



- Turbo machinery
 - Steam turbines
 - Industrial turbines
 - Gas turbines
- Turbo machinery valves
- Generators
- Rotating equipment
 - Pumps
 - Fans
 - Compressors
 - Gear boxes
 - Centrifuges

Fact Finding Report

Report-No.:	80051273
Customer:	E.ON Benelux B.V.
Plant:	RoCa Power Station
Unit #:	RoCa 3
OEM/Type:	GE / Thomassen Int. bv
OEM-No.:	296470
Contract-No:	4500108281/C11/1100
Date:	30 th of November 2015
Description:	
Number of pages:	
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OEM- No.: 296470	Author Thom ter Stege, Christian Busch	Report- No.: 80051273	Date: 30 th of November 2015	Page: 2 of 60

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INTRODUCTION

The gas turbine ROCA3 was available on Tuesday the 18th of August for a planned Major Inspection. During this inspection the following capital parts were replaced:

- Fuel nozzles primary (refurbished)
- Fuel nozzles secondary (refurbished)
- Liners (refurbished)
- Transition pieces and bullhorns (refurbished)
- 1st stage nozzle (refurbished)
- 1st stage buckets (refurbished)
- 1st stage shrouds (refurbished)
- 2nd stage nozzle (refurbished)
- 2nd stage buckets (refurbished)
- 3rd stage buckets (refurbished)

The scope of work consisted of a planned Major Overhaul of the Gas Turbine, without removal of the Rotor, plus Mechanical work on the Generator, meaning Inspection of Bearings and removal of shields.

A visual Inspection and a bearing check were made for the accessory gearbox.

All four Gas valves were overhauled by van der Ende Valve repair. All Flexible Gas hoses were refurbished by Amnitec Hose Repair. 2 Hoses were fabricated to long, but Amnitec repaired their mistake within 3 days.

Challenging part during this Overhaul was the refurbishment of the Exhaust Duct and Diffusor. Diffusor was in EAS scope, Exhaust Casing was originally in the EAS scope, but EBX decided to take this part in their own portfolio.

The Overhaul started in one shift of 10 hours, 8 Technicians from GPW, 2 Technicians, one Gas turbine Specialist, one NDT Specialist and a Control Engineer of Fortum. Because of delays, later on it changed to 2 shifts, with in total 14 Technicians.

The Turbine was Mechanical Complete on Saturday the 25th of September and went into commercial operation on Wednesday the 27th of October.

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NAMEPLATE INFORMATION

Turbine: GE / Thomassen Int. bv
 Type: MS 9171- E DLN Single Fuel
 Rating: 130790kW @ Gas, 533°C, 1.013bar
 Serial Number: 296470
 Total starts: 961
 Fired starts: 545
 Fired hours: 144442
 Emergency trips: 257

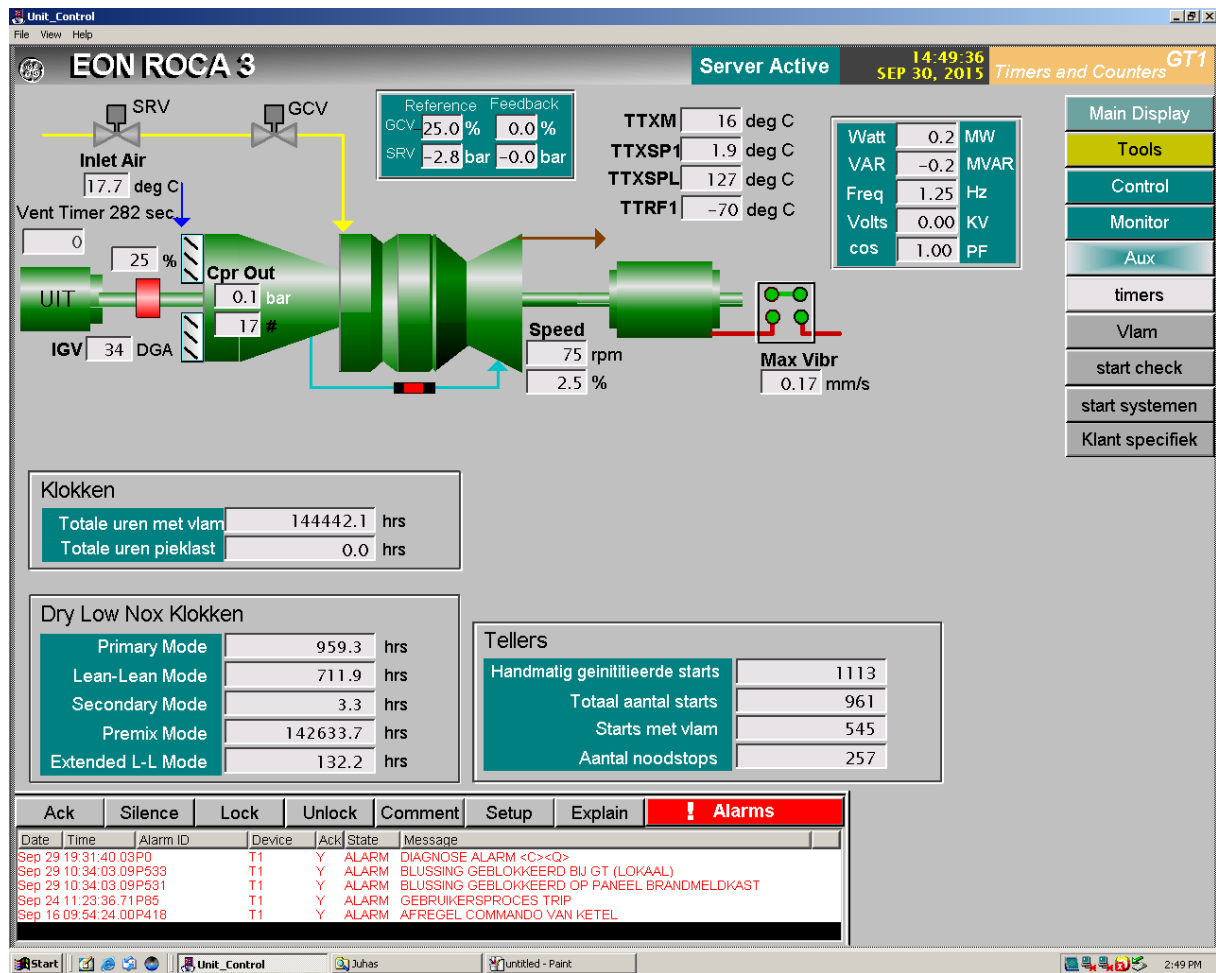
Starter: E-motor HOLEC
 Type: IK 162 HB02
 Rating: 1420kW
 Serial Number: I-6130-I/B

Acc. Gearbox: BHS Voith
 Type: A 919
 Rating: 696 kW, 3382/3000/1419rpm
 Serial Number: 516313

Generator: ABB
 Type: WY21Z-092LLT
 Rating: 168750 kVA, 15kV, 50Hz
 Serial Number: GM214650

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Timers and Counters



Engine on slow roll after Overhaul

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Daily Reports

Monday 17.8.2015, working day #0, 7.00-17.00

Crew:

- C. Busch, Projektleider (EON)
- Juha Turkia, GT Specialist (Fortum)
- Jari Kotilainen, Control Engineer (Fortum)
- Jesse Tuomi, Mechanic (Fortum)
- Jaakko Alhanen, Mechanic (Fortum)
- Frank Kuligk, Generator specialist (Vogelenzang)
- Anton Huijjer, Mechanic (GPW)
- Mike Meelberg, Voorman (GPW)
- Leo Oudzegeel, Mechanic (GPW)
- Elsio Fernandes de Pinho, Mechanic (GPW)
- Henny Schouten, Mechanic (GPW)
- Artan Mulletti, Mechanic (GPW)
- Stefan Menzel, Mechanic (GPW)
- Leon Aarnink, Mechanic (GPW)
- Thom ter Stege, TA (EON)

- Site Induction
- Fortum travelling to site

Tuesday 18.8, working day #1, 7.00-17.00

- Removal of combustion piping (flex hoses). Marked as follows to chamber end: A=primary (outer manifold, B=secondary (middle most manifold and C= transfer (inner manifold)
- Removal of flexible parts of supply piping between gas skid and manifold. Marked as follows: A=primary (outer manifold, B=secondary (middle most manifold and C= transfer (inner manifold)
- Removal Secondary Nozzles
- Removal of auxiliary coupling cover and installation of turning device. Electrical pump found from Customer
- Removal of combustion instrumentation cables
- Removal of spark plugs and flame detectors
- Decoupling of IGV actuator and opening of IGVs
- Measurement of IGV back lashes
- Preparations for inlet bell mouth removal in back and front such as removal of rubber joint, loosening of after wall of plenum etc.
- Preparations with casing supports 4 x 50 ton mechanical jacks ordered.

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- Loosening of large piping, ongoing. 2 bolts left in of each.
- Removal of combustion piping ring manifolds UH. Primary (A), Secondary (B) and Transfer (C)
- Opening of primary nozzle bolting, ongoing.
- Removal of LVDTs and other cables from SRV, GCV, GSV and GTV

Remarks:

- Crane not in use for couple of hours due to maintenance break for app. 3 hours
- Compressor front end found in real dirty condition
- Flexible gas piping ready to send, 5 pallets to Amnitec

Wednesday 19.8, working day #2, 07.00-17.00

- Remaining preparations with large piping removal
- Remaining preparations for inlet bell mouth related structure removal
- Remaining openings of primary fuel nozzle bolts, 2 left in of each
- Removal of primary nozzles from chambers #4 and #11
- Removal of liners and flow sleeves of chambers #4 and #11
- Oil on for rotor position measurement, watch for leaks OK
- Rotor position measurement
- Continuation of IGV measurement, not completed
- Opening of X-fire tube flanges, ongoing
- Lifting off prepared large piping, not completed
- Fabrication of casing support stands, not completed
- Removal of radial pin dowels from split line of TC-EXC, not completed
- Fabrication of DTI stands
- Removal of flex plates on load tunnel side LH started
- Removal of bearing #1 instrumentation as required for removal of bearing housing
- Calibration checks of various field instruments
- Gas control valves removed and transported by dedicated company
- Flexible gas piping picked up
- Scaffolding activities: Scaffs both sides inside of inlet, removal of scaffs above inlet duct and compressor front casing

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Remarks:

- Fabrication of casing support stands may not be in scope (1 + 3 h)
- Oil leaks found from every gas control valve actuator
- Limitation with crane availability due to parallel works in generator
- Jacks for casing supports arrived by the end of the day

Thursday 20.8, working day #3, 07.00-17.00

- Remaining liftings with large piping removal
- Removal of remaining outer cross fire tube flanges
- Opening of hatches on inlet plenum floor for one more casing support
- Opening of LH flex plates to see situation inside the joint
- Fabrication of last support stands
- Supporting of lower casings with mechanical jacks, 5 pcs
- Finalization of IGV measurements
- Removal of radial pin dowels, 7 pcs from TC-EXC vertical joint
- Casing bolt opening started with turbine casing, compressor casing and inlet bell mouth
- Removal of primary fuel nozzles, liners, inner cross fire tubes, flow sleeves and outer cross fire tubes UH, CCs #11-4 empty
- Lifting off the inlet cone forward rubber joint piece
- Lifting off the inlet cone
- Calibration checks of various field instruments
- Scaffolding activities: scaffoldings to LHS wrapper and turbine casing area. Modification of scaffolding in RHS turbine casing area for better access to casing bolts

Remarks:

- Challenges with removal of TC-EXC radial pin dowels due to casing deformation
- Fabrication of casing support stands may not be in scope (2 h)
- Locking welds of inlet plenum hatches were not done in cleverest way. Some nut welded almost all around. Unnecessary time consuming (2h) with opening
- Flex joint opened and first look to inside showed the joint to be in bad condition. L-shape fixation ring bent badly out of shape.

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- Test opening of Wrapper-TC (vert.) radial bolts. Bolts seems to be tightened with very high torque. One 1½" flogger broken and 1 bent. There might be challenges.

Friday 21.8, working day #4, 07.00-17.00

- Unbolting of remaining compressor casing bolts
- Unbolting of remaining inlet bell mouth bolts, 1 of inner ones remaining in both sides
- Unbolting of Wrapper-TC radials. RHS completed including horizontals in blind holes, 6 pcs
- Opening and removal of wrapper and TC body bounds of LHS
- Lifting off the inlet plenum rubber joint piece on plenum after side
- Removal of combustion LH hardware, all out (exc. TPs, to be removed after removal of Wrapper)
- Removal of combustion chambers #4 and #11
- Calibration checks of various field instruments
- Scaffolding activities: Scaffolding built for UH of flex plates. Scaffoldings both RHS/LHS on the position of compressor after casing/CDC removed for combustion hardware of LH removal. Scaffoldings both RHS and LHS on the position of Compressor forward casing modified so that inlet bell mouth could reversed as required.

Remarks:

- Minor oil leakage in gas compartment while re-filling of hydraulic oil accumulator. Mostly cleaned by EAS (Jari, Juha). Finishing of cleaning shall be done in next day.
- Safety walk by client by today. 1 remark regarding to working on the top of the TC using naked flame with sleeves shortened. No big issues.
- Ensured, that spares of gas cylinders of oxy-acetylene are available also on Saturday. Just if needed for bolt heating.
- Hytorc power unit defected. Motor did not run smoothly and constantly. Client gave permission to use their property.
- Client gave a permission to also use their welding unit.

Saturday 22.8, working day #5, 07.00-15.00

- Unbolting of remaining inlet bell mouth bolts
- Lifting of the inlet wall

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- Removing of TPs #1 and #14 for bearing #2 cooling air flange opening
- Creation of lifting plans
- Lifting off the compressor casings in 1 package
- Unbolting of turbine casing. All radials out, 1 RHS horizontal left, 5 LHS horizontals left
- Calibration of various field instruments

Remarks:

- Scaffolders have been maybe a bit too many times slipped from their promised schedules. For example "7.30 in the morning" of "after lunch".
- Sweeney hydraulic wrench was reported to not work by work crew. Tested and found to work well.

Monday 24.8, working day #6, 07.00-17.00

- Transportation of compressor casing to other turbine hall and turn it to upward
- Better storage of inlet wall
- Lifting off the bearing #2 cooling air pipe as required
- Opening off the remaining turbine casing bolts
- Lifting of the turbine casing and turn to upward on the floor
- Removal of remaining flex plates from load tunnel side
- Opening of remaining combustion wrapper bolts
- Lifting off the combustion wrapper
- Transportation of wrapper to other turbine hall
- Removal of upper TPs, on going
- Starting of parts and bolt cleaning

Remarks:

- Searching of compressor wrapper jacking bolts and finally manufacturing of them, 2 hours possible extra work
- Near miss with dropped bolt

Tuesday 25.8, working day #7, 07.00-17.00

- Removal of remaining TP's

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- Removal of 1st stage nozzle, upper and lower halves
- Removal of support ring upper half
- Removal of bolts from CDC, inner horizontal split line bolts still in
- Turbine clearance measurement. Evaluation of readings not done yet
- Removal of 1st stage shrouds and second stage nozzle partly from upper half
- Transportation of the parts from the turbine hall to other hall carried out as required
- Continuation of part / bolt cleaning

General remarks:

- Damages in the support ring seals, RHS.
- TP set back clearances were not measured while removal
- Baskets / boxes for the parts and bolts are running out

Wednesday 26.8, working day #8, 07.00-17.00

- Removal of remaining 2nd stage nozzle segments and 1st stage shrouds from upper half
- "trial fit" of new 1st stage shrouds. Drillings seems to be the same than in those which are taken out of the unit.
- Opening of remaining CDC bolts
- Lifting of CDC
- Turning of CDC in the upright position for inspections and cleaning
- Removal and inspection of emergency and auxiliary lube oil pumps and e-motors 88QA-1 and 88QE-1. Both e-motors are requiring work shop overhaul
- Removal of inner barrel
- Clearance measurement of compressor
- Removal of second and third stage nozzle segments from lower half started
- Continuation of part / bolt cleaning

General remarks:

- Crane was shared with generator project
- Plan for the broken e-motors is as follows: Auxiliary lube oil pump and e-motor 88QA-1 will be installed back to allow rotating of the shaft. Work shop overhaul for the e-motor will be done at the same time than

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refurbishment of exciter bearing. Emergency lube oil pump will be installed back on tomorrow and e-motor 88QE-1 will be sent to work shop overhaul asap.

Thursday 27.8, working day #9, 07.00-17.00

- Continuation of 2nd and 3rd stage nozzle segment removal of the lower half
- Opening of Bearing #1
- NDT Inspections of bearing #1 (journal and thrust) started
- Visual inspection of compressor blades as visible without turning the rotor carried out
- Visual inspection of compressor vanes from upper half up to 10th stage
- Packing of primary burners and sending of them to Sulzer
- Preparation for the IGV removal
- Cleaning of bolts
- Installation of auxiliary and emergency oil pumps and e-motor 88QA-1
- Packing of emergency lube oil pump e-motor 88QE-1
- Pre-opening of bearing #2 cover

General remarks:

- Crane was shared with generator project and also between activities on the turbine (nozzle segments / bearing works)

Near miss with the crane: Crane was driven against scaffolds in the side of the turbine hall where EAS tool container is located. Scaffolds needs to be inspected before further usage

Friday 28.8, working day #10, 07.00-17.00

- Continuation of 2nd and 3rd stage nozzle segment removal of the lower half, still one segment of third stage in the machine
- Continuation of 1st stage shroud removal
- Inspections of bearing #1 finished
- One indication of loosen white metal in inactive thrust bearing bad #8
- Scratches found from journal bearing
- Turning of air inlet casing in upright position for IGV removal
- Preparation of tools for IGV bushing removal
- Removal of IGVs from upper half

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- Assembly preparations (bearing #1, CDC, bolts etc)

General remarks:

- Local C&I people dismantled thermo couples from bearing #1. Installation of thermo couples to be carried out on Monday so we are not able to close the bearing during weekend.
- Received Riverhawk and bearing lifting tool from Burghausen

Saturday 29.8. working day #11, 07.00-14.00

- Removal of IGVs from lower half, to be continued on Monday
- Removal of 2nd and 3rd stage shrouds from lower half to make bucket removal easier, to be continued on Monday
- Opening of 2nd and 3rd stage bucket twist locks (30%)
- Removal of IGV bushings from upper half
- Assembly preparations of IGVs
- Cleaning of the bolts and general assembly preparations

Monday 31.8. working day #12, 7.00-17.00

- Removal of remaining 2nd stage shrouds from lower half
- Removal of 3rd stage shrouds from as required for bucket removal
- Installation IGV bushings to the upper half
- Starting on IGV bushing removal from lower half
- Cleaning of IGVs
- NDT inspection of IGVs (50%)
- Installation of bearing #1 thrust pads. 1 broken thermo couple found from inactive side. Thermo couple replaced by locals
- Continuation of bucket twist lock openings
- Preparations of #3 bearing removal

General remarks:

- Part of helicoil installation tool is missing. Length of tool is approximately 100mm and diameter around 6-7mm. It is possible that it is in the bearing casing. Searching to be continued on tomorrow.

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Tuesday 1.9. working day #13, 7.00-17.00

- Installation of bearing #1 cover. One thermo couple went broken during installation. Replacement will be done when rotating is not required for a two days.
- Continuation of bucket removal. Second stage is coming out. Twist locks of third stage almost opened.
- Replacement of IGV lower half bushings.
- IGV upper half ready for trial fit
- Cleaning of parts and bolts generally
- Works with compressor upper half vanes. Preparations for shimming done. If this is extra work, 5 hours could be marked for Jaakko
- Scaffolding works as per needs

Wednesday 2.9. working day #14, 7.00-17.00

- Removal of 2nd stage buckets completely
- Removal of first stage buckets (~15 pcs)
- Removal preparations of 3rd stage buckets
- Installation of lower half IGVs, next step is to lift the upper half in for the "trial fit"
- Continuation of compressor vane shimming
- Assembly preparations, cleaning of turbine casing, cleaning of bolts
- Continuation of NDT inspections

Thursday 3.9. working day #15, 7.00-17.00

- Removal of remaining 1st stage buckets
- Removal of 3rd stage buckets (5-6 pcs)
- Inventory of remaining refurbishment/cleaning works
- Temporary installation of air inlet casing
- Setting of IGV angles for drilling the pin holes (when upper and lower half were together)
- Continuation of assembly preparations
- Continuation of compressor shimming
- Cleaning of turbine discs #1 and #2 (30-40%)

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Friday 4.9. working day #16, 7.00 -17.00

- Removal of remaining 3rd stage buckets
- Continuation of assembly preparations, lower half combustion chambers, bolts etc
- Continuation of compressor shimming
- Setting of angles of remaining IGVs
- Lifting of air inlet casing

Saturday 5.9. working day #17, 7.00-15.00

- Removal of remaining 3rd stage shroud blocks
- Cleaning of turbine casing lower half, on going
- Drilling of IGV pin key holes on lower section, half done
- Inspection of turbine disc dove tails stg 1-3 UH
- Preparations with bearing #3 inspection like pre-opening of the housing
- Made 3rd defected (old and new defects) buckets available for further reporting
- Half turn of the rotor by the end of the day for continuation of dovetail inspections

Remarks:

- Stork did not leave load tunnel area for us even if agreed so earlier this week. Something to discuss about +/- item due to affect for progress
- Scaffolders are needed early in the morning. First in load tunnel, second nearby inlet casing

9 of 3rd stage buckets are having new defects, 15 of them old defects. Separate document created regarding to serialnumbers

Monday 7.9. working day #18, 7.00-17.00

- NDT of second half of turbine wheels, OK
- Removal of auxiliary oil pump, sent for overhaul
- Removal of exciter bearing, delivered to overhaul
- Opening of bearing housing #2 and clamp
- Cleaning of bearing housing #2, on going
- Removal of bearing #2, Uh and LH
- Cleaning of turbine casing lower half

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- Lifting off the bearing housing #1
- Removal of aux. coupling cover
- Opening of main lube oil pump. Removal of TS shims, bearings and gears themselves.
- Repairing of TS outer flex plate broken screws, started
- Drilling of IGV key pins to LH and UH. Drilling completed, but see remarks

Remarks:

- Due to misunderstanding / (something else?) lost another working day with bearing #3
- Severe hot spot found from bearing # 2 UH
- Installation error happened with removal of bearing clamp #2. Bently probes got damaged.
- Broken thermo couple found from bearing #1. Reason found to be getting cut between half joint area
- 2 low most IGV pinion stop screws on LHS are not locked on UH. Need to be done when lifted up at the first time up from the floor enough.

Tuesday 8.9. working day #19, DS+NS 07.00-23:30

- NDT Bearing #2
- Removal of main lube oil pump second stage (tandem pump after part) housing
- Removal of main lube oil pump first stage internal parts, bearings and gears
- NDT and visual inspection of main lube oil pump parts
- Removal of broken thermocouple of bearing #1 and thrust pad IA#3. Second half of broken thermo couple still in place up to junction box.
- Drilling and tapping of outer flex plate bolt holes, TS
- Cut out the piece to get inner flex seals to be removed
- Compressor stator shimming, complete
- Starting to remove inner flex plates
- Removal of bearing # 3 Bently probes
- Unclamp of bearing #3 instrumentation tubing
- Opening of remaining 4 bolts of bearing #3 housing
- Jacking up the bearing #3 housing for 30 mm
- Installation of trolley track for bearing #3 inspection

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- Removal of bearing housing #3
- Lifting of bearing #3 upper half, not moved yet
- Removal of brush seals bearing #2, not completed
- Removal of 2 mostly damaged flex plates of TS inner from top most position
- Cleaning of inlet casing and compressor casing LH horizontal flanges, not completed
- Cleaning of remaining bolts and refurbishment of large bolt threads, ongoing

Remarks:

- Minor marks of cavitation in main lube oil pump bearings of stage #1
- Still, even if discussed with the client unclear situation in load tunnel. Is the area prioritized for GT or for exhaust repair?? Need to be clarified tomorrow when bearing is supposed to be open and no grinding or welding is permitted in that area.
- Shimming of compressor, possible extra work (Jaakko) 7 hours
- Inner flex plates of TS seemed to be very difficult to remove. Noticed that inner and outer layer of plated were spot weld together which could be considered to be a bit abnormal
- Labyrinth seals of bearing #2 were tried to be removed. Found to be very difficult. Further discussion regarding to further actions needed tomorrow

Wednesday 9.9. working day #20, DS+NS 07.00-23:30

- Audit in the works shop in the morning
- Removal of bearing #3 upper half out from load tunnel
- NDT of upper 3 tilting pads
- Shelves for buckets (scaffs)
- Handrails around main hydraulic pump (scaffs)
- Finishing with compressor shimming with locking of keys
- Moving of new buckets from boxes to shelves
- Dimensional check of main lube oil parts
- Removal of main hydraulic oil pump
- Dimensional check of bearing #2 and journal
- Installation of bearing #2 lower half
- Lowering the rotor from bearing #2 aux. bearing

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- Clearance check of bearing #2
- Lead wire check of bearing #2
- Installation of upper half and clamp of bearing #2
- Replacement of defected Bearing #1 thermocouple
- Lifting of the rotor with hydraulic jack for turning of bearing #3 lower half into upright position
- Removal of bearing #3 lower half from load tunnel
- NDT of lower 2 tilting pads
- Moving old buckets to the boxes to make them ready to be sent to Sulzer
- Installation of bearing #1 housing
- Removal of brush seals of bearing #2, ongoing
- Installation of bearing #3 lower half
- Trial removal of discourager seal
- Installation of old buckets (6 pcs) of stages 1-3 back to rotor for platform clearance check
- Removal of bearing #2 auxiliary bearing

Remarks:

- Still, even if discussed with the client several times, situation still unclear in load tunnel. Is the area prioritized for GT or for exhaust repair?? Need to be clarified tomorrow when bearing is supposed to be open and no grinding or welding is permitted in that area. Time delay affect due this to be listed later (Thom and Juha)
- Shimming of compressor, possible extra work (Daniel, Mike) 1 hours
- 1 Nut dropped to bearing #2. Localized with borescope, got out with a magnet
- Jack (hydraulic with mechanical lock) purchased due to incomplete kit of customer for bearing #3 inspection
- Bearing #2 auxiliary bearing other nut of U-bolt seems to be seized

Thursday 10.9. working day #21, DS+NS 07.00-23:30

- Check of bearing #3 thermocouples by local C&I group
- Check of bearing #2 and #1 thermocouples by local C&I group, all alive
- Installation of old buckets (6 pcs) of stages 1-3 back to rotor for platform clearance check. Second time, results fully comparable.
- Installation of bearing #1 Bently probes and check of DC gaps by local C&I group

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- Connection of bearing #2 thermocouples by local C&I group
- Installation of inlet bell mouth, bolt torque tightening ongoing
- Installation of the main lube oil pump
- Continuation with auxiliary gear inspection
- More shelves for buckets (scaffs)
- Cross check of bucket #3 documentation and fixing of pins
- Lifting of auxiliary lube oil pump for gasket replacement. Gasket pre-form material given by client and manufactured by GT group.
- General cleaning of scaffolding platforms and turbine hall
- Turning of bearing #2 housing for continuation with brush seal replacement
- Installation of bearing #3 lower half
- Connection of bearing #3 thermocouples by local C&I group
- Installation of bearing #3 upper half with lead wire check
- Installation of auxiliary lube oil pump with a new gasket
- Installation of bearing #2 remaining brush seals, ongoing
- Installation of bearing #3 housing
- Repair of broken seal of FSN support ring

Remarks:

- Even if informed previous evening that bearing #3 thermocouples were going to be removed from bearing body and tilting pads for “live check”, they were only checked with calibrator “in-situ” without removal. Due to this “live check” declaration, no activities with bearing # 3 could not be performed during previous late shift. => caused waste of time in the time when area would had been free to work without obstruction to exhaust repairs
- Still some conflicts with works located in load tunnel area. GT group “took a bit over” today afternoon. No other choice found!!
- Bearing of the main lube oil pump first stage were swopped due to cavitation of axial surfaces
- By the end of the day local C&I group informed that all bearing thermocouples are given OK readings in MkV
- Lead wire check of bearing #3 gave funny readings as expected

Friday 11.9. working day #22, DS+NS 07-23:30

- Completion of inlet bell mouth torque tightening
- Removal of bearing #3 special tooling from load tunnel

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- Torque tightening of bearing #3 housing
- Checking of bearing #3 temperature measurements from SpeedTronic, still OK
- Completion of auxiliary gearbox installation, excluding main hydraulic oil pump
- Installation of flex seals of TS inner
- Final cleaning of compressor casing split lines
- Transportation of compressor casing from different hall
- Taking compressor clearances on position of compressor housing
- Cleanness inspection of lower casing of compressor with a borescope, OK
- Installation of compressor casing
- Bolting of compressor casing and torque tightening, on going
- Welding of cut out section TS inner flex joint by Stork
- Installation of exciter bearing
- Installation of bearing #2 Bently probes by local C&I group
- Preparation of bucket assembly hardware of stages 1-3, all OK
- Installation of remaining brush seal to bearing #2 housing
- Installation of inlet plenum after wall
- Installation of half rings of inlet plenum
- Installation of inlet cone

Remarks:

- Bearing #3 Bently probe cables were found to be slightly damaged when vibrating inside of conduit. Repaired by local C&I group with a shrink plastic
- In inventory of new parts found out that looks like the other(s) packing list is missing. Should compare packing lists available to original order sheet.
- Bowex coupling picked up by Leon
- Exciter bearing picked up by Thom

Saturday 12.9. working day #23, DS 07.00-15:00

- Installation of Bently probes of bearing #2, local C&I team
- Installation of Bently probes of bearing #3, local C&I team
- Installation of inlet cone
- Installation of Aux. side half ring for rubber joint
- Installation of TS and Aux. side rubber joints

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- Torque tightening of compressor casing
- Lock welds of bearing #2 clamp bolts
- Installation of bearing #2 housing with Loctite 510

Monday 14.9. working day #24, DS 07.00-23:30

- Installation of bearing #2 insulation boxes
- Cleanness inspection with a borescope prior to installation of compressor inner barrel
- Installation of compressor inner barrel
- Measurement of remaining compressor clearances
- Cleaning of CDC split lines in LH
- Final cleaning of CDC UH
- Finalization with inlet duct rubber joints
- Cross checks of 1st and 2nd stage buckets SNs / wheel position
- Fixing of bucket pins of 1st and 2nd stage with silicone
- Opening of IGVs to fully open
- IGV clearance check
- Inventory of shroud and nozzle assy hardware
- Installation of IGV actuator, cylinder side still open
- Installation of TS outer flex plate clamps, 7 new screws
- Cleanness check of the compressor later stages with a borescope prior to installation of CDC UH
- Installation of CDC UH
- Torque tightening of CDC, ongoing

Remarks:

- Crane out of service from 10:00 until 20:30
- Local C&I group did not have a chance to install bearing #3 Bently probes
- 1 bucket of 1st stage is missing, #72
- Hydraulic wrench tripped during CDC torque tightening

Tuesday 15.9. working day #25, DS 07.00-23:30

- Inventory of assembly hardware: Casing bolts and shroud / nozzle assembly hardware

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- Searching for missing items of shrouds. One 3rd stage shroud key found, no other objects.
- Cleaning of combustion wrapper split lines
- Installation of Bently probes of bearing #3 by local C&I group
- Torque tightening of remaining CDC bolts
- Finishing with IGV clearances
- Final cleaning of turbine casing lower and upper half holes, threads etc.
- Starting to rebuild upper half of turbine casing
- Cleaning of some still non-cleaned bolts
- Putting FSN together and perform clearance check
- Trial fit of transition pieces to FSN
- Removal of TPs from FSN
- Cleaning of combustion chambers
- Removal of discourager seal up to flush with the rotor surface
- Switching on the lube oil pump and leakage watch of opened areas: Bearings#1-#3 and auxiliary gear box, no leaks found.
- Transportation of new 2nd stage nozzle boxes to turbine hall
- Preparations with gas manifolds
- Packing of old transition pieces into boxes

Remarks:

- Missing items found from assembly hardware: 2 different seals of 1st stage shrouds, 1 shorter assembly pin of 2nd stage shrouds, 4 broken keys of second stage shrouds, 5 broken keys of 3rd shrouds, 5 damaged plugs of 2nd / 3rd shrouds
- Replacement of one damaged turbine casing bolt found from customer's stock
- Replacement of 5 damaged 3rd stage shroud keys found from customer's stock
- Replacement of 5 damaged 2nd / 3rd shroud plugs found from customer's stock
- Missing bucket of 1st stage was found from Sulzer

Wednesday 16.9. working day #26, DS 07.00-23:30

- Completion of re-building of turbine casing upper half
- Inventory of assembly hardware: Piping gaskets and bolts

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- Unpacking of remaining 2nd stage nozzle segments onto pallets in the turbine hall
- Packing of old 2nd stage nozzle segments into boxes
- Pre-fitting of bull horns, left loose
- Packing of old bullhorns into box
- Transportation of manifolds UH to turbine hall and installation of them
- Opening of exciter bearing for lead wire check and immediately closing of it
- Continuation with cleaning of still non cleaned fasteners, only few were left
- Installation of outer cross fire tubes as applicable
- Oil pumps started, also generator lifting oil pump. Leak watch performed and no leaks found.
- Rotor turned for bucket installation. Turns smoothly.
- Buckets of stage 1 installation started and continued during late shift
- Cleaning of large piping flanges
- Double check of some IGV clearances
- Greasing of IGV pinions and installation of gear covers excluding the piece of cover with indicator
- General inspection of cleaned parts. Better cleaning if foreseen necessary.

Remarks:

- Small cable was found had been between split line of exciter bearing. Replaced with new.
- Bull horns assembled with old but well cleaned bolts. New bolts not available.
- Waiting time for witness point regarding to exciter bearing 2 x 1,5 h. Customer's representative not available.
- Different lengths of 1st stage shroud cloth seals were mixed up during turbine casing UH installation. Cut to correct length. Still 1 is missing.
- In the part inventory some missing parts were found: Gaskets, TP side seal brackets, TP side seal bracket bolts etc. Listed separately.
- Over all running very near that there is not enough work for whole of the group in DS and LS prior to 1st buckets, support ring, shrouds and nozzle is installed

Thursday 17.9. working day #27, 07.00-23:30

- Installation of 1st stage bucket locking pin

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- Cleaning of turbine casing lower half with compressed air and vacuum cleaner
- Cleanness inspection with a borescope prior to installation of 1st stage nozzle support ring
- Transportation and assembly of 1st stage nozzle support ring UH
- Installation and torque tightening of support ring most nearest horizontal studs of CDC
- Inventory of assembly hardware: Combustion section assembly hardware, OK.
- Transportation and assembly of 1st stage shroud blocks LH
- Installation of large gas flexibles: From gas skid to gas manifolds.
- Transportation of FSN halves to turbine hall
- Rectifying actions with damaged IGV angle indicator.
- Installation of W-seal to lower half of 1st stage shroud groove
- Installation of FSN lower half
- Taking of relevant turbine clearances prior to installation of FSN upper half
- Installation of FSN upper half
- Removal of power / control block of IGVs
- Overhaul of power / control block of IGVs?
- Concentricity set up of FSN and installation of lower eccentric pin
- Transportation of TPs into turbine hall
- Starting to install TPs

Remarks:

- Onsite machining company arrived 10:30.
- 10"-150 spiral wound SA/CA was delivered by Customer instead of required 10"-300. Correct size shall be searched further on
- 2" -300 spiral wounds without inner support ring usage for primary fuel gas flexibles were accepted by Customer
- A problem noticed with primary gas flexible 1C. Length of flexible found to be 75 mm too long. Removed for rectifying actions and will require a new gasket 5"-300. (Should be available, but shall be confirmed tomorrow)
- Additional work with rectifying of old damage of LHS compressor discharge temperature measurement thermo couple tubing. 2 x 1,5 h during DS, 1 h during LS.
- Crane not available due to installation of onsite machining device. Caused waiting time with FSN installation 3 x 2h during DS.

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- IGV power block was overhaul during LS, 2 x 4h

Friday 18.9. working day #28, 07.00-23:30

- Supporting works for onsite machining company. Machining going well when started.
- Continuation with TP installation excluding TPs #1 and #14
- Recording TP set back clearances
- Inspection of TP + BH locking means, see note
- Installation of 1 remaining large flexible, OK
- Cleaning and preparations with 3rd stage shrouds
- Repair thermo couple tubing
- Preparations with combustion wrapper bolting material
- Installation of combustion wrapper UH
- Torque tightening of combustion wrapper UH
- Installation of bearing #2 internal cooling piping arrangements
- Installation of TPs #1 and #14, taking set back clearances
- Installation of combustion chamber # 11

Remarks:

- Supporting works for onsite machining, 2 x 2h
- Repair of damaged thermocouple tubing, 2 x 1h
- TP set back clearances were found to be large, mostly out of spec.
- Unlocked locking plate found from TP #4, locked but loose bolt was found in TP #11
- Need of speech once again about accuracy in the work
- Onsite machining completed

Saturday 19.9. working day #29, 07.00-15:00

- Supporting works for onsite machining company such as cleaning and lifting
- Removal of onsite machining tools
- Final cleaning of discourager seal groove on the rotor
- Installation of combustion chamber #4, torque tightening
- Installation of remaining cross fire tubes

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- Installation of flow sleeves
- Searching for new inner cross fire tubes, found
- Transportation of combustion liners to turbine hall
- Checking of liners to determine the 2 for chambers having the spark plugs
- Mechanical connection of IGV actuator
- Continuation with checks of bolting material + applying anti-seize

Remarks:

- Supporting works for onsite machining, 2 x 2h
- Cleaning work of groove and installation works of new discourager seal, 2 x 6h
- Seal installation work was little bit obstructed by late arrival of OSM to remove to the tooling
- One 12"-150 gasket found to be missing for bearing #2 cooling extraction piping. Asked from customer

Monday 21.9. working day #30, 07.00-03:00

- Final cleaning of discourager seal groove on the rotor
- Installation of new seal
- Locking of seal stripe
- Inspection inside of the rotor with borescope and necessary cleaning activities
- Installation of remaining (12 pcs) liners
- Determining the installation order of primary and secondary fuel nozzles
- Installation of primary fuel nozzles
- Installation of secondary fuel nozzles
- Installation of combustion piping, ongoing
- Removal of support underneath of inlet bell mouth
- Trial fit of 2 low most blocks of 3rd stage shrouds, OK
- Installation of 3rd stage buckets
- Installation of couple of 3rd stage shroud blocks

Remarks:

- 12"-150 and 10"-300 gaskets ordered. Arrived in the afternoon.
- Amnitec picked up 2 flexibles at 9:00

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- Supporting work given to Customer by lifting works of fans. Item to be added to +/- list
- Additional work with discourager seal installation. During DS 2 x 9h, During NS 2 x 4h.

Tuesday 22.9. working day #31, 07.00-03:00

- Turning and locking of 3rd stage bucket twist locks
- Installation of combustion piping
- Installation of air inlet plenum hatches, lock welds of nuts
- Turning of the turbine casing to horizontal position
- Cleaning of exhaust side vertical flange from turbine casing
- Removal of 3rd stage wheel space (after) well nipple and clean dirt out
- Preparations with 2nd and 3rd stage LH nozzle segment. All assembly hardware exists and all seals/grooves chamfered
- PT of 3rd stage twist locks, OK
- Installation of remaining combustion piping as applicable
- Installation of 3rd stage shrouds
- Locking one more time discourager seal
- Installation of 2nd stage buckets, some of them need to be get a bit further
- Cleaning of inlet plenum with a vacuum cleaner
- Installation of SRV and GTV by company Van Der Ende
- Installation of generator roof sections
- Installation of cooling and sealing air pipe above the compressor section

Remarks:

- Combustion piping of chambers # 3 and #10 shall be left out. They will obstruct later when installing compressor bleed piping.
- 32 pcs of 3/8" UNC hexagon nuts asked from Customer for inlet plenum hatches. Customer supplied nuts as requested
- Additional work 2 x 1,5 h with removal of 3rd stage after wheel space thermo couple well nipple. Found lots of dirt inside. Cleaned and reassembled. Tested by local C&I group, OK.

Wednesday 23.9. working day #32, 07.00-03:00

- Final installation of 2nd stage buckets
- Turning and locking of twist locks of 2nd stage

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- Visual inspection and PT of twist locks
- General arrangements in the turbine hall
- Transportation of all large piping work into turbine hall
- Preparations flange by flange of all the bolting and gasket material of large piping work
- Removal of supports underneath of front support leg (plate support)
- Loosening further the IGV ring support and locking of it
- Unlocking of IGV actuator arm for adjustment of IGV angle
- Installation of 2 large flexibles
- Visual inspection and PT of twist locks
- Installation of 2nd stage shrouds
- Installation of 2nd and 3rd stage nozzle segments, LH, on going
- Checking of implosion hatches correct operation
- Cleaning and checking of load tunnel side flex plate clamps
- Cleaning of auxiliary coupling cover parts
- Removal of turning gear, on going
- Installation of grating nearby IGV actuator
- Installation of VGS and VGT by company Van Der Ende
- Checking of gas valve bolting

Remarks:

- Gas flexibles arrived at 14:30 to site. Installed and found to be good in length.
- Found problems with installation of 3rd stage nozzle segments. Some of them in contact with insulation boxes of casing. Modification works needed.
- Installation error with 2nd stage shrouds. Order number failed
- Cleaning of coupling guard and inspection of implosion doors additional work, 2 x 5h

Thursday 24.9. working day #33, 07.00-03:00

- Taking of 2nd stage platform clearances for reference, 5 pcs
- Installation of remaining 2nd and 3rd stage nozzles
- Removal of turning gear "star"
- Removal of auxiliary coupling

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- Recording of turbine clearances
- Preparations of TC lower casing and upper casing for installation
- Cleanness inspection with borescope of lower casing
- Installation of turbine casing
- Bolting and torque tightening of turbine casing
- Installation of FSN UH eccentric pin
- Removal of casing supports
- Starting of large piping installation
- Installation of flex plates, ongoing

Friday 25.9. working day #34, 07.00-03:00

- Installation of large piping
- Axial float measurement
- Installation of casing support hatches
- Installation of combustion flexibles of CC #2 and #13
- Preparations for sending of electrical container away
- Preparations for alignment check
- Alignment check
- Installation of auxiliary coupling
- Installation of flex plates
- General arrangements in the turbine hall
- Installation of gas valve LVDTs

Remarks:

Pointer/fixation piece of VGC LVDT was installed upside down. Drilling / tapping of 2 new holes, 2h. Something to compensate in Van Der Linde invoice.

Saturday 26.9. working day #35, 07.00-14:30

- Welding of flat steel pieces on the UH of radial pin dowels TC-ExC vertical flange
- Removal of coupling cover in applicable parts and installation of turning gear
- Perform rotor position measurement
- Removal of turning gear
- Installation of coupling cover

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- Installation of gas valve LVDTs
- Testing and installation of flame detectors
- Testing and installation of spark plugs
- Starting with Gas valve calibration
- General arrangements in the turbine hall

Monday 28.9. working day #36, 07.00-15:30

- Installation of wheel space thermo couples
- Installation of last bolt to load tunnel side flex plates
- Installation of lost radial pin dowels to LH vertical joint between TC and ExC
- Cleaning and final inspection of exhaust diffuser
- Removal of scaffoldings from RHS
- Closing of exhaust diffuser man hole, bolts tag welded
- General arrangements in the turbine hall

Remarks:

- Installation of dropped radial pin dowels to TC-ExC vertical joint LH. 2 x 3 h additional work.
- Changing of damaged wheel space thermo couple and investigation of mixed ones in LHS. 1 x 3 h additional work.
- Steel wedge was dropped to inlet plenum from the top by scaffolders.

Tuesday 29.9. working day #37, 07.00-15:30

- Calibration of IGVs
- Finishing with gas valve calibration
- Welding and installation of additional flex plate turbine side LHS
- Installation of missing instrument piping clamps in load tunnel
- Removal of exciter bearing orifice plate for inspection, drilling a 6.5 mm hole and marking of diameter
- Removal of scaffoldings from LHS
- Removal of scaffoldings from inlet plenum
- Final inspection of inlet plenum
- Closing of inlet plenum hatch

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- General arrangements in the turbine hall
- Final external inspections, completion of the work
- Mechanical Complete at 17.05

Remarks:

- Calibration of IGVs were slightly out of spec. (34-88 deg) Changed 32-86 deg
- Works with turbine side LHS flex plates, 2 x 2 h additional works
- Removal of exciter bearing orifice.... 2 x 1 h additional work

Wednesday 30.9. working day #38, 07.00-15:30

- Demobilisation of Fortum Crew
- Report

Thursday 01.10. working day #39, 07.00-15:30

- Waiting for Startup
- Problems with Steam Turbine Software

Friday 02.10. working day #40, 07.00-15:30

- Waiting for Startup
- Problems with Steam Turbine Software

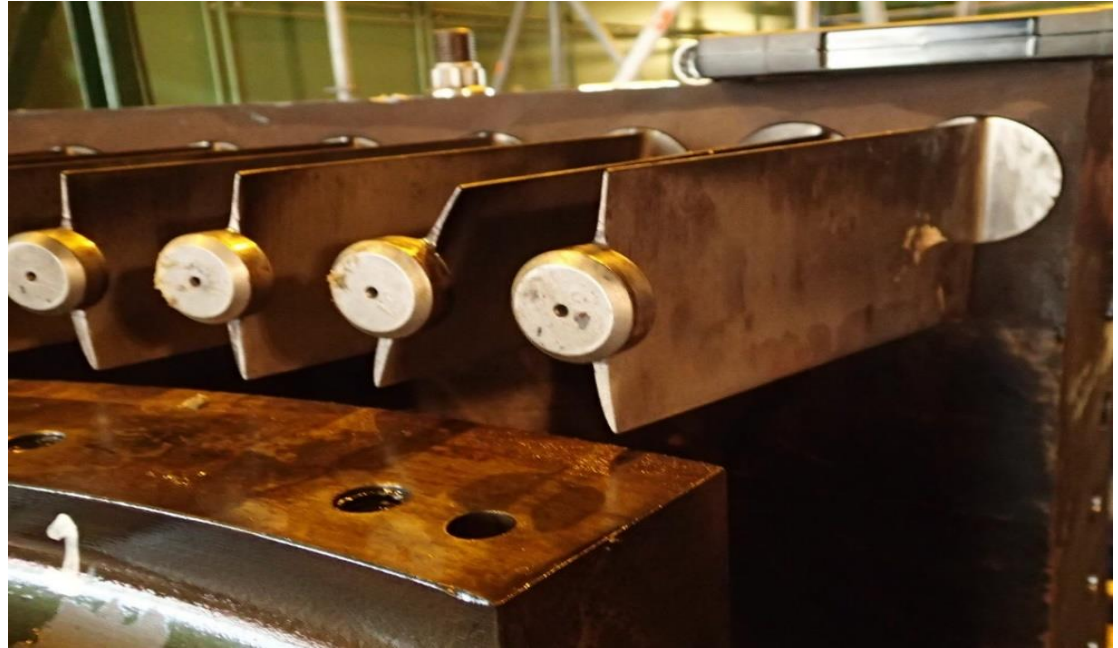
Monday 05.10. working day #41, 07.00-15:30

- Waiting for Startup
- Problems with Steam Turbine Software

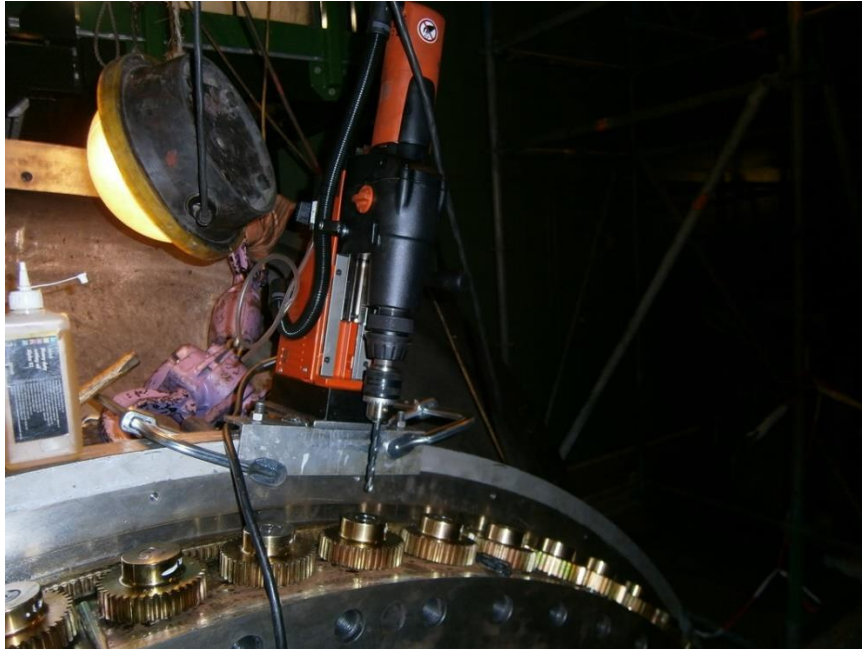
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Summary

IGV's



IGV Dismantling



Drilling of IGV's with new Gears and Rack

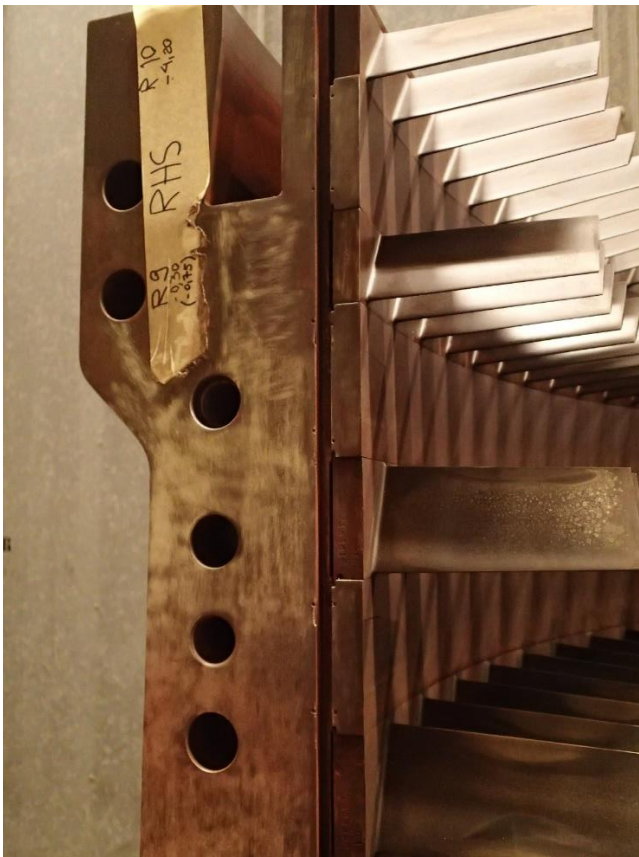
All IGV's were disassembled, cleaned and Dye Penetrant checked, no indications found. All Chemloy and Inner/Outer Bushings were replaced with new Components. New Gears and Rack were installed. IGV's are drilled for the third and last time now. Mechanical Stops are on 90deg, and 32deg. IGV actuator was overhauled by Customer due to leaking of Actuator Stem.

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Compressor

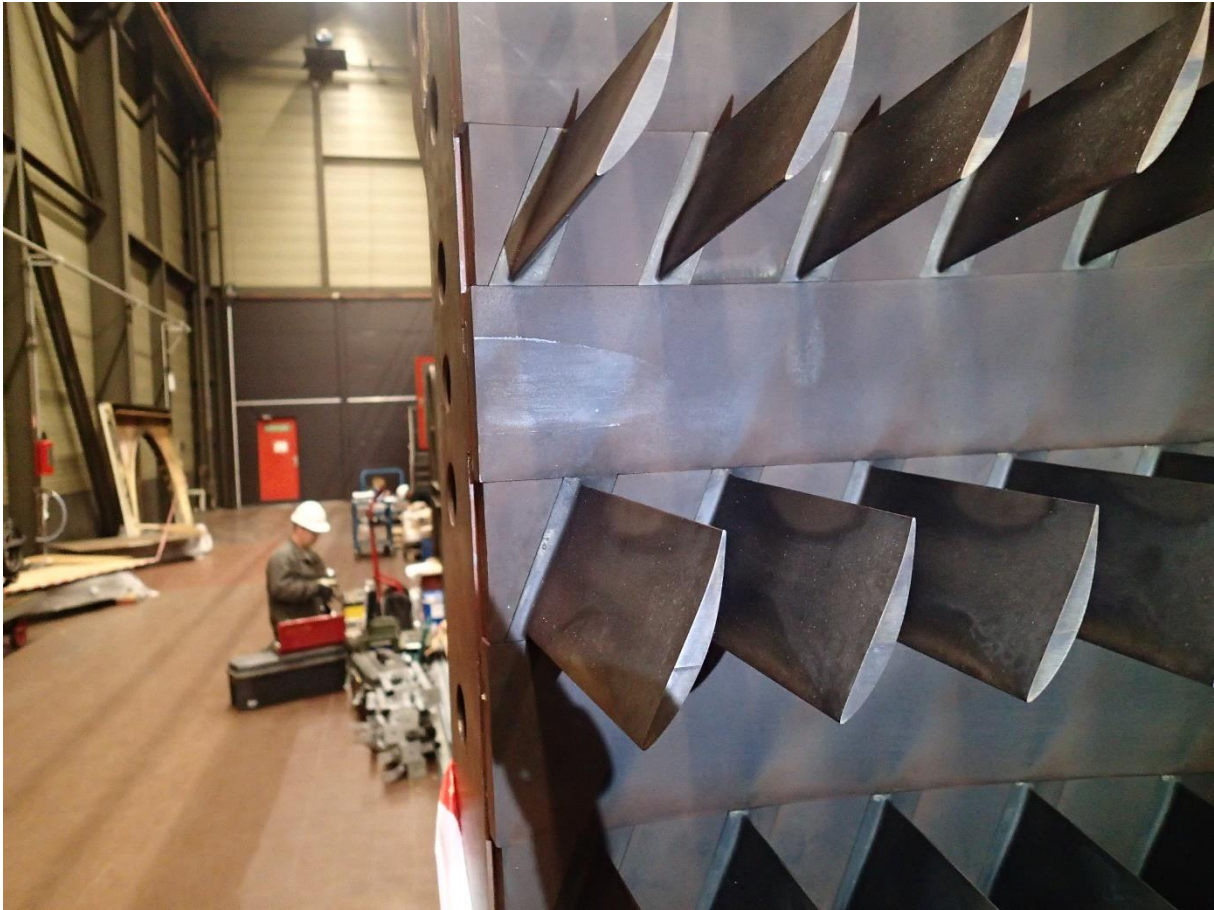


Quit heavy, old Rub Marks on Upper Half Compressor Casing R11



Compressor Casing Upper Half RHS before Shimming

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Compressor Upper Half RHS before Shimming. Notice Rub Marks R6 and S7

Compressor Casings Upper Half were Visually and Dye Penetrant checked. Row R14 gave some indications. After removal of 9 Vanes, and checking those Vanes, it turned out to be some scaling, probably formed during the rubbing of compressor Blades and Casing. After cleaning and checking, no indications were found, and Vanes were returned to Service.

All Rows of Vanes were shimmed to the correct clearances given on drawing 91-201318 Vane Arr. Which can be found in the Parts Manual.

Casings

The Turbine Casing Upper Half was checked according the TIL 1628, cracking of Turbine Shell, no Indications found. Threads of Bearing cover #1 were damaged in an earlier stage of turbine life. Two helicoils were installed. Four Helicoils CDC to TC were replaced. All remaining Threads were retapped and cleaned.

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Damaged Thread Bearing #1



Another Damaged Thread Bearing #1

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First Stage Buckets



Removed 1st stage Buckets



Some Minor Damage of Squealer Tip

Buckets were removed because of running hours. TBC was still OK, some Minor Damage of Squealer tip was observed. Refurbished set was installed with new Hardware. Refurbished set was compiled with some Buckets from another set. During installation these buckets gave some problems because Trailing and Leading Edge of Buckets interfered quite heavy. See Photo

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Misfit of 1st stage Buckets

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First Stage Nozzle



Loss of TBC Leading Edge



Cracks on Leading Edge

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Massive Loss of TBC on Leading Edge



Medium Cracks on 1st Stage Nozzle partition

The 1st stage Nozzle was replaced because most partitions showed medium cracks and loss of Thermal Barrier Coating. Refurbished nozzle was installed, and adjusted. No modification of eccentric Pin needed.

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First Stage Shrouds



Light Erosion of TBC



Removed 1st Stage Shrouds

Shrouds were replaced with a refurbished set and new hardware. This set was pre-drilled and fitted flawless

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Second Stage Buckets



Medium Z-notch deflection



Deflection of Z-Notches 2nd stage Buckets

All 2nd Stage buckets were replaced with a refurbished set according the given Moment weight chart.

Buckets showed showed Z-Notch Deflection. Check with TIL 1067-R3 indicated that the deflection had not progressed beyond the point of rejection.

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Second Stage Nozzle



Damaged Seal Area



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Burned Seal and Diaphragm area because of installation failure



Damage of 2nd Nozzle because of misalignment during former installation

Second Stage Shrouds



Shrouds ready for assembly

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Third Stage Buckets



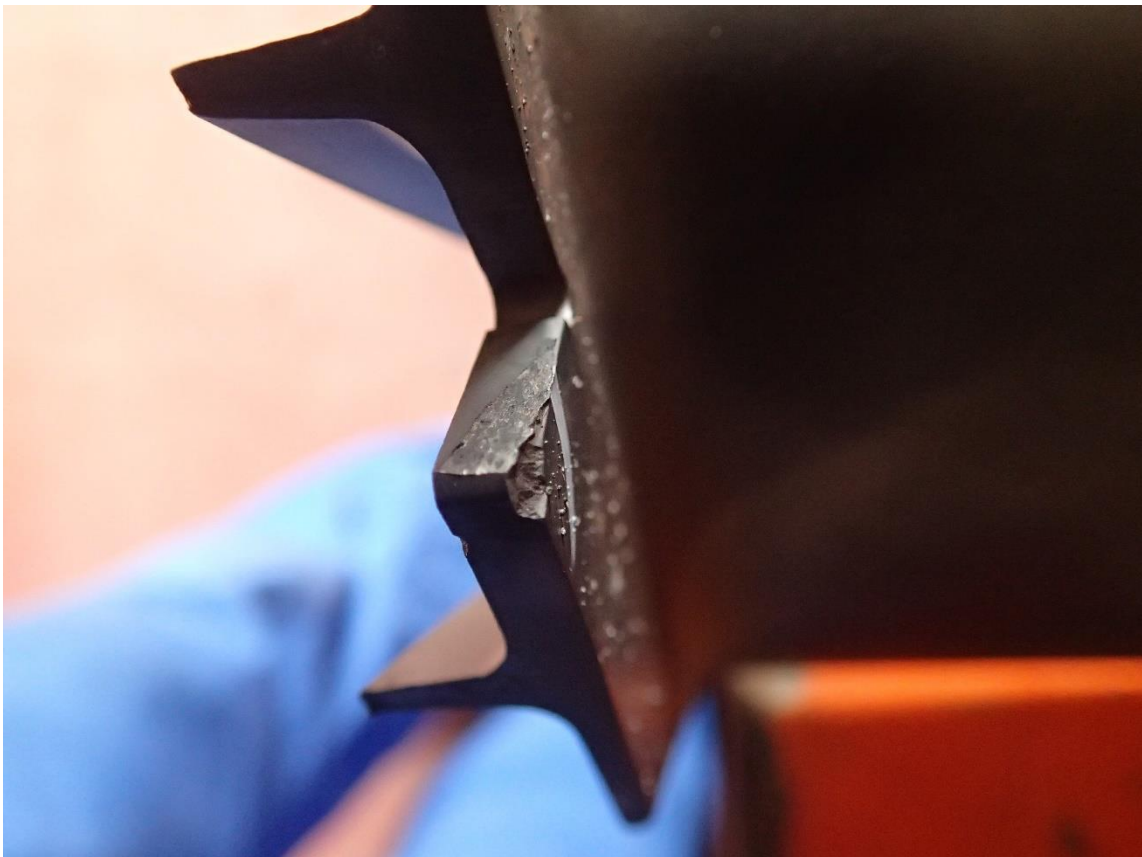
Installation of refurbished 3rd stage Buckets

During Removal of the 3rd stage Buckets it became clear that some 30 buckets had damaged Z-Notches. It also was clear that there was some existing damage, and some new damage. New damage happened through to rough disassembly of these Buckets. A refurbished set was installed according the given Moment Weight Chart

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New damage 3rd stage Bucket



Existing damage 3rd stage Buckets

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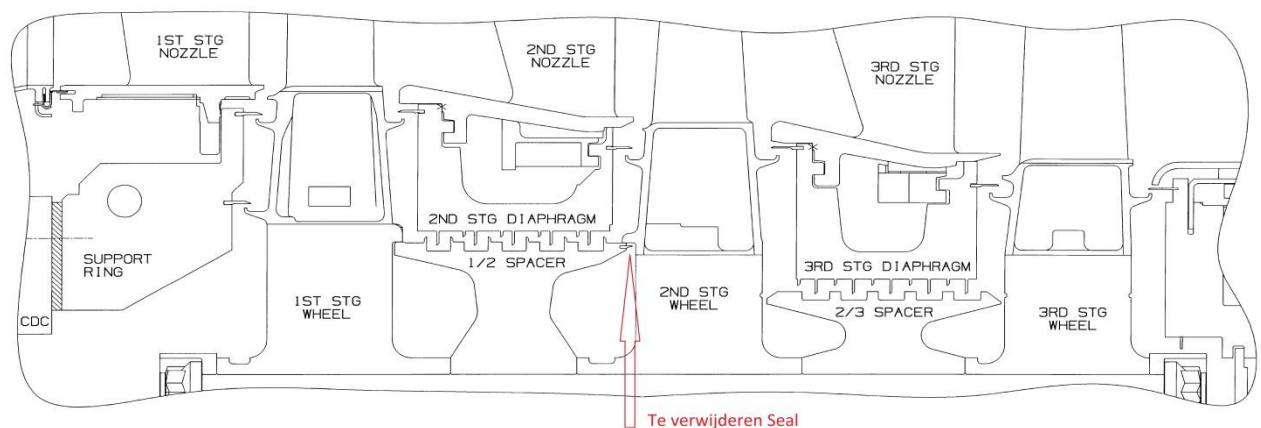
Third Stage Nozzle



The 3rd stage nozzle was removed from the Lower Turbine Casing to facilitate the removal and installation of the 3rd stage Buckets. No cracks or deformation was observed, and after visual inspection the Nozzle was returned to Service

Discourager Seal

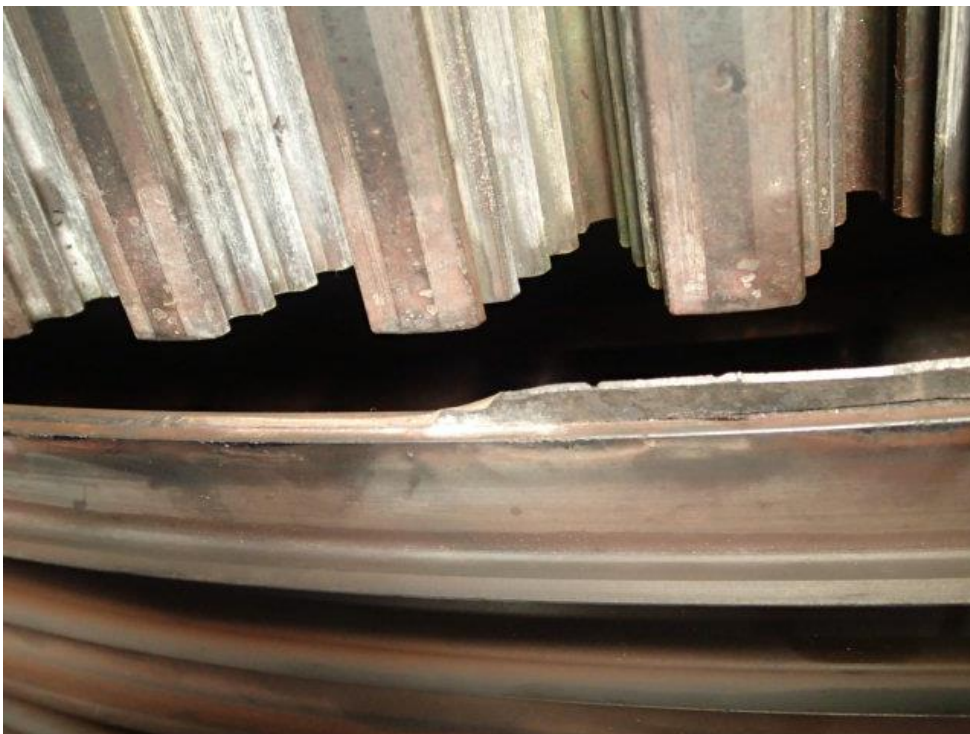
After removal of the Second Stage Buckets, it became clear that the Discourager Seal was in a far more bad shape than was expected. Rough indication showed that almost 20% of the seal had disappeared, and some pieces could be broken by hand from the remaining seal.



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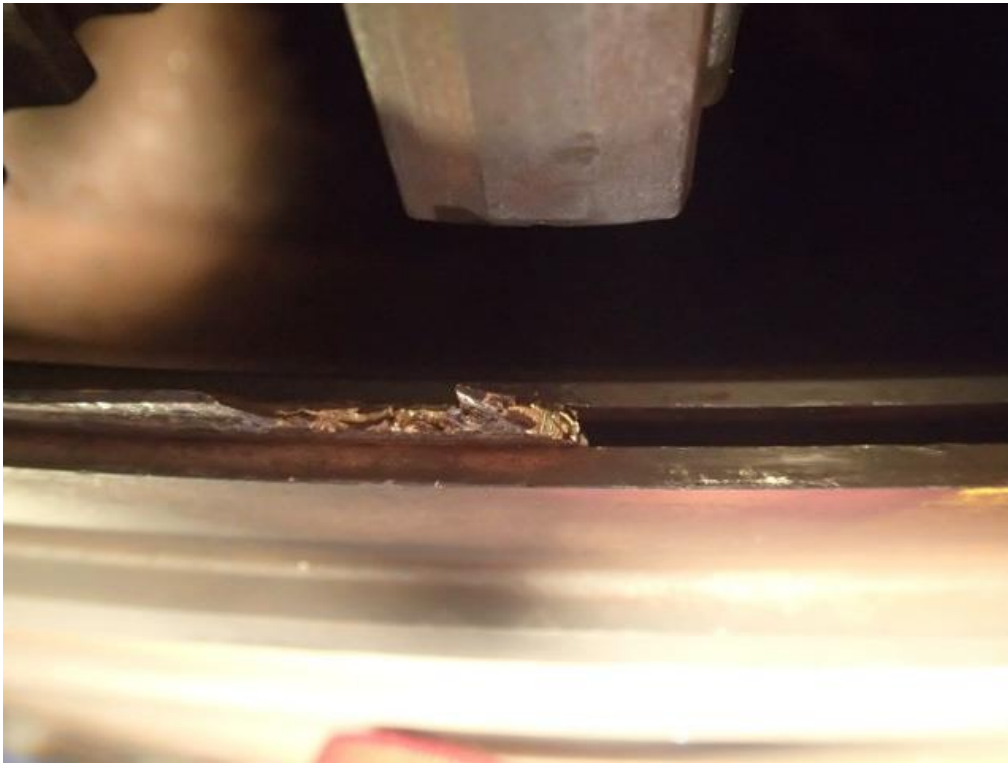


Damaged Discourager seal



Damaged Discourager Seal

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After attempt to remove seal by hand.

After several attempts to remove this seal by hand, Furmanite was invited to site to remove this seal. They could not do it. In the meantime a local company "Onsite Machining" showed up, and they would give it a try. After adjusting their machine, removal of this seal went straight forward, and after cleaning of the groove from pieces of old seal, the new seal was installed and locked by peening.

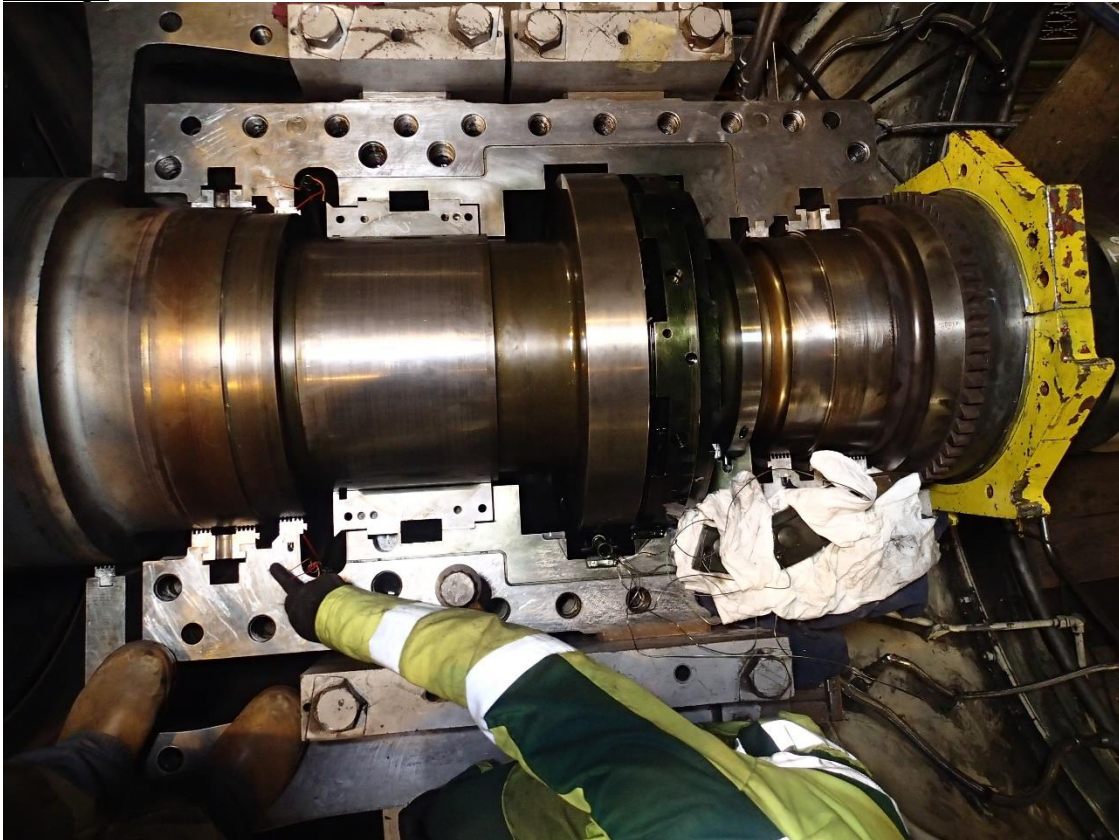
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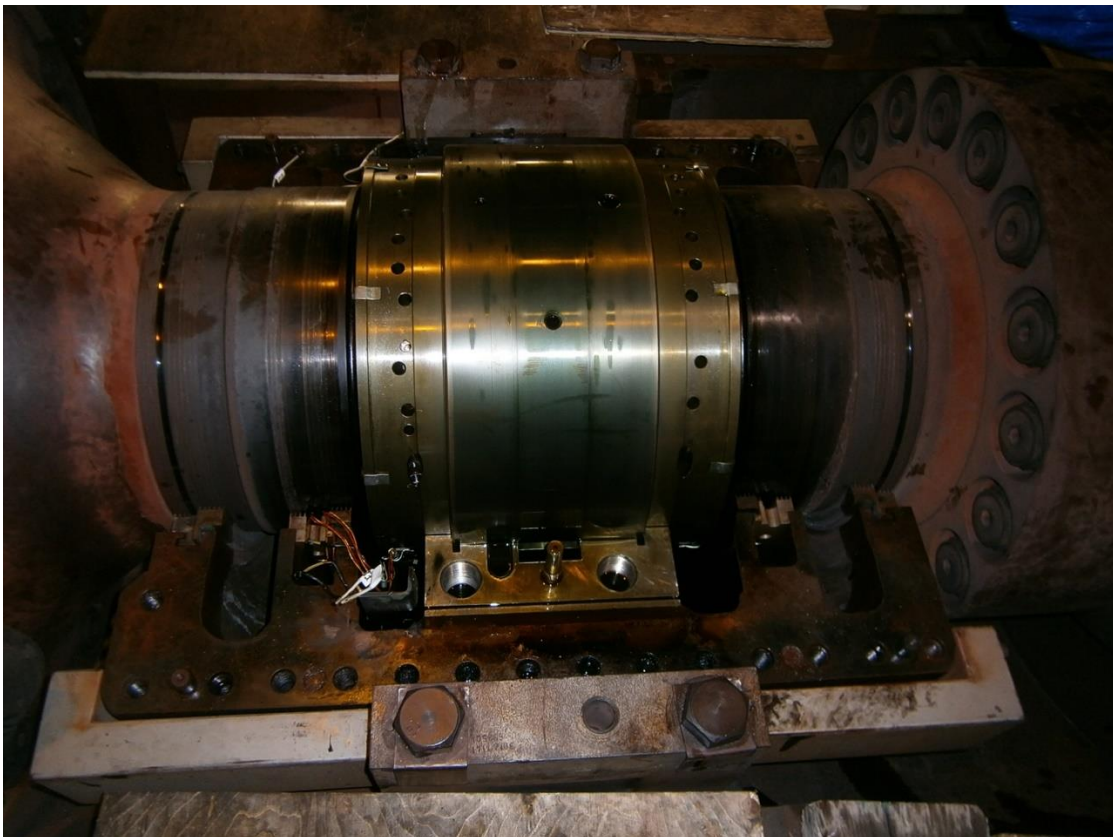
Installed new Discourager seal

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Bearings

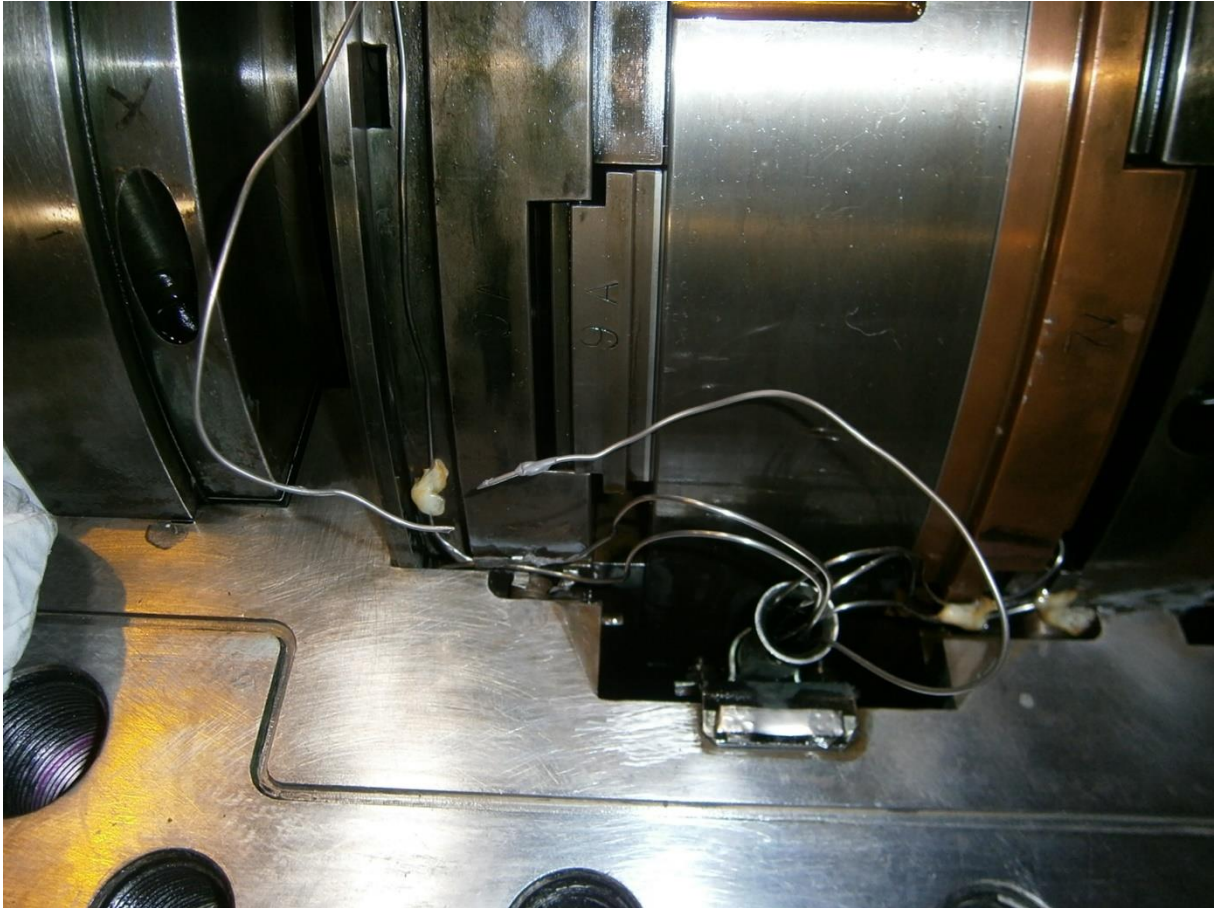


Bearing #1



Bearing #2

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Broken Thermocouple Wire Bearing #1

All Lower halves of Bearings were removed, with the rotor In Situ, which made it a bit of a challenge. The Bearings were cleaned, Ultra Sonic and Dye Penetrant checked. Because no Spare Bearings were present, a dimensional check was not possible. During installation a Lead Wire check was made, which were in Tolerance, except for Bearing #3 which was of the 5 pad design, and therefore gave erratic values. For detailed information check Protocols and NDT reports.

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Inner Barrel



Inner Barrel Brush Seal Right Hand side



Inner Barrel Damaged Brush Seal Left Hand Side

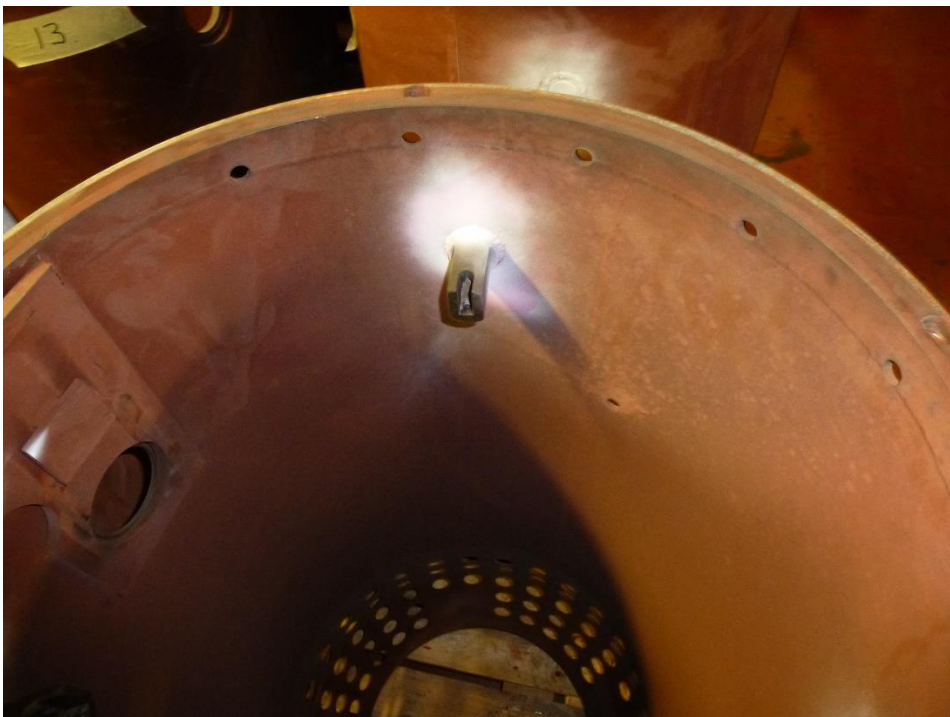
From the Upper Half Inner Barrel LHS one part of the brush seal was damaged. EBX had some undamaged parts available which was replaced the damaged one.

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Combustion Parts

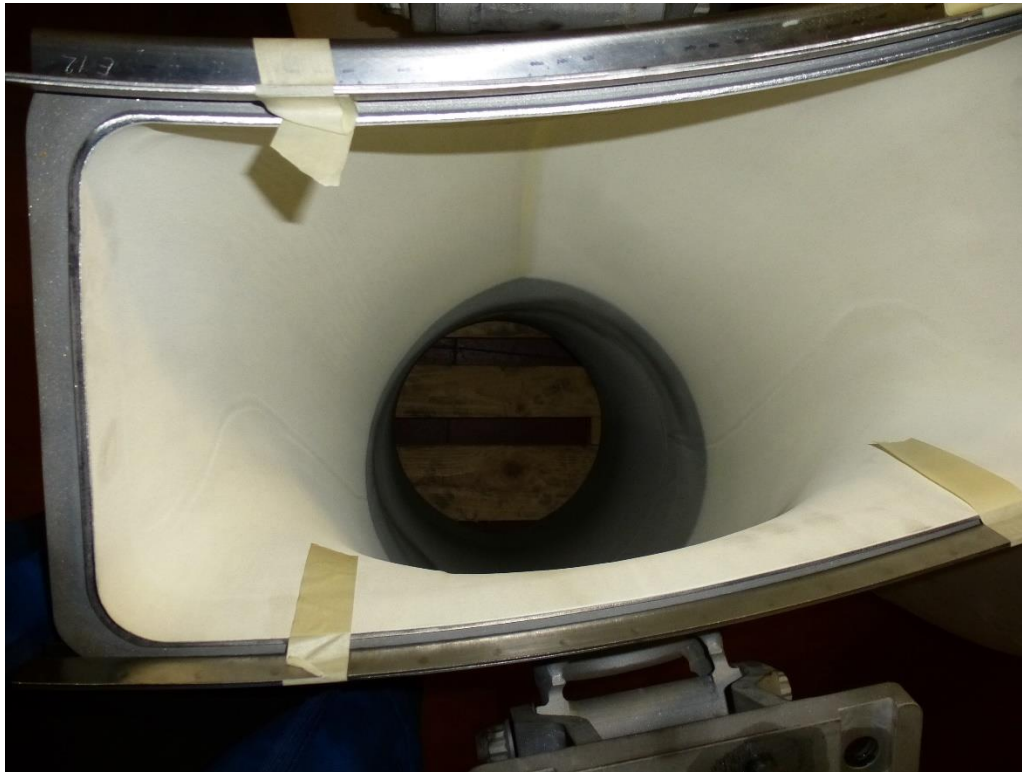


Loose Locking Ring Primary Burner



Dye penetrant checked Liner stop in Flow Sleeve

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Picture Frame refurbished Transition Piece

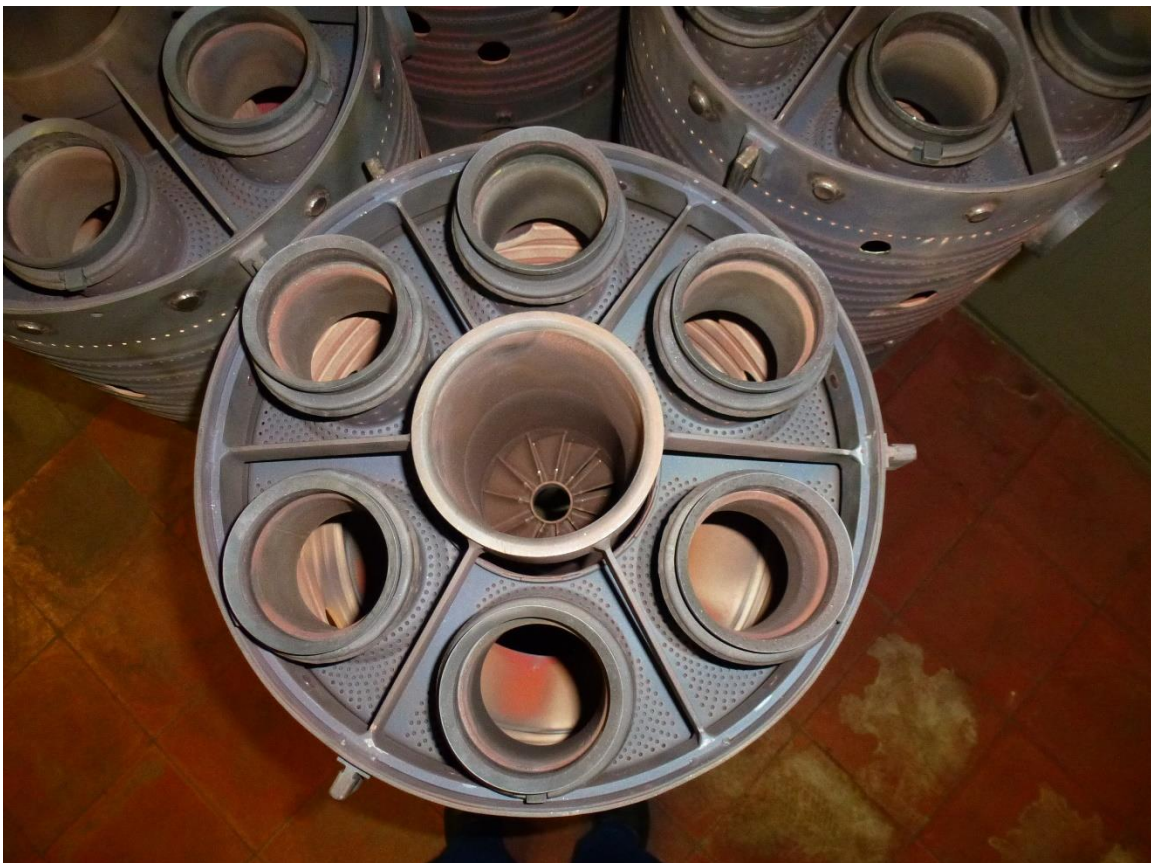


Disassembled Secondary burners

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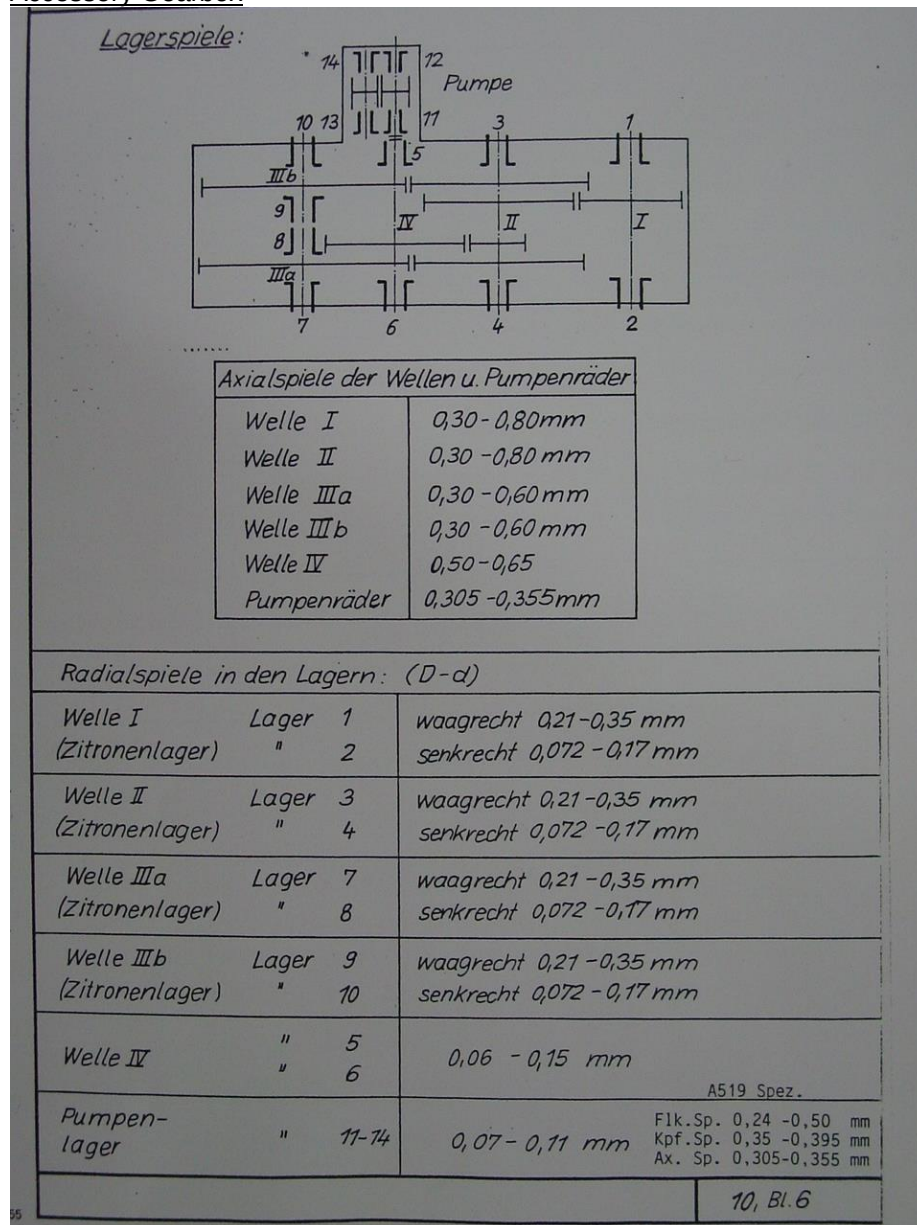
Disassembled Liners



Disassembled Liner Cap

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Accessory Gearbox



Accessory Gearbox Covers were opened and a visual inspection was made. No abnormalities observed. The Vertical bearing clearances were recorded, the Backlash of gears was recorded and the axial movement of the shafts was recorded. Both the main oil pumps were opened, and gears plus bearings were inspected and diameters of shafts and bearings were recorded. Main HP hydraulic pump was disassembled, and BOWEX 32 coupling was changed for a new one.

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Recorded clearances of shafts Accessory Gearbox

Shaft #1	Bearing #1	Vertical :0,14mm
	Bearing #2	Vertical: 0,12mm
	Axial Clearance	0,49mm
Shaft #2	Bearing #3	Vertical: 0,14mm
	Bearing #4	Vertical: 0,12mm
	Axial Clearance	0,35mm
Shaft #4	Bearing #5	Vertical: 0,09mm
	Bearing #6	Vertical: 0,09mm
	Axial Clearance	0,45mm
Backlashes	Shaft #1 – Shaft #2	0,16mm
	Shaft #2 – Shaft #4	0,30mm

Recorded Outer (GT-Side) Oil Pump Clearances

Bearing Upper/Outer	75,11mm	Shaft Upper/Outer	74,98mm	0,13mm
Bearing Upper/Inner	75,09mm	Shaft Upper/Inner	74,97mm	0,12mm
Bearing Lower/Outer	75,08mm	Shaft Lower/Outer	74,98mm	0,10mm
Bearing Lower/Inner	75,09mm	Shaft Lower/Inner	74,98mm	0,11mm
Axial Clearance	0,35mm			

Bearings and Gears showed very minor Cavitation marks, so bearings were replaced in the original position.

Recorded Inner (Starter Motor-Side) Oil Pump Clearances

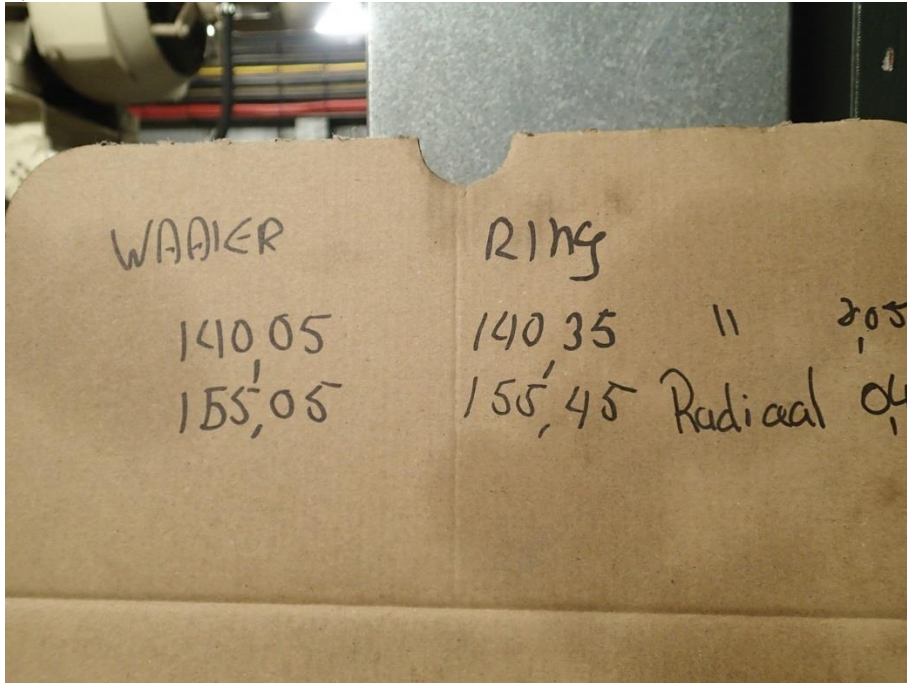
Bearing Upper/Outer	75,09mm	Shaft Upper/Outer	74,98mm	0,11mm
Bearing Upper/Inner	75,09mm	Shaft Upper/Inner	74,99mm	0,10mm
Bearing Lower/Outer	75,09mm	Shaft Lower/Outer	74,99mm	0,10mm
Bearing Lower/Inner	75,11mm	Shaft Lower/Inner	74,98mm	0,13mm
Axial Clearance	0,30mm			

Bearings replaced like inner-outer becomes upper lower, due to minor cavitation marks.

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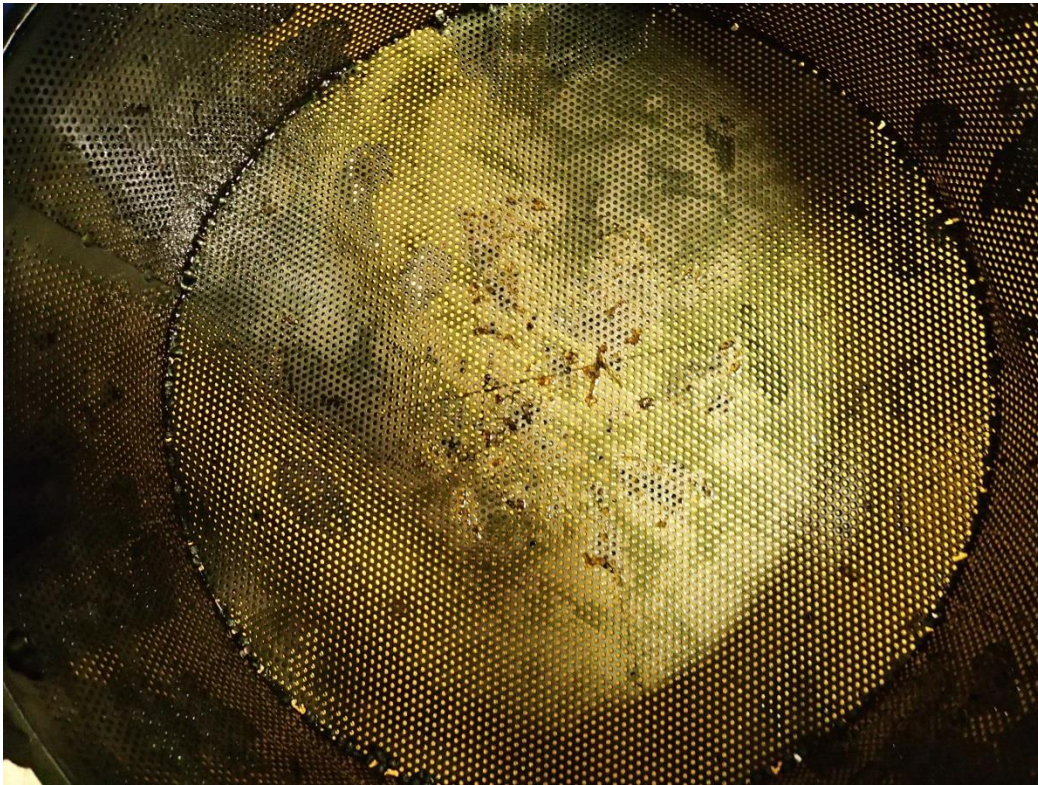
Aux and Emergency Lube Oil Pumps.

Both E-Motors were serviced with new Bearings, and cleaned by EON Benelux. During the overhaul of the motors, both Pumps were removed from the Lube Oil Tank for a visual inspection. Both inlet screens were fouled with a little varnish like debris. Inlet Cones were disassembled and radial clearances were recorded. Max Radial clearance must not exceed 0,45mm. Emergency Pump clearance was 0,05mm, Auxiliary Pump 0,40mm



Auxiliary Lube Oil Pump

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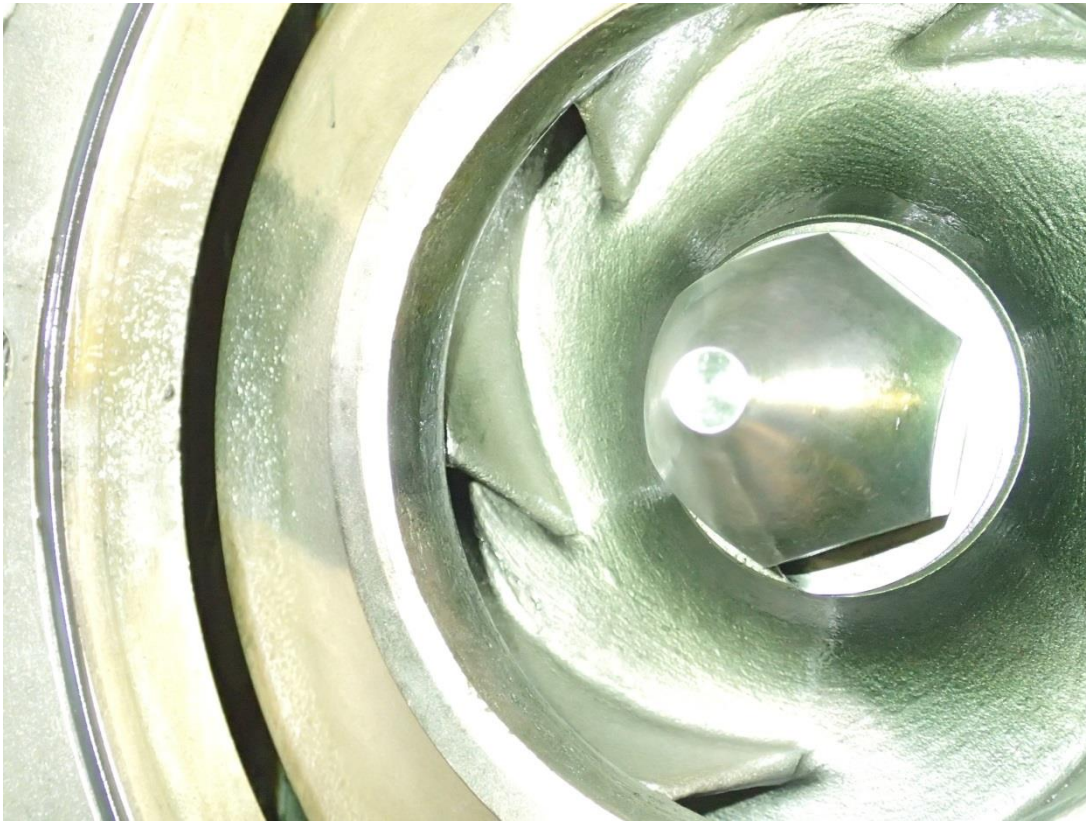


Inlet Screen Auxiliary Pump



Emergency Lube Oil Pump

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Cleaned Emergency Lube Oil Pump Impeller

Christian
Busch

E.ON Anlagenservice GmbH

Digital unterschrieben von Christian
Busch
DN: c=DE, o=E.ON SE,
serialNumber=C5487, cn=Christian Busch
Datum: 2015.12.02 11:23:48 +01'00'