irreversible process. Power plant equipments are no exception. Like habits dictate human aging process, there are such several factors dictating the aging process of power plant equipments. Configuration, construction, operation and maintenance practices are major factors determining the aging process. Understanding the aging process and monitoring the health of equipment right from conception/ inception will prolong the life period besides ensuring sustained output. Therefore, assessment of residual life of critical components of steam turbines and life extension, Uprating, Renovation and Modernisation are of prime importance. BHEL has vide experience in the field of Residual Life Assessment (RLA) and life extension. Considering the potential necessity and growing age of Steam Turbine sets BHEL has also been continuously improving its product designs for Renovation/ Retrofitting/ Refurbishment. This paper deals with BHEL methodology for RLA based R&M for enhancing power output, availability, reliability & efficiency of 210 MW(LMW design) as well as 210 MW (KWU design) sets.

1.0 INTRODUCTION

In developed as well as developing countries increase in power generating capacities is becoming essential. It is now for utilities to see how this capacity addition is to take place. In addition to other measures like reduction in T&D losses, utilities can prolong life of existing power stations and use them more efficiently without compromising on safety standards. This brings in need for Ageing Management based renovation & modernization including uprating of existing plants. We must go out there and see the health of the equipment, assess the residual life of various components, and take necessary measures **for life extension including uprating** of the unit as a whole. The life extension including uprating of an existing unit amounts to capacity addition with much less burden on resources, both monitory as well as environmental. A new machine implies more of everything, steel, manufacturing of castings, forgings, machining, transportation, cement & lot more. All this has severe impact on environment. An environment friendly policy without impacting human need for quality life at micro level, requires better utilization of existing resources, life extension and by implication management of cracks in components becomes very important.

For the future power plants incorporating health monitoring gadgets for systematic evaluation of remaining life is very simple. For the existing power plants, residual life assessment study is the first step for determining remaining life popularly known as RLA Study. This study will provide details for decision making about the plant TO RETIRE or REFURBISH or RENOVATE & MODERNISE or RENOVATE & UPRATE or any such measures.

2.0 STEPS OF RESIDUAL LIFE ASSESSMENT

2.1 COLLECTION OF BACK GROUND INFORMATION

Plant data management plays a crucial role and involves the collection, storage, and manipulation of data associated with operating and maintenance histories, inspection, failure analysis, life assessment, resources, schedules etc. Data management systems often contain plant generic as well as plant specific data which can be used to identify key influences and root causes of existing or future threats to plant availability or performance.

2.1.1 Material Data

Following information are required to be collected regarding the set whose life is to be estimated:

- The drawings of critical components viz. rotors, casings, valves & valve chests, guide blade carriers, steam inlet & exhaust connections etc.
- Materials of various critical components as mentioned above & their test certificates including NDT results like defectograms etc.
- Thermodynamic cycle and strength design data. Stress distribution in various critical components as envisaged during design stage.

2.1.2 Operational History

It is very important to know how the set has been operated in the past at the power station.

The effectiveness of the calculations made depends upon the accuracy of this data. The observations during planned shut downs provide lot of information on equipment's condition. Generally, the Maintenance Planning Division of the power plant utilises this information for preventive maintenance and replacements. History cards covering the replacements done during routine maintenance / forced outages and planned overhauls are reviewed so that present status of the equipment is assessed and equipment degradation trend is formulated.

2.2 PRELIMINARY RESIDUAL LIFE ASSESSMENT CALCULATIONS TO IDENTIFY CRITICAL ZONES

Based on design data the critical components / zones which need special attention with regard to normal wear, erosion, cracks, material properties etc. are identified. The background information & operational history facilitate preliminary residual life assessment studies / calculation.

Condition-based techniques are used to refine the accuracy of calculation-based methods and are essential to expose any defect or unforeseen damage derived from initial fabrication or unrecorded operational upsets.

The components & zones identified as above are rigorously inspected after opening of the turbine / assemblies & checks mentioned in following clauses shall be carried out:

2.3 COMPONENT INTEGRITY ASSESSMENT

All the rotating and stationary components are cleaned by abrasive jet using Alumina powder or sand. This is done to remove all products of oxidation from the surfaces to facilitate proper interpretation of the subsequent tests. Various components of steam turbine are subjected to the following tests:

2.3.1 Visual Examination

Visual examination is carried out very minutely to ascertain damages such as breakage, cracks, corrosion, pitting, wear etc. Wherever necessary, optical aids e.g. mirror, magnifying glass etc. is used.

2.3.2 Dye Penetration Test (DPT)

This technique is adopted primarily for detection of cracks or crack like discontinuities that are open to the surface of the component. The area to be examined is cleaned and then the penetrant is applied over the surface. After removing the excess penetrant, the developer is applied which by blotting action helps to draw the penetrant from defect and spread it over the surface.

2.3.3 Magnetic Particle Inspection (MPI)

This technique is adopted for locating surface or sub surface discontinuities like seams, laps, quenching cracks etc. This method is also used for detecting surface fatigue cracks developed during service.

Wet fluorescent continuous method is used for examining accessible surface area of the components. Magnetisation is done using coiling and / or Electro magnetic yoke. Adequacy of the field strength is verified by using field strength indicator.

Water or kerosene based fluorescent particles are sprayed on the magnetised area by means of the spray bottles, while magnetising field is still on. The magnetised and sprayed areas are examined under hand held ultra violet light for the presence of defect indications. All components like casings, surfaces of rotor discs etc. are examined by this method.

All cylindrical surfaces including blades are examined by the coiling method. This method is only suitable for ferromagnetic materials.

2.3.4 Ultrasonic Testing (UT)

By using ultrasonic sound waves, the sub-surface flaws and non-metallic inclusions can be detected. Size and configuration are also determined and recorded. The testing is carried out using suitable techniques and probes depending on the component geometry and its location. Wire brushing and light grinding are employed to mend local irregularities and undulations on the surface, if any. Machine oil mixed with grease is used as couplent. All accessible critical areas are examined ultrasonically using normal and angle probes. These include steam chests, casings, rotors, welds in stationary components etc. The surfaces thus prepared, are first checked with 2-4 MHz normal probes followed by 45° angle probes. The circumferential welds are checked with 45/60° angle probes.

2.3.5 Hardness Test

Hardness can be used as an indicator for the state of the steel in its life cycle. Hardness measurements provide a useful indication of the extent of microstructural degradation due to thermal exposure and creep damage in components operating at high temperatures and pressures. In-situ hardness testing is performed at suitable locations, using portable hardness tester. All critical areas, especially the high temperature zones of rotor, heat affected areas of welds in stationary parts are tested for their hardness.

2.3.6 In-situ Metallographic Examination by Replication Technique

Replication is the technique adopted to obtain microstructure in-situ by non-destructive metallography. In this technique, each of the spots chosen for examination is finely polished using portable metallographic surface preparation equipment, etched by suitable chemical agent, examined by microscope and the reverse image of the metal surface is taken on to a plastic replicating film for detailed laboratory examination. The replica of the microstructure is examined at site for its quality by portable optical microscope.

All the critical areas of the rotors and the stationary components with special attention to the high temperature zone and welds are metallographically examined and their replica taken. If any defect has been observed by non-destructive testing at any zone, then such zones are given extra attention. The replicas are first examined in the laboratory under light microscope for gross metallurgical structure and then, if necessary, under the Scanning electron microscope for detection of creep damage, if any.

2.4 TESTS PERFORMED ON CRITICAL TURBINE COMPONENTS

2.4.1 Turbine Rotors

After thorough cleaning of the rotor surface and blading, following examinations are carried out :

- Visual examination of the rotor surface, moving blades and shrouds for any abnormality.
- Boroscopic examination of rotor bore
- Magnetic particle examination and/or dye penetration test of the rotor with special emphasis on the inlet zone, blades and shrouds.
- Ultrasonic test of accessible areas of the rotor for internal defects to ascertain major flaws and how far they have grown from initial stage of manufacture. Special attention is given to inlet zone of the rotor.
- Hardness and Microstructure testings at steam entry and exit sides
- Natural Frequency Measurement of free standing blades of LP Rotor.

2.4.2 Stationary Components

All stationary components viz. turbine casings & guide blades, high temperature inlet & exhaust connections, stop & control valves, strainer housings, U, I, & L- seal rings, gland seal bodies etc. are cleaned thoroughly and following examinations are carried out :

- Visual examination of the component with special emphasis to the transition zones and welded areas for crack, corrosion, erosion or any other defect.
- Magnetic particle inspection and/or dye penetration test to detect surface and sub-surface cracks.
- Ultrasonic examination for internal defects.
- In-situ microstructure examination and hardness test.

2.4.3 High temperature fasteners

- All the fasteners of high temperature zone will be checked for detection of cracks by MPI / DPT / UT.
- Sample survey of turbine inner casing joint plane fasteners of high temperature zone is carried out by destructive test on sample studs to determine mechanical properties and impact values. Microstructure examination is also carried out.

2.4.4 Turbine Bearings

All turbine bearings are checked visually for any damage, by DP test for cracks, and by UT for babbit bondage.

3.0 FINAL RESIDUAL LIFE ASSESSMENT

Based on the material defect data generated (as mentioned at para 2.4 above) and the operational data obtained from site, stress analysis and life estimation calculations are performed.

Operational data along with material properties and design parameters are used for residual life calculation. This residual life evaluation provides important information on components' life consumed and further use-worthiness or otherwise of the component. Based on above evaluation and material testing, decision regarding rectification / replacement is taken.

In all these calculations the reliability and accuracy of the operating data is of vital importance. Any prediction of remaining life may prove to be inaccurate if data is incomplete or inaccurate.

Based on these studies, for extending life of steam turbine components , recommendations are given regarding:

- Remaining life of steam turbine components.
- Immediate replacement of a component is required or it can be replaced after a prescribed period.
- Repair of a particular component
- Change in steam parameters at the inlet, if required.
- De-rating of steam turbine.
- Alterations in the mode of future operation of the set.
- Alterations in the material of certain components
- Need for more often inspections.
- Proposals for R & M.

4.0 R & M OF STEAM TURBINES :

Reliable and economical power generation is the primary goal of each electrical utility worldwide. Such a goal can be achieved through:

- Maximizing the efficiency of the turbine-generator.
- Extending the intervals between inspections and
- Achieving greater reliability in operation.

During the development and design of its steam turbines, BHEL considers all of these factors in order to offer attractive products to its customers. This is achieved by the following:

- Improving the efficiency of the turbine with use of advanced blading.
- Maximizing the use of existing hardware whenever practical.
- Extending the service intervals by use of advanced manufacturing techniques as well as carefully selected materials for the components. This also leads towards greater reliability in plant operation.

IMPROVEMENT IN PERFORMANCE & OUTPUT OF STEAM TURBINE CAN BE ACHIEVED BY FOLLOWING:

- Use of improved blade profile which result into reduction in the aerodynamic flow losses e.g. profile loss, secondary flow loss & tip leakage loss.
- More uniform flow distribution.
- Optimization of flowpath.
- Improvement in shaft sealing system.

- Reduction in pressure drops.
- Reduced friction losses.
- Optimization of inlet & exhaust section geometry of valves & casings.
- Optimization of exhaust loss.

5.0 BHEL'S PROPOSAL FOR R&M OF 200 / 210 MW STEAM TURBINES (LMW DESIGN):

BHEL, Haridwar, has manufactured and supplied 57 sets of Type K-210-130 (LMW Design) steam turbines. About 10 sets of similar design, imported directly by Utilities, from Russia, are also under operation. These sets have already completed 13 to 30 years of operation. Thus the useful life of most of the sets is already over. The Steam Turbine of Type K-210-130 (LMW Design) was designed in early 60's, therefore, there is good scope for renovation & modernization of these sets to extend their operating life, making them efficient and increasing their output. The upgradation of HP and LP Turbines is possible by incorporating features mentioned al S.No. 2.0 above.

EXISTING DESIGN:

Existing 210 MW Steam Turbine (LMW design) is fitted with impulse blading. Figure 1 shows its cross section of HP Turbine & Figure 3 shows the cross section of LP Turbine. In this design steam pressure drop takes place mainly in guide blades provided in the diaphragms, while passing through moving blades there is negligible pressure drop.

The LP Turbine is double flow and is provided with 2X4 stages. It has impulse blading. The maximum heat drop takes place across the fixed / guide blades. The fixed / guide blades are called DIAPHRAGMS which are in two halves. 1^{st} & 2^{nd} stage diaphragms are fitted in liners, which in turn are fitted in the casing. The penultimate stage of this LPT is BAUMEN STAGE which is provided to direct part of the steam flow to the condenser so as to reduce the moisture content as well as the volume of the steam flow in the last stages.

The LP Rotor has a shaft and the discs of all the stages are shrink fitted on it. The blades are fitted in the grooves provided in the discs. These blades are provided with damping wire for dampening the vibrations.

5.1 IMPROVEMENT IN HP TURBINE:

The HP turbines of 200 / 210 MW having impulse blading can be retrofitted by BHEL with state of art high efficiency reaction blading. In this design steam pressure drop takes place in guide blades as well as moving blades. Outer casing is kept same, if found healthy in RLA study. The internals i.e. Rotor, Liners and diaphragms are to be replaced with Monoblock HP Rotor and Guide Blade Carriers having more efficient reaction blading (Tx profile).

ADVANTAGES

It gives following advantages over existing turbine:

- Reduction in specific heat consumption.
- Increased power output
- Renewed blade lifetime.
- Separate Diaphragms are eliminated.
- Servicing time will be reduced as no centering of diaphragms will be needed which is otherwise time consuming.

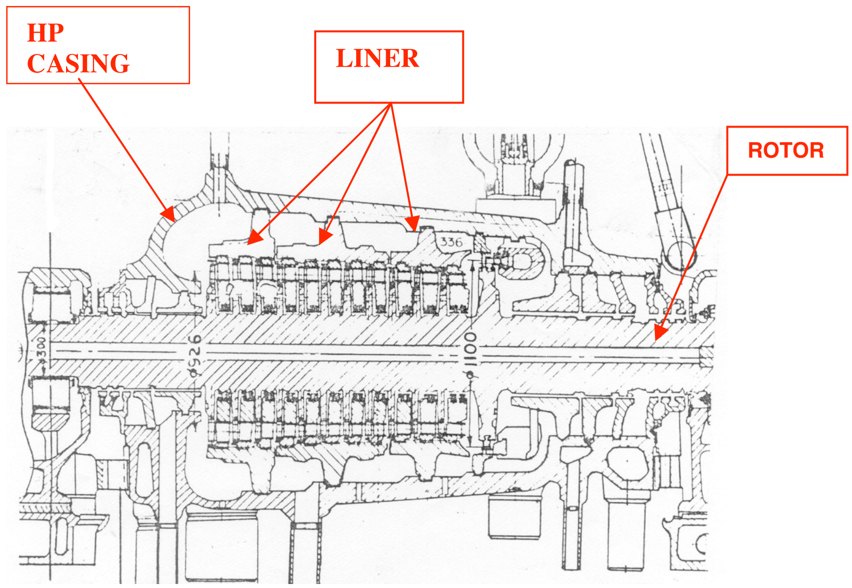


Fig. 1 : Existing HP Turbine with Impulse Blading

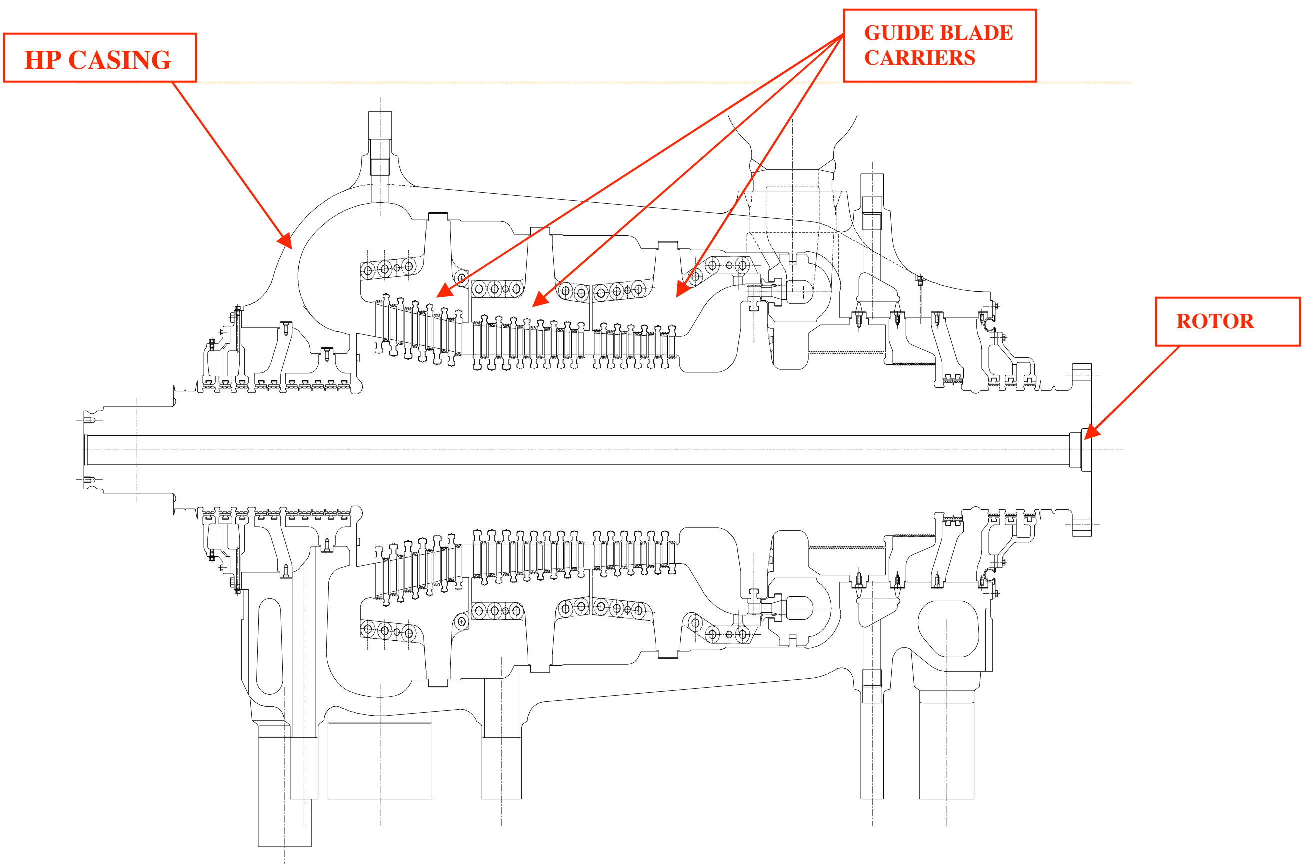


Fig. 2 : HP Turbine retrofitted with Reaction Blading

ADVANTAGES

It gives following advantages over existing turbine:

- Reduction in specific heat consumption.
- Increased power output
- Renewed blade lifetime.
- Separate Diaphragms are eliminated.
- Servicing time will be reduced as no centering of diaphragms will be needed which is otherwise time consuming.

5.2 IMPROVEMENT IN LP TURBINE:

Monoblock LP Rotor with advanced blading is provided for retrofit and existing liners & diaphragms are to be replaced by new liners & guide blade carriers. LP Rotor blades as well as guide blades are state of art high efficiency blading. The LPT will have 2X4 stages. The 1st stage of moving & guide blades will be having "Tx" blading. The 2nd stage of moving blades will be "F" blading. The moving blades of 3rd & 4th stages will be "TAPER & TWISTED FREE STANDING BLADES". The guide blades of 2nd and 3rd stages will be "TAPER & TWISTED PRECISION CAST BLADES". The guide blades of 4th stage will be "BANANA TYPE" hollow guide blades.

LPT EXHAUSTHOOD:

Existing LP Exhaust hood of LP Casing shall be reused and modified at site as part of upgradation. In the Exhaust hood portion some sheet metal will be cut off & modified to improve the steam flow and some additional stiffening arrangements will be provided.

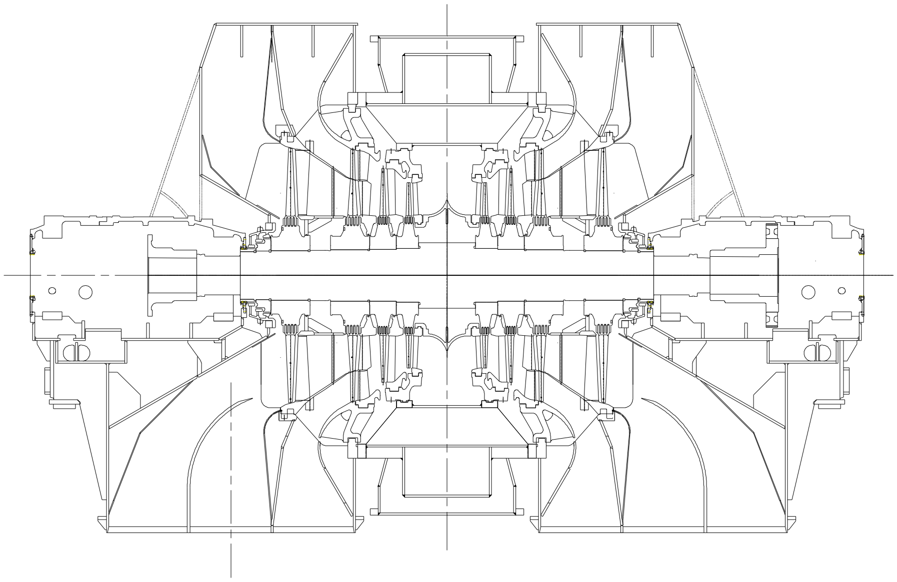


FIG.3-A: DETAILS OF EXISTING DESIGN FLOWPATH

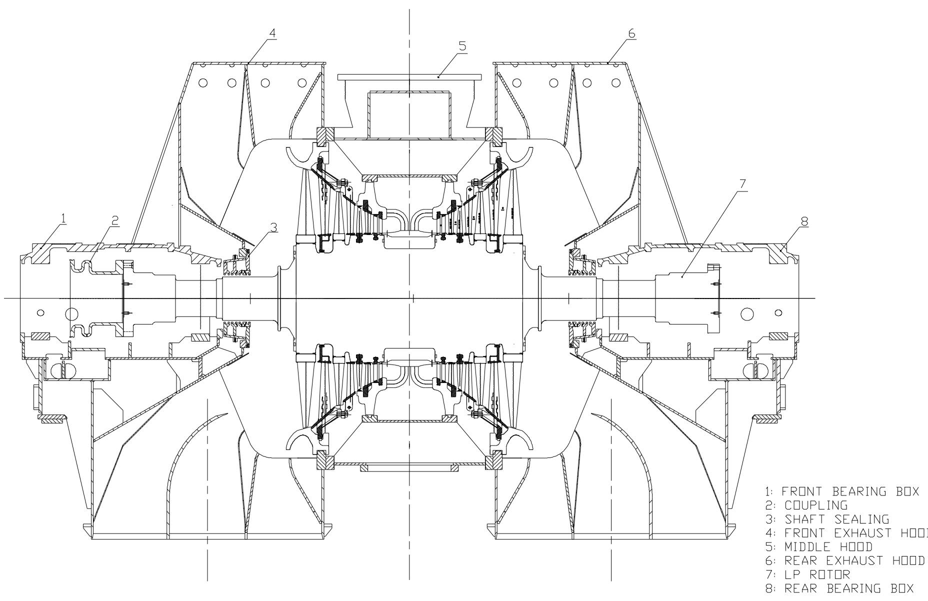


FIG. 3-B: DETAILS OF MODIFIED FLOWPATH

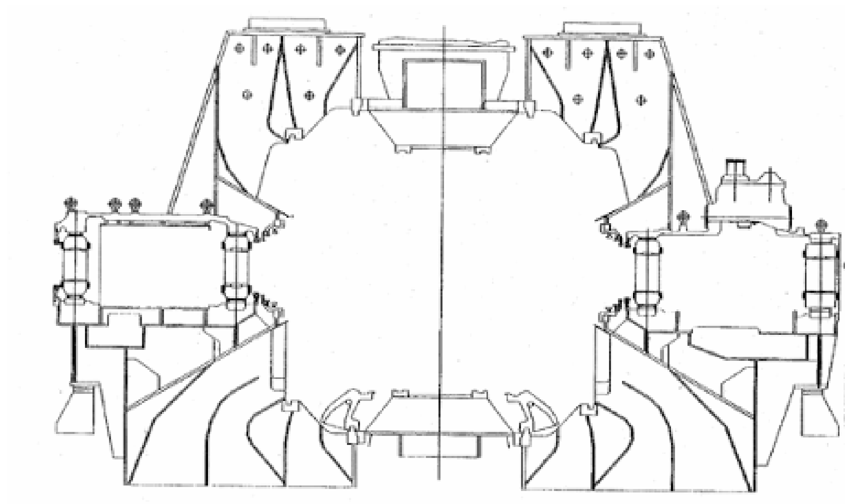


Fig. 4 : LP CASING: EXISTING DESIGN

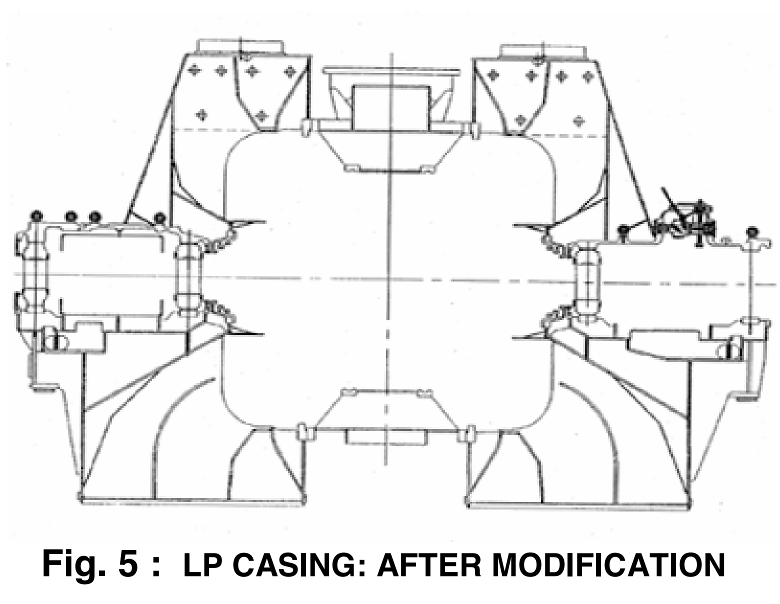


Fig. 5 : LP CASING: AFTER MODIFICATION

5.3 UPRATED CONDITION (UNDER NORMAL CYCLE OPERATION):

The steam turbine after uprating shall be able to generate power as per following parameters:
Reference original HBD TCD-210-33-2 Regime no. 1
Main Steam Flow : 662 T/Hr

Main Steam / HRH Steam Temperature: 535/535ºC
Main Steam Pressure: 130 ata
Back Pressure: …0.1042 ata

5.3.1 EXPECTED PRESENT PERFORMANCE LEVEL:

Considering deterioration due to aging as per ASME-PTC-6 Report 1985, following will be the performance levels:

PRESENT power output with steam flow of 662 t/h & rated parameters : 202.4 MW

EXPECTED PERFORMANCE IMPROVEMENT IN THE EXISTING IMPULSE DESIGN SET AFTER REFURBISHMENT OF HP& LP TURBINES AT RATED PAPARMETERS, 0% MU& 33 DEGREE COOLING WATER TEMPERATURE:

	BRAND NEW ST	DETERIORATED CONDITION	UPGRADED ST	UPGRADED ST WITH ENHANCED STEAM FLOW
MAIN STEAM FLOW T/Hr	662	662	662	695
LOAD (MW)	210	202.4	217.5	225

(This is only indicative data and will subject to change for specific project)

5.3.2 TIME REQUIRED FOR IMPLEMENTATION OF THE MODIFICATION:

This modification is expected to be implemented at site during extended CAPITAL OVERHAUL.

5.4 WORK INVOLVED IN RETROFFITING:

- Residual Life Assessment (RLA) study of steam turbine components.
- Overhauling / Replacement of internals of IP Turbine and correction in steam flowpath.

5.4.1 FOR HP TURBINE:

- Removal of existing HP Rotor, Liners, Diaphragms, nozzle segments and shaft seals.
- Removal of H.P.Casing from its position after cutting the pipelines connected with the casing. The pipelines must be suitably locked before taking up the cutting job.
- Installation of the NEW H.P.Casing in its position & welding of relevant pipe connections.
- Installation of new HP rotor, Guide Blade carriers having reaction blading and shaft seals.
- Nozzle segment rings of first stage are also proposed to be replaced by new ones (of existing design) to enhance the efficiency.
- Usage of new set of parting plane fasteners of HP Cylinder.

5.4.2 FOR LP TURBINE:

- Removal of existing Liners, Diaphragms & Rotor.
- Measurement of log dimensions (as per log sheet to be supplied by BHEL, Hardwar), during previous overhaul.
- Cutting of deflectors / ribs & blanking the space in LP casing due to removal of baumen stage.
- Modification of structure at the exhaust end of LPC to facilitate installation of liner & guide blade carrier.
- Installation of water spray system in position.
- Matching / machining of parting plane and correction, if any.
- Installation of Liners & Guide Blade Carriers in position.
- Installation of new Mono-block LP Rotor in position.
- Measurement of Steam Flowpath and correction, if any.

5.5 PAY BACK PERIOD:

Pay back period will be approximately 3 years.

6.0 BHEL'S PROPOSAL FOR R&M OF 200 / 210 MW STEAM TURBINES (KWU DESIGN):

EXISTING DESIGN:

- Existing 210 MW Steam Turbine (SIEMENS-KWU design) is fitted with T2 reaction blading. Figure 6 shows its cross section of HP Turbine, IP & LP turbines. The LP Turbine is double flow and is provided with 2X8 stages. It also has T2 reaction blading.
- For HP Inlet assembly, HP Outer casing has buttress threads of 580x9 and accordingly Breech nuts are provided with matching buttress threads.(Fig.7)
- The HP Exhaust elbows are provided with Serrated Packing.

6.1 DESIGN CRITERIA

The purpose of the proposal for modernization of HP & IP Turbines (Siemens-KWU Design), is to provide a cost effective modifications & upgradation package, to maximize the improvements on HP & IP Turbines' performance.

After renovation & modernization of HP & IP Turbines, by implementation of the proposal, including action taken in accordance to recommendations of RLA Study, by way of rectification / replacements of steam turbine components which are being retained, their service life is expected to be about 30 years. The interval between inspections of inner parts of HP & IP Turbine is 6 years.

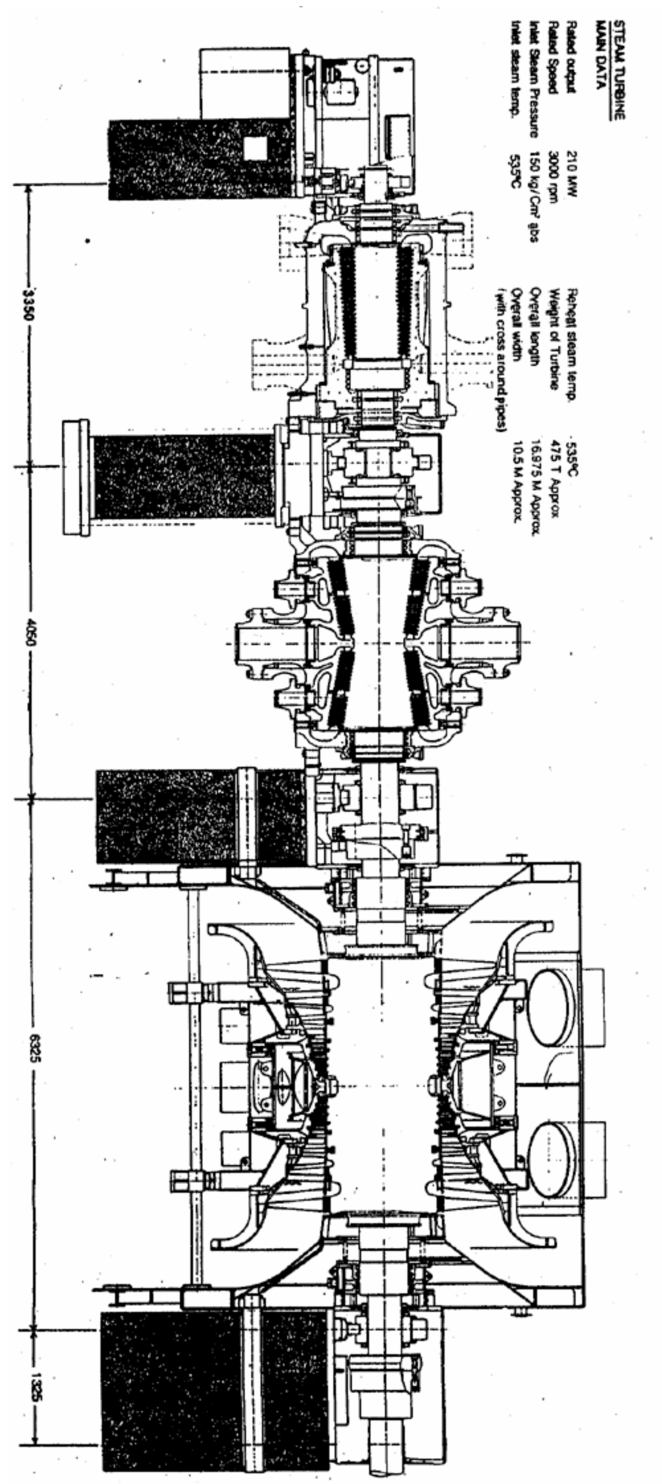
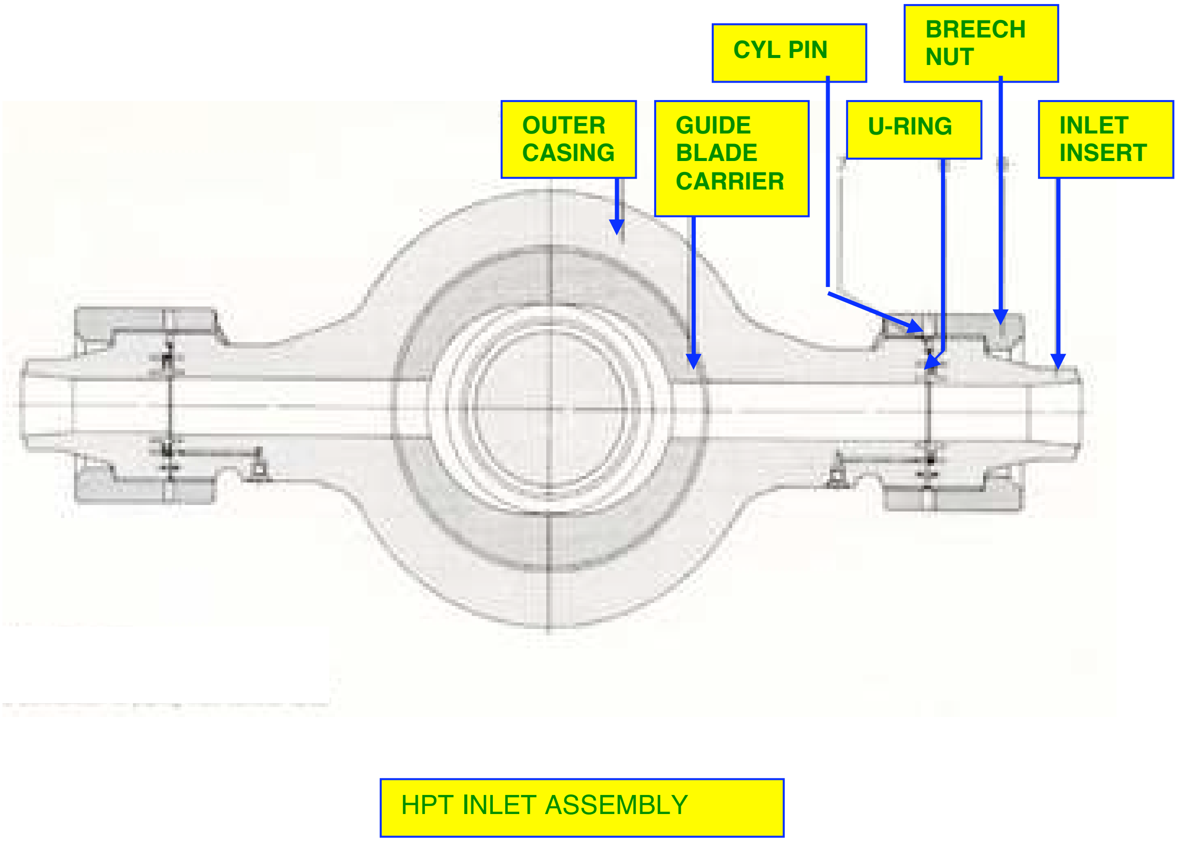

STEAM TURBINE
MAIN DATA
Rated output 210 MW
Rated Speed 3000 rpm
Inlet Steam Pressure 150 kg/Cm² abs
Inlet steam temp. 535°C
Reheat steam temp. 535°C
Weight of Turbine 475 T Approx.
Overall length 16.975 M Approx.
Overall width 10.5 M Approx.
(with cross around pipes)
3350
4050
6325
1325

FIGURE 6



DESCRIPTION	BUTTRESS THREDS SIZE	
	OLD DESIGN	**NEW DESIGN**
HP OUTER CASING	580X9	580X20
BREECH NUTS	580X9	580X20

Fig. 7 : HP INLET ASSEMBLY EXISTING DESIGN

6.2 IMPROVEMENT IN HP & IP TURBINE:

The HP & IP turbines of 210 MW, having T2 profile blading, can be retrofitted by BHEL with state of art high efficiency T4 profile reaction blading. The existing HP Inlet Assembly will be replaced by new design well proven HP Inlet Assembly for ease in its assembly & dismantling (Refer Fig.7). The existing HP Exhaust elbows having Serrated Gaskets will be replaced by well proven new design HP Exhaust Elbows having U-Ring for enhancing reliability (Refer Fig.8). This will require following components:

SCOPE OF SUPPLY FOR HPT	**SCOPE OF SUPPLY FOR IPT**
COMPLETE ASSEMBLED MODULE OF HPT FITTED WITH HP ROTOR & HP INNER CASING WITH T4 / T4X PROFILE BLADING (WITH STEAM FLOWPATH SO THAT INCREASED QUQNTITY OF STEAM MAY PASS) ALONGWITH HP INLET ASSEMBLY AND HPT EXHAUST ELBOWS.	IP INNER CASING BLADED WITH T4 PROFILE BLADES, FULLY BLADED IP ROTOR WITH T4 PROFILE BLADES, IP SHAFT SEALS, A SET OF HPR-IPR & IPR-LPR COUPLING BOLTS ALONG WITH NECESSRY KEYS ETC.

6.3 RECOMMENDED CHANGES IN LPR FOR LIFE EXTENSION:

It is recommended to replace last two stages of free standing blades i.e. stage no. 2L, 3L, 2R & 3-R, as the set has already completed more than 1,60,000 hours of operation, by new ones, and NFT be performed for improving reliability during operation. This will require following material

SCOPE OF SUPPLY FOR LPT
COMPLETE SET OF MOVING BLADING MATERIAL OF 2L, 2R, 3L & 3R OF LP ROTOR ALONGWITH CLAMPING PIECES.

6.4 THERMAL INSULATION:

Mineral wool spray thermal insulation will be supplied for Steam Turbine.

6.5 WORK REQUIRED TO BE DONE:

S.No.	IN HPT
1.0-	▪ REMOVAL OF OLD HPT MODULE FROM ITS POSITION AFTER DISMANTLING THE HP INLET ASSEMBLY AND HPT EXHAUST ELBOWS.
1.1-	▪ THE OLD HP INLET ASSEMBLY (INLET INSERTS WITH BREECH NUTS) AND HPT EXHAUST ELBOWS ARE TO BE CUT FROM MAIN STEAM PIPES AND CRH STEAM PIPES RESPECTIVELY.
1.3-	▪ NEW IMPROVISED HPT MODULE IS TO BE PLACED IN POSITION, ALIGNED & CENTERED WITH OTHER TURBINE MODULES / ELEMENTS.
1.4-	▪ HP INLET ASSEMBLY OF NEW MODULE IS TO BE WELDED WITH MAIN STEAM PIPES.
1.5-	▪ HPT EXHAUST ELBOWS ARE TO BE WELDED WITH CRH STEAM PIPES.
1.6-	▪ THE ASSEMBLY OF "HP INLET ASSEMBLY" AND HPT EXHAUST ELBOWS WITH HPT IS TO BE COMPLETED.
	IN IPT
2.0-	▪ **REMOVAL OF OLD IP ROTOR & IP INNER CASING.**
2.1-	▪ INSTALLATION OF NEW IP INNER CASING WITH T4 PROFILE BLADING, ITS CENTERING & ALIGNMENT.
2.2-	▪ INSTALLATION OF NEW IP ROTOR WITH T4 PROFILE BLADING, ALIGMENT & CENTERING.
2.3-	▪ COMPLETION OF BOX UP OF IPT.
	IN LPT
3.0-	• REMOVAL OF EXISTING OLD BLADING OF STAGES 2L, 2R, 3L & 3R.
3.1-	• CLEANING OF GROOVES OF BLADES PROVIDED IN LP ROTOR AND CRACK DETECTION BY MPI.
3.2-	• ASSEMBLY OF NEW BLADES OF ABOVE MENTIONED STAGES IN POSTION.
3.3-	• ENSURING PROPER ASSEMBLY OF BLADES BY NATURAL FREQUESNCY TESTING (NFT).
3.4-	• BALANCING OF LP ROTOR AT 3000 RPM.

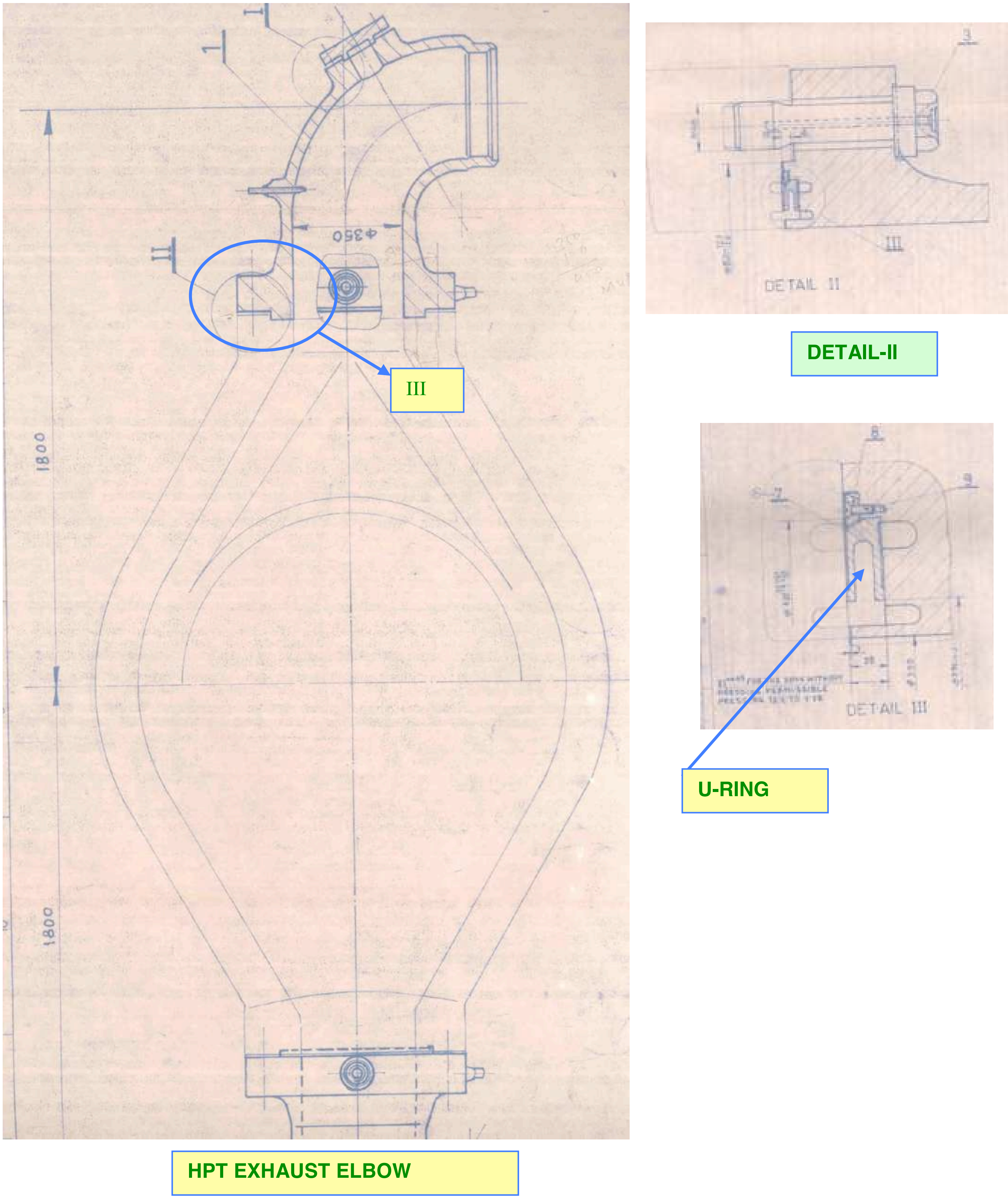

III
1800
1800
DETAIL II
DETAIL-II
DETAIL III
U-RING
HPT EXHAUST ELBOW

FIGURE- 8

6.6 RLA BASED REPAIR / REPLACEMENTS OF THE COMPONENTS / ASSEMBLIES

The major assemblies / components, such as given below, shall be subjected to RLA Study:

- IP Outer Casing
- LPT Inner-Inner Casing, Guide Blades, guide Blade carriers, Gland Seal Housings.
- Cross Around Pipes (CAP)
- ESV & Control Valve Steam chests of HPT as well as their Internals.
- IV & Control Valve Steam chests of IPT as well as their Internals.
- Main Steam (MS) / Hot Reheat (HRH) Steam Strainer Housings & their Strainer elements.
- Turbine Bearings

6.7 ADVANTAGES:

It gives following advantages over existing turbine:

- Reduction in specific heat consumption.
- Increased power output
- Renewed blade lifetime.
- Life extension of steam turbine.
- For ease of assembly & dismantling of HP Inlet assembly, the buttress threads of 580x20 have been provided on HP Outer Casing & Breech nuts in place of existing buttress threads of 580X9.
- The HPT Exhaust Elbows assembly has been provided with U-Ring in each exhaust connection in place of Serrated Gasket provided earlier thus increasing reliability of the assembly.

6.8 Expected Performance Improvement in the existing impulse design set after Refurbishment of HP & IP Turbines & replacement of Blades Of 2L, 2R, 3L & 3R Blades Of LP Rotor:

(A) FOR TMCR CONDITION

	AS PER HBD	AS PER EXISTING CONDITION (for specific project)	AFTER R&M(for specific project)
LOAD (VWO) IN MW	210	197	216.5
STEAM FLOW (T/Hr)	630	662	650
MS PR (ata)	150	142	150
MS TEMP DEGREE C	535	538	535
HRH STEAM TEMP DEGREE C	535	535	535
VACUUM (ata)	0.1033	0.15	0.105

(This is only indicative data and will subject to change for specific project)

(B) FOR VWO CONDITION:

	AS PER HBD	AS PER EXISTING CONDITION	AFTER R&M
LOAD (VWO) IN MW	221	197	228
STEAM FLOW (T/Hr)	662	662	686.3
MS PR (ata)	150	142	150
MS TEMP DEGREE C	535	538	535
HRH STEAM TEMP DEGREE C	535	535	535
VACUUM (ata)	0.1033	0.150	0.106

(This is only indicative data and will subject to change for specific project)

7.0 CONCLUSION

Remaining Life Assessment based R&M and UPRATING of the units of Thermal Power Station is most cost effective way of augmenting generation capacity and life extension. BHEL have acquired a vast experience of conducting RLA studies and handling variety of defects in the components. BHEL being designer of power plant equipment naturally have an advantage in dealing with unforeseen situations encountered during implementation of R&M including UPRATING proposals. It is advisable that utilities take initiative to have their machines studied thoroughly for their remaining life before implementing R&M proposals for improvement in Output, reliability & efficiency. While choosing the agency for conducting such studies BHEL's inherent advantage and vast experience should be given due consideration.

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