Exhibit G-1

Comanche Unit 3 - Spring 2020 Outage

Full Train Major, Main Steam Valves & Generator

COMANCHE (CO)

Steam Turbine ESN: SY0093272

Generator ESN: SY0350139

Job Start Date: 13 Jan 2020

Oracle Project ID: FSP-285469 | C-10344497

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Approved By
Joel Chadbourne,

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1 Summary

1.1 Site Personnel

Name	Category	Role
Joel Chadbourne	GE	Service Manager
Kellan Frericks	FieldCore	Service Manager
Sean Connor	FieldCore	Outage Manager
Mark Cain	FieldCore	Project Manager
David Johnson	FieldCore	Lead Technical Advisor
Chris Mack	FieldCore	Technical Advisor
Laura Caceres	FieldCore	Technical Advisor
Celeste Menard	FieldCore	Technical Advisor
Steve Maxwell	FieldCore	Generator Specialist
Kole Rogers	Contractor	APM Superintendent - Dayshift
Jimmy Amidon	Contractor	APM Superintendent - Nightshift
Jessee Carpenter	Contractor	APM Superintendent - Nightshift
Andrew Johnson	Contractor	APM Superintedent

1.1 Site Personnel

Name	Category	Role
[redacted]	Customer	Station Director
[redacted]	Customer	Outage Coordinator
[redacted]	Customer	Plant Engineer
[redacted]	Customer	Turbine Engineer
[redacted]	Customer	Turbine Engineer
[redacted]	Customer	Turbine Engineer
[redacted]	Customer	Generator Specialist
[redacted]	Customer	Non-Destructive Testing Expert

1.2 Executive Summary

Comanche Unit 3 is a super critical Mitsubishi TC4F36, frame N-61, steam turbine-generator set. A combined nine stage high pressure - six stage reheat turbine and two six stage dual flow LP turbines are coupled together, in a tandem configuration. LPB is coupled to a 829 MW MELCO hydrogen cooled generator with stator winding cooling water.

On January 13, 2020 the unit experienced a step change in vibrations after a loud noise was observed coming from the second LP turbine. General Electric was contacted to investigate the source of the vibration. Fieldcore and APM personnel arrived onsite January 17, 2020 and work began January 18, 2020 after LOTO verification. Prior to the arrival of GE personnel, the customer maintenance crew had removed the LPB crossover and began removal of the LPB exhaust hood to begin the investigation. The investigation revealed that the source of the vibration change was the failure of a generator end L-1 bucket. The bucket had sheared at approximately the halfway point along its length and the liberated portion had damaged several partitions of the subsequent stage 6 blade ring. The generator end LPB

1.2 Executive Summary

L-0 buckets and erosion shields had also sustained impact damage, as a result of the failure.

After the discovery of the failed L-1 bucket, it was decided that both LP rotors should be removed, grit blasted and examined, non-destructively. The resulting discovery, from the non-destructive examination, was that all of the L-1 buckets had linear indications at the location where the generator end LPB bucket had failed. It was at this point that Xcel Energy made the decision to replace all four rows of L-1 buckets and enter into the full train major inspection, that had been scheduled for the fall.

Manpower for the inspection was supplied by APM. Grit blasting was performed by ARCO. Nondestructive testing was conducted by 3 Angles. Laser steam path alignment services were provided by Turbine Laser Alignment. Induction bolt heating was executed by Industrial Bolting. The L-1 buckets were removed by Fieldcore bucket techs. Visual inspections and electrical testing of the generator were carried out by Fieldcore Generator Specialists. Onsite machining was performed by GE OSS machinists and Accurate Machine & Tool machinists. New L-1 buckets were supplied and installed by Ethos. The rotors were also low speed balanced onsite by Ethos.

Generator Major (Rotor Out) Test & Inspection was performed as part of the additional scope. Stator visual inspections were performed on the end windings, stator core iron, wedges, core compression nuts, spring bars, HV bushing box and other surrounding components. Field visual inspections included, but were not limited to; End windings, retaining rings, main leads, collector studs, pole & coil jumpers, end winding blocking, Field body, body wedges, creepage blocks, collector rings & ventillation holes. A full electrical test series was also performed on both the field & stator, per the most current revision of GEK103566, "Creating an Effective Generator Maintenance Program". Hydraulic Integrity Testing was also performed to verify the integrity of the Stator Winding cooling circuit. Shear wave ultrasonic testing was performed on the generator field retaining rings.

Major findings of the inspection included severe damage found on the high pressure last stage (stage 9) integral shroud buckets (stages 7 and 8 also exhibited evidence of damage), failure of the #1 dummy ring center row packing hook fit, all of the lower half HP-IP turbine spill strips were found severely rubbed. Both the turbine and generator end hydrogen seal babbit surfaces were found damaged and in need of repair. Additionally, and in general, deficient maintenance practices, questionable operating procedures and poor steam quality were observed throughout the machine.

Another finding of significance was made during the lube oil flush. Small wires and magnetic particles were found in the filter bags at the turbine bearing jumper oil lines. The source of the wires was found to be a failed filter element. It was discovered that the lube oil filter elements had not been changed for several years. The OEM recommends that the filter elements be changed when the differential pressure, across the filter element, reaches 15

1.2 Executive Summary

psi or every six months, whichever comes first. Differential pressure across the filter was found to be 3 psi, which is quite low. Also, the filter elements that had been installed were not correct, per OEM design. Furthermore, the stabilizing brackets at the top of the filter housing were found damaged. This bracket was the only component that was found to be magnetic, so, it is assumed to have been the source of the magnetic particles.

During start-up the lube oil supply to the bearings was cut-off and the unit coasted down from approximately 3400 RPM to zero in approximately 4 minutes. The result of this loss of oil was substantial damage to all components in the rotor train. The details of the damage and remedial actions taken can be found in a separate report.

Due to the catastrophic bearing failure and resultant rotor position shift, none of the power train clearance measurements or steam path alignment measurements taken during the inspection are valid any longer. The only portions of the executed work scope that were not materially affected by the failure are the valve scope, both the main steam and non-return valves, and the stationary to stationary component relative position clearances.

1.3 Work Scope

Outage Type: Forced Outage

Turbine
Major

Generator
Major (rotor out)

2 Technical

2.1 Recommendations

DC Leakage & Hipot Test
Next Outage

Services

Continue to perform Stator Electrical testing and trend DC Leakage data at prescribed outage intervals, per the most current revision of GEK103566, "Creating an Effective Generator Maintenance Program"

ELCID Test
Next Outage

Services

Perform ELCID testing at the next available outage in which the Rotor is removed, in order to verify the integrity of the Stator Core Iron.

Wedge Tightness Test
Next Outage

Services

Perform Wedge Tap testing at the next available outage in which the Generator Rotor is removed, in order to trend wedge tightness data and ensure Stator wedges are not loosening over time.

Pressure & Vaccum Decay Testing
Next Outage

Services

Continue to perform hydraulic integrity testing to verify the tightness of the Stator Winding during every outage and prior to electrical testing, unless testing on a Nitrogen blanket.

Megger Test with Polarization Index (PI)
Next Outage

Services

Continue Field Electrical testing at prescribed intervals per the most current revision of GEK103566, "Creating an Effective Generator Maintenance Program"

Stator End Winding Assembly
Next Outage

Repairs

At the next outage in which the Rotor is removed, perform torque spot-checks on End Winding structural and insulation bolts. If torque checks are unsatisfactory and a full torque sequence is required, purchase and install new lock plates, as they should not be exercised a second time.

2.1 Recommendations

HP-IP Rotor
Next Outage

The rotor should be grit blasted and non-destructively examined.

LPA Rotor
Next Outage

Consideration should be given to replacing the L-0 buckets, based on the separation of the erosion shields and erosion at the "Z" locks.

The rotor should be grit blast cleaned and non-destructively examined.

LPB Rotor
Next Outage

The generator end L-0 buckets should be replaced at the next opportunity. Separation between several of the turbine end buckets and erosion shields was also observed, and, strong consideration should be given to replacing this row as well.

The rotor should be grit blasted and non-destructively examined.

The L-0 buckets should be inspected on a regular basis when the unit can be taken off of turning gear.

HP-IP Outer Cylinder
Next Outage

If the HP inner cylinder base is to be removed for inspection of the inlet seal rings, then the drain pipe should be cut outside of the outer cylinder base and the weld should ground out at the boss. It will be necessary to block the inner cylinder base up high enough for the drain pipe to be off the ground.

The thermowell weld at the HIP outer cylinder base should be ground out and the thermowell removed before attempting to install the HP inner cylinder base. The thermowell will need to be inserted and welded after the the HP inner cylinder base is reinstalled. The thermocouple should be removed before the well is welded.

Inner Cylinders
Next Outage

Fit areas should be non-destructively examined.

Dummy Rings
Next Outage

The female packing hook fits should be non-destructively examined.

2.1 Recommendations

Glands
Next Outage

The female packing hook fits should be non-destructively examined.

Main Steam Inlets
Next Outage

Clearances and roundness of the seal rings and pipes should be checked.

Reheat Steam Inlets
Next Outage

The OEM should be contacted to determine the design clearances of the floating seal rings.

New floating seal rings should be installed in the HIP outer cylinder and the pipes on the inlet casing should be welded and machined to restore roundness and design clearance.

Journal Bearings
Next Outage

The bearings and floating seal rings should be dimensionally, ultrasonically and dye penetrant examined.

Thrust Bearing
Next Outage

The bearing pads should be ultrasonically and dye penetrant examined.

Stack checks should be performed to verify axial thrust clearance.

The flatness of the shim plates should be checked.

The screw heights of the thrust bearing locating mechanism should be adjusted so to maximize the available axial adjustment. This can be achieved by changing the thicknesses of the "ear" shims.

Oil Deflectors
Next Outage

The oil deflectors should be dimensionally and visually examined.

Throttle Valves
Next Outage

The indication on the right side throttle valve seat should be monitored during future outages. Pre-outage planning should include provisions for seat replacement. This would include procuring a new seat from the OEM and having machinists available to remove the seat and

2.1 Recommendations

Throttle Valves

Next Outage

install a new seat. The new seat will also need to be seal welded. Since the material of the seat and weld prep lip is unknown, the OEM should be contacted for guidance with regards to the seal welding.

At least one new stem assembly (including the spring pilot parts) should be on-hand before the next outage
.
Since the exact cause of the steam cuts on the spring guide of the right side valve is unknown, a new spring guide should be on-hand prior to the next outage.

The fine mesh strainers should be removed after three months or if there is a decrease in inlet pressure, whichever comes first.

Governor Valves

Next Outage

Spring cans should be disassembled and the springs should be inspected during the next planned outage.

The indications found at the corners of seats #1 and #2 should be monitored for propagation.

#3 governor valve should be completely disassembled during the next outage to investigate the excessive pilot travel. Since it is unlikely that the stem/plug can be disassembled without resorting to destructive means, a new stem/plug should be on-hand.

The lower steam chest fit areas were beyond design clearance and should be investigated during the next outage. These bores locate the centerline of the stem to the centerline of the seat and misalignment could result in the valve not seating correctly.

Reheat Stop Valves

Next Outage

Consideration should be given to adding a post to the valve covers that the disc post can seat against when the valve is fully opened. This would hold the disc rigidly against the seat of the yoke and not allow the disc to fret in operation. Similar valves incorporate this arrangement and it's abscence is the likely cause for the circumferential indications found on both discs.

Consideration should be given to adding flanges or unions to the trip pilot pipe so that it does not need to be cut and rewelded each time the valve is disassembled. Discussions were undertaken during this outage, but, this recommendation was not implemented.

At least one new shaft and two new shoulder rings should be on-hand before the next

2.1 Recommendations

Reheat Stop Valves

Next Outage

scheduled outage.

Intercept Valves

Next Outage

The right side inboard seat should be weld repaired and lapped during the next outage. The intercept valve body was PMI'ed by the customer and found to be either 434 SS or grade 91 Steel.

The indications found in the right side strainer grooves should be monitored for propagation during future outages.

At least two new stems should be on-hand prior to the next outage. These stems are rather small in diameter and bend easily.

Stator - Mechanical

Next Shutdown

Upgraded instrumentation should be installed to more accurately measure the gas leakage from the generator.

IP Blade Rings

The stage 11 and 12 partitions should be repaired to prevent further solid particle erosion downstream and restore design steam flow.

The spill strips should be replaced and machined to size to restore design efficiency.

It should be assumed, and planned for, that during the next outage, the stage 11 partitions will need to be repaired.

3 Turbine

3.1 Rotors

3.1.1 HP-IP Rotor

Part Description:

The HP-IP rotor is a combined, opposing flow rotor with two integral balance pistons. The thrust runner is part of the control rotor that is mounted to the turbine end with a coupling. All of the buckets are of the integral shroud design. Nine stages of HP buckets are on the turbine end and six rows of IP buckets are on the generator end of the rotor.

At disassembly it was found that the integral shrouds of the stage nine buckets had sustained significant damage, presumably due to overheating from a hard rub with the blade ring spill strips. Distortion and elevated hardness was also found on the stage seven and eight bucket shrouds. Additionally, it was found that a middle row of the #1 dummy ring packing had several segments that had failed hook fits and allowed the stationary packing to come into contact with the rotor during operation. The castellations on the balance piston in this area were found to have been "machined" off, and grooves had been worn into the rotor due to contact with the offending packing segments. The cause of the hook failure is not known at this time, however, overheating of this area is suspected.

Hardness measurements were taken on the rubbed area of the balance piston and showed that the area was actually softer than other areas of the rotor, however, it is suspected that the "softer" material is inlaid packing seal material.

The rotor was grit blasted and non-destructively examined. The stage nine buckets were not examined. No reportable indications were discovered.

The stage 7 thru 9 buckets were removed by GE OSS bucket technicians. New buckets were supplied and installed by Ethos Energy. Final machining of the bucket covers and rotor balance piston was performed by Ethos Energy. New dummy ring packing was also supplied by Ethos to replace the damaged row. After final machining the rotor was low speed balanced.

Due to elevated PH levels being found in the steam path in the dovetail areas of the buckets, the rotor was washed with a neutralizing solution.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The rotor should be grit blasted and non-destructively examined.

HIP Rotor

HIP Rotor

HP Stage 4-9 – As Found

HIP Rotor

HP Stage 9 covers – As Found

HIP Rotor

HP Stage 9 Covers – As Found

3.1.2 LPA Rotor

Part Description:

The LPA rotor was removed, grit blasted and non-destructively examined. Through the wet magnetic particle inspection, linear indications were found on all of the L-1 buckets. The buckets were removed and the serrations were glass bead blasted and non-destructively examined.

Due to elevated PH levels found in the steam path, the rotor bucket dovetails were washed with a neutralizing solution.

The L-1 buckets were replaced and the rotor was low speed balanced by Ethos Energy. More detailed observations can be found in the NDE report included in the appendix portion of this report.

Several of the L-0 erosion shields were found to have "bleed out" during the dye penetrant examination. Erosion was found observed on all of the "Z" lock L-0 shrouds.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

Consideration should be given to replacing the L-0 buckets, based on the separation of the erosion shields and erosion at the "Z" locks.

The rotor should be grit blast cleaned and non-destructively examined.

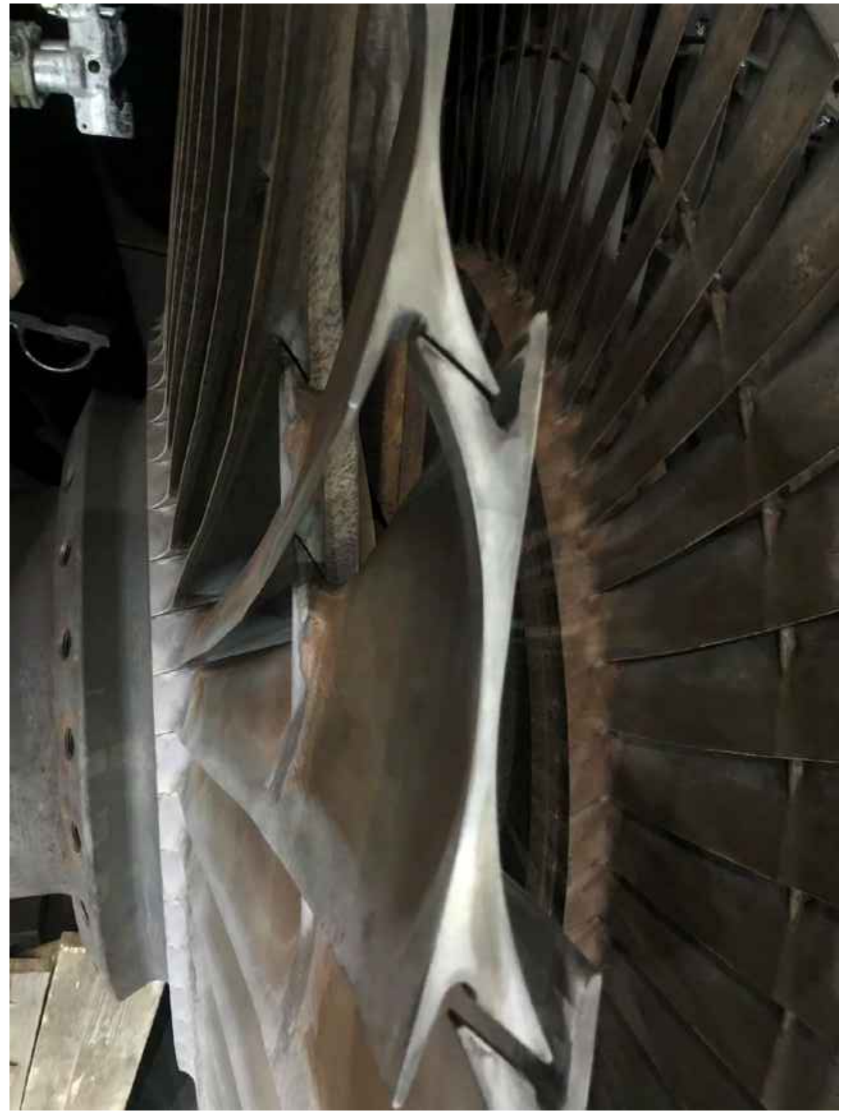
LPA Rotor

LPA Rotor

LPA Rotor

LPA Rotor – As Found

LPA Rotor



LPA Generator End – L-0 As Found Condition

3.1.3 LPB Rotor

Part Description:

One of the generator end L-1 buckets failed in service, causing damage to the other buckets in that row, the spill strips, partitions of the adjacent blade ring, L-0 buckets and L-0 erosion shields. The LPB rotor was removed, grit blasted and non-destructively examined. Through the wet magnetic particle inspection, linear indications were found on all of the remaining L-1 buckets on both ends of the rotor. The buckets were removed and the serrations were glass bead blasted and non-destructively examined.

Due to elevated PH levels found in the steam path, the rotor bucket dovetails were washed with a neutralizing solution.

The L-1 buckets were replaced and the rotor was low speed balanced by Ethos Energy. Several of the L-0 erosion shields were found to have indications on the generator end due to impact damage from the failed L-1 bucket. The damaged erosion shields were removed. All significant impact damage to the generator end L-0 buckets was blended out. More detailed observations can be found in the NDE report included in the appendix section of this report.

Several of the turbine end L-0 erosion shields were found to have "bleed out" during the dye penetrant examination. Erosion was found observed on all of the "Z" lock L-0 shrouds.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The generator end L-0 buckets should be replaced at the next opportunity. Separation between several of the turbine end buckets and erosion shields was also observed, and, strong consideration should be given to replacing this row as well.

The rotor should be grit blasted and non-destructively examined.

The L-0 buckets should be inspected on a regular basis when the unit can be taken off of turning gear.

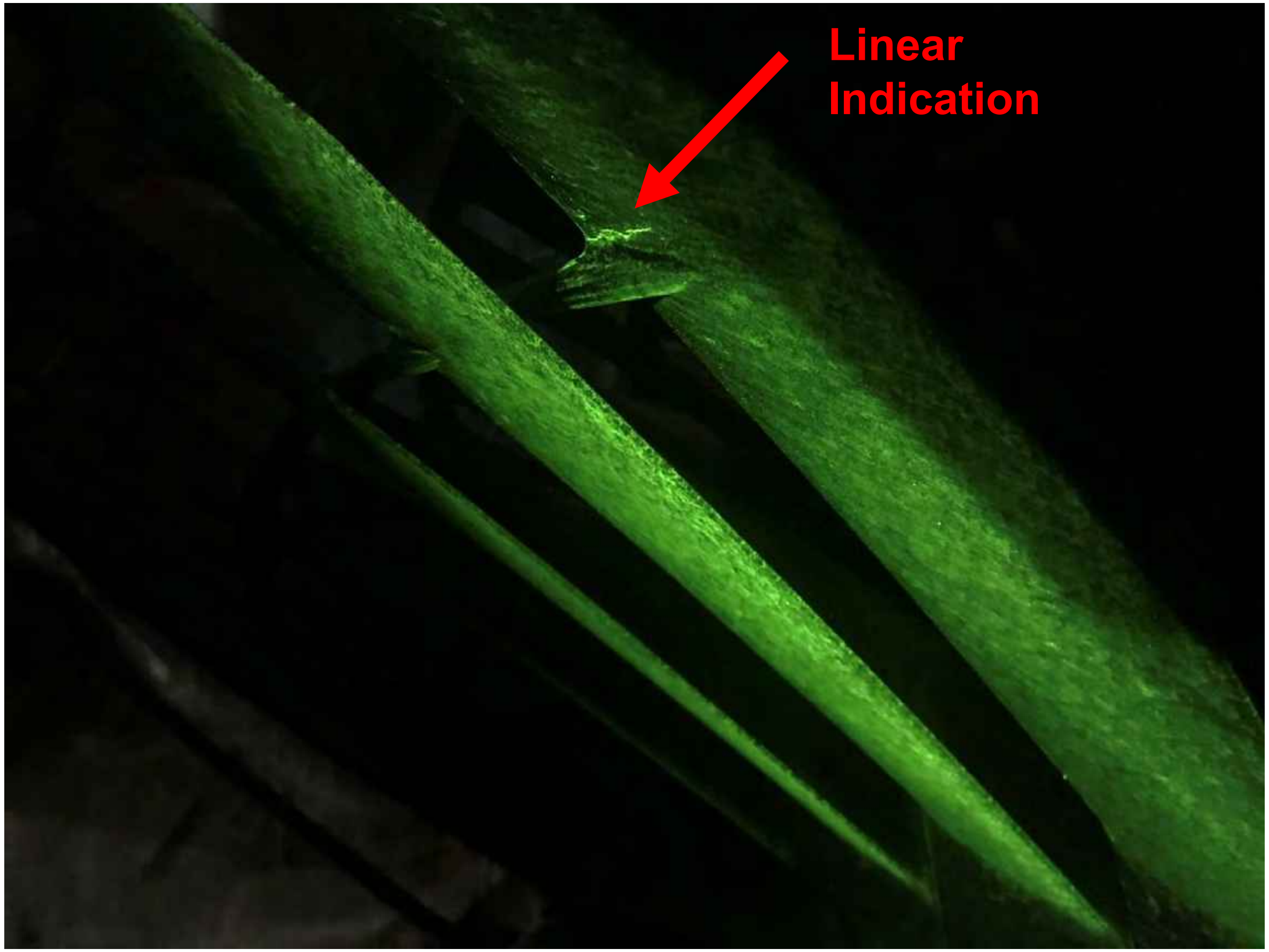
LPB Rotor

LPB Rotor

LPB Rotor

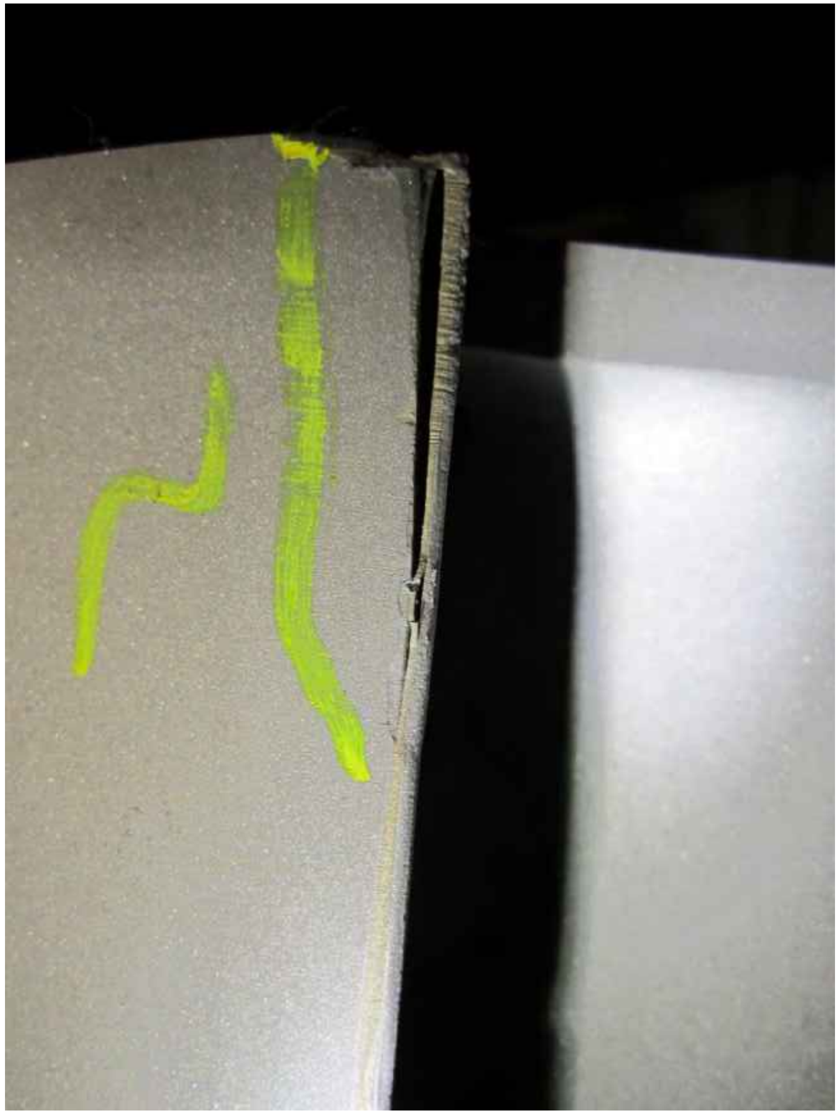
LPB Generator End - Failed L-1 Bucket

LPB Rotor



LPB L-1 Buckets - Linear Indication

LPB Rotor



LPB Generator End - Damaged L-0 Buckets

LPB Rotor

LPB Generator End - Damaged L-0 Buckets

LPB Rotor

LPB Generator End - Damaged L-0 Buckets

LPB Rotor

LPB Generator End - Damaged L-0 Buckets

3.2 HP-IP Stationary Components

3.2.1 HP-IP Outer Cylinder

Part Description:

The outer cylinder houses the various internal components of the turbine and holds them in position by close fitting tongue and groove arrangements. Four pipes are welded to both the cover and base to admit steam. Several other penetrations are machined into the cylinder for various different instrumentation. A horizontal parting flange is machined to accept bolts.

After the steam inlet flanges were unbolted and the upper half outer glands were removed, the outer cylinder horizontal joint bolting was loosened using induction heating. Gaps were measured at the horizontal joint both before and after the bolting was loosened. The cover was then jacked up, rigged and removed.

The fit areas were hand cleaned and non-destructively examined, per the customer's NDE matrix. The horizontal joints were cleaned with hones. All bolting was ultrasonically examined.

At disassembly it was found that three of the four struts, which act to stiffen the cylinder cover in the area of the crossover pipe flange, were dislocated or loose. These struts enter axially through the generator end of the cylinder cover and are attached to the inner side wall. The struts are then seal welded to the exterior surface. The dislocated and broken struts were welded by APCOM/FieldCore boiler maker welders, per a welding procedure supplied by the customer.

During the removal of the HP inner cylinder base it was necessary to cut the drain pipe. This is common and, typically, there is a boss that the drain pipe passes through on the bottom of the outer cylinder base. The boss weld is ground out and the pipe is cut below the outer cylinder base. This allows for the pipe to be welded again at assembly. The configuration from previous construction, did not allow for that process to be followed. The HP inner cylinder base had to be lifted high enough so that the pipe could be cut in the region between the inner and outer cylinder bases to remove HP inner cylinder base. It was found that the smaller P22 drain pipe from the inner cylinder base was attached to a larger diameter P91 pipe on the bottom of the outer cylinder base. The larger diameter P91 pipe was then welded to the bottom of the outer cylinder. A section of the larger diameter P91 pipe was removed from the outer cylinder base and a new boss was installed to allow the smaller diameter P22 drain pipe to pass through. A the section of P22 drain pipe was then welded to the HP inner cylinder base pipe stub and the pipe was plumbed to tie into the remaining existing drain pipe outside of the outer cylinder base. Two 45-degree elbows and several straight sections were added to tie into the existing pipe. This is the conventional configuration and will allow for the HP inner cylinder base to be removed without having to cut the pipe in an area where it can not be accessed for re-welding. All of the welding and plumbing was performed by APCOM/FieldCore boiler makers using the customer's welding

3.2.1 HP-IP Outer Cylinder

procedures.

During assembly for alignment the thermowell that passes through the outer and inner cylinder bases was damaged. This thermowell houses a thermocouple that measures the first stage metal temperature. The thermowell was bent beyond repair and the thermocouple was damaged. The thermowell was PMI'ed by the customer and found to be 304 SS. The remaining section of thermowell that passes through the outer cylinder base was removed. The pieces were sent out as samples and a new thermowell was fabricated. A new "in kind" thermocouple was acquired. The new thermowell was installed at assembly. The thermowell was welded by Xcel Comanche welders using a weld procedure supplied by the customer.

At assembly the outer cylinder cover was installed with triple boiled linseed oil applied to the parting flange. Bolting was tightened, per OEM drawing IWE-N26-10M7762. The horizontal joint was checked for gaps after the bolting was tightened and found to have none. A ring check was performed to verify that all bolting was tight.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

If the HP inner cylinder base is to be removed for inspection of the inlet seal rings, then the drain pipe should be cut outside of the outer cylinder base and the weld should ground out at the boss. It will be necessary to block the inner cylinder base up high enough for the drain pipe to be off the ground.

The thermowell weld at the HIP outer cylinder base should be ground out and the thermowell removed before attempting to install the HP inner cylinder base. The thermowell will need to be inserted and welded after the the HP inner cylinder base is reinstalled. The thermocouple should be removed before the well is welded.

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HIP Outer Cylinder Horizontal Joint …

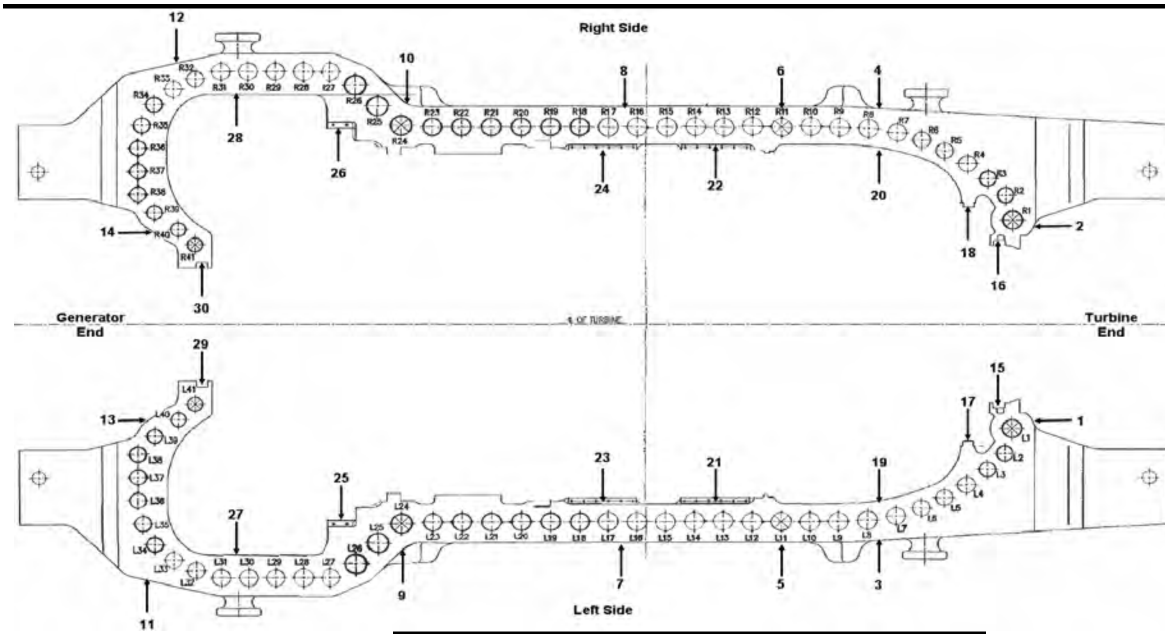
(Westinghouse Datasheet)

Horizontal Joint Gaps

HP-IP Outer Cylinder

Date (m/d/y) 5/28/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
HP -IP Outer Cylinder	1	0	2	0
	3	0	4	0
	5	0	6	0
	7	0	8	0
	9	0	10	0
	11	0	12	0
	13	0	14	0
	15		16	
	17		18	
	19		20	
	21		22	
	23		24	
	25	0	26	0
	27	0	28	0
	29	0	30	0

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

HIP Outer Cylinder Horizontal Joint …

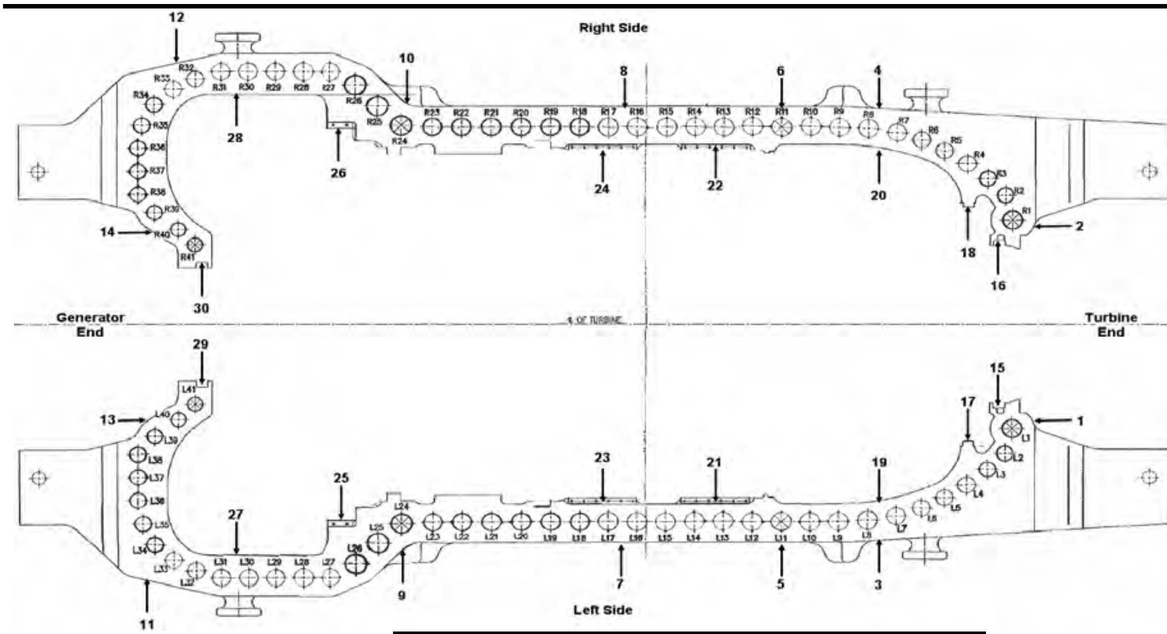
(Westinghouse Datasheet)

Horizontal Joint Gaps

HP-IP Outer Cylinder

Date (m/d/y) 3/10/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



	Left Side		Right Side	
	Position	Gap	Position	Gap
HP -IP Outer Cylinder	1	0	2	0
	3	0	4	0
	5	0.005	6	0.005
	7	0	8	0
	9	0	10	0
	11	0	12	0
	13	0	14	0
	15	0	16	0
	17	0.005	18	0.005
	19	0.006	20	0.007
	21	0.008	22	0.008
	23	0	24	0
	25	0.003	26	0.003
	27	0.002	28	0.003
	29	0	30	0

Bolts Tight ☒ As Found ☒

Bolts Loose ☐ As Built ☐

Comments	
Measurements taken during tops-on alignment after tightening bolts	

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HIP Outer Cylinder Horizontal Joint …

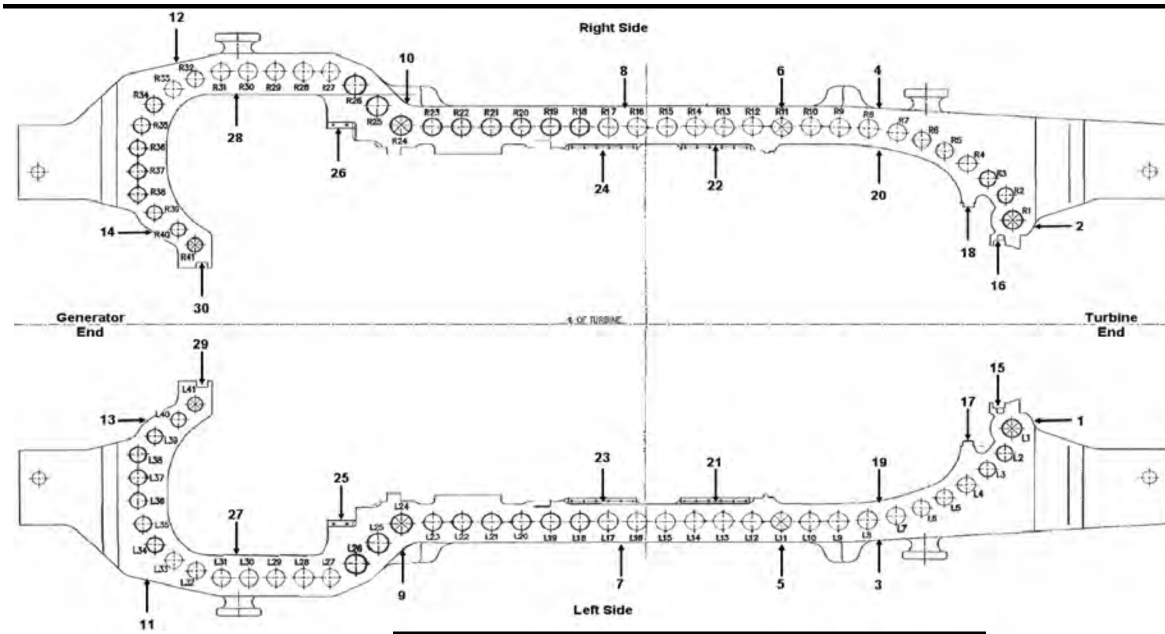
(Westinghouse Datasheet)

Horizontal Joint Gaps

HP-IP Outer Cylinder

Date (m/d/y) 3/10/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



	Left Side		Right Side	
	Position	Gap	Position	Gap
HP -IP Outer Cylinder	1	0.001	2	0.012
	3	0.009	4	0.021
	5	0.003	6	0.013
	7	0	8	0.001
	9	0.009	10	0.006
	11	0.032	12	0.021
	13	0.025	14	0.021
	15	0.002	16	0.015
	17	0.007	18	0.020
	19	0.015	20	0.027
	21	0.010	22	0.010
	23	0.001	24	0
	25	0.015	26	0.010
	27	0.027	28	0.019
	29	0.086	30	0.080

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments
Measurements taken during tops-on alignment before tightening bolts

Outer Cylinder Cover

HIP Outer Cylinder Cover

Strut Repair

Broken HIP Outer Cylinder Strut – Typical 3 of 4

Strut Repair

Weld Area

HIP Outer Cylinder Exterior Strut Weld

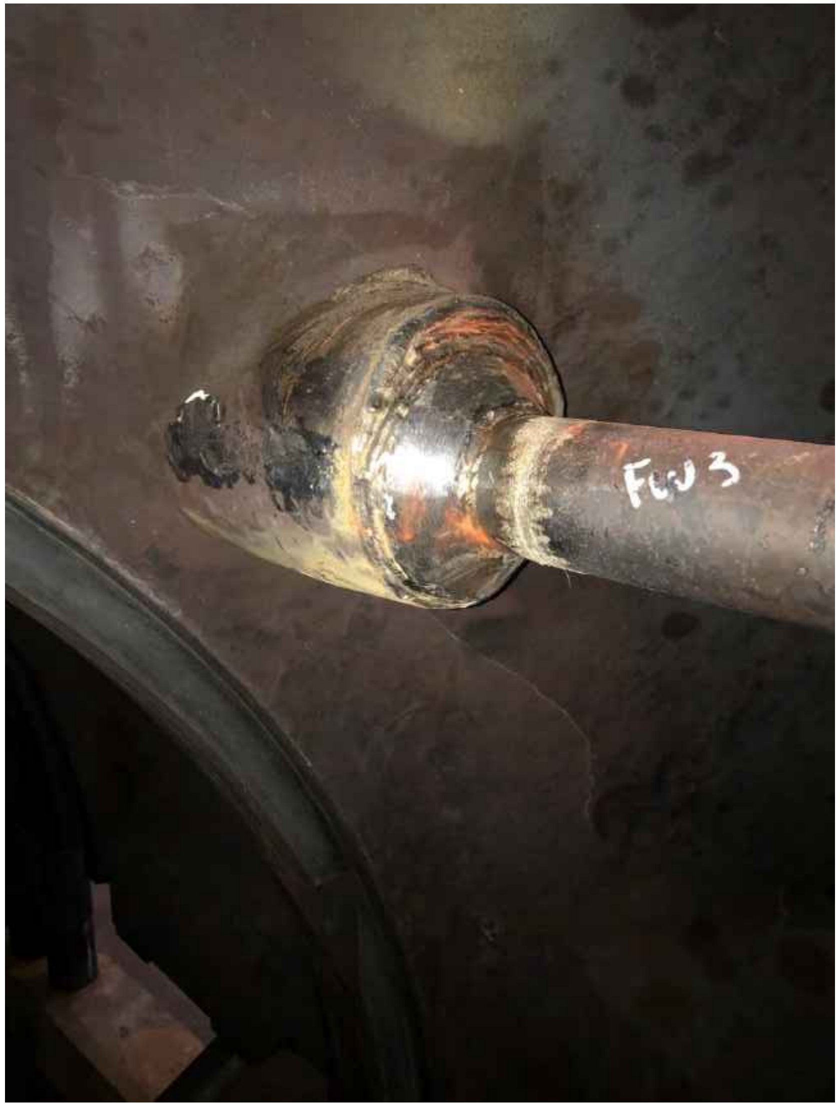
Strut Repair

Strut Weld Prep

Strut Repair

HIP Outer Cylinder Struts – Weld Repaired

Strut Repair



Left Side Bottom Strut – Weld Repaired

Left Side Top Strut – Weld Repaired

Strut Repair

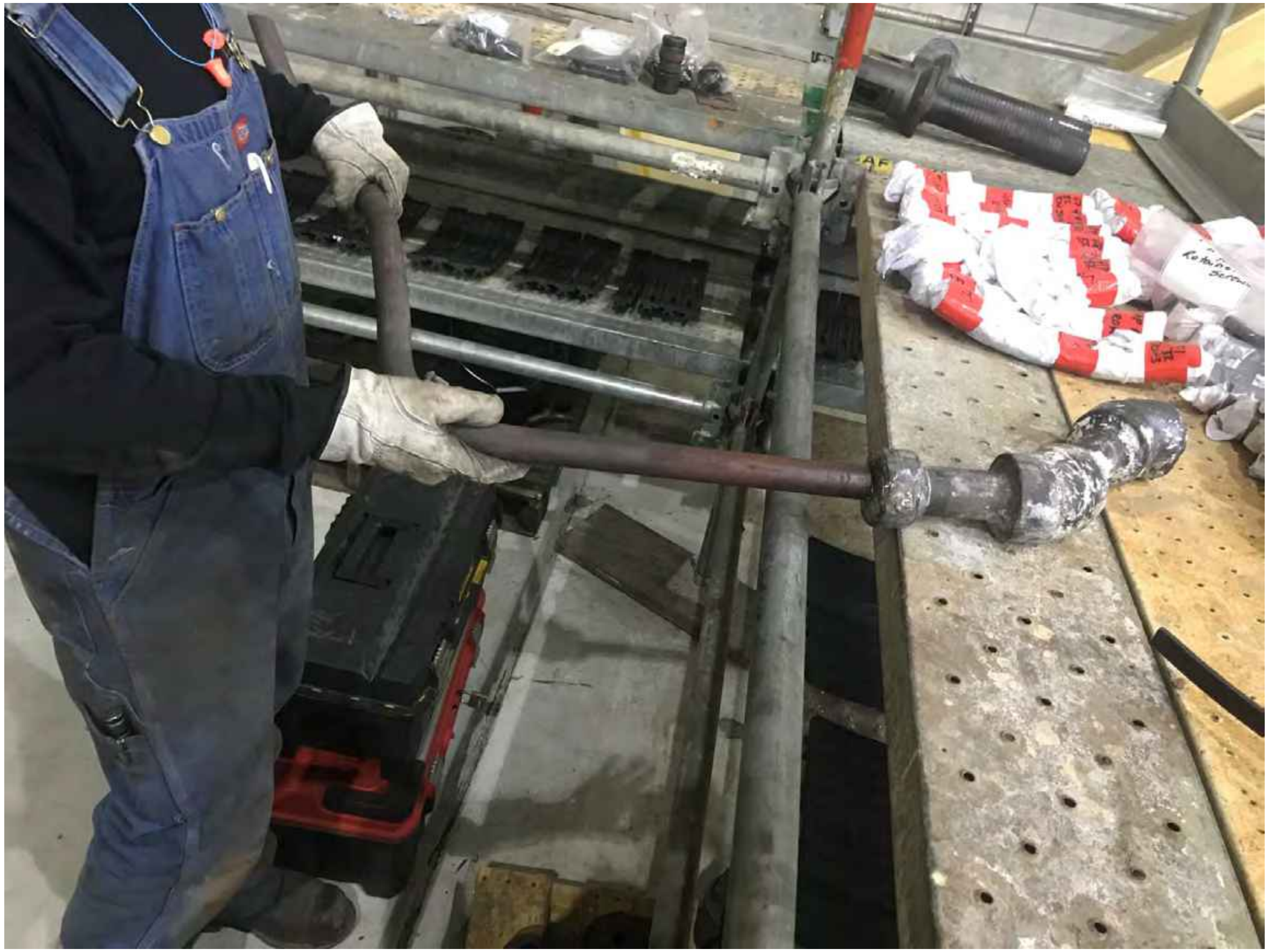
Right Side Top Strut – Weld Repaired

Right Side Top Strut – No Repair Needed

HIP Inner Drain Piping

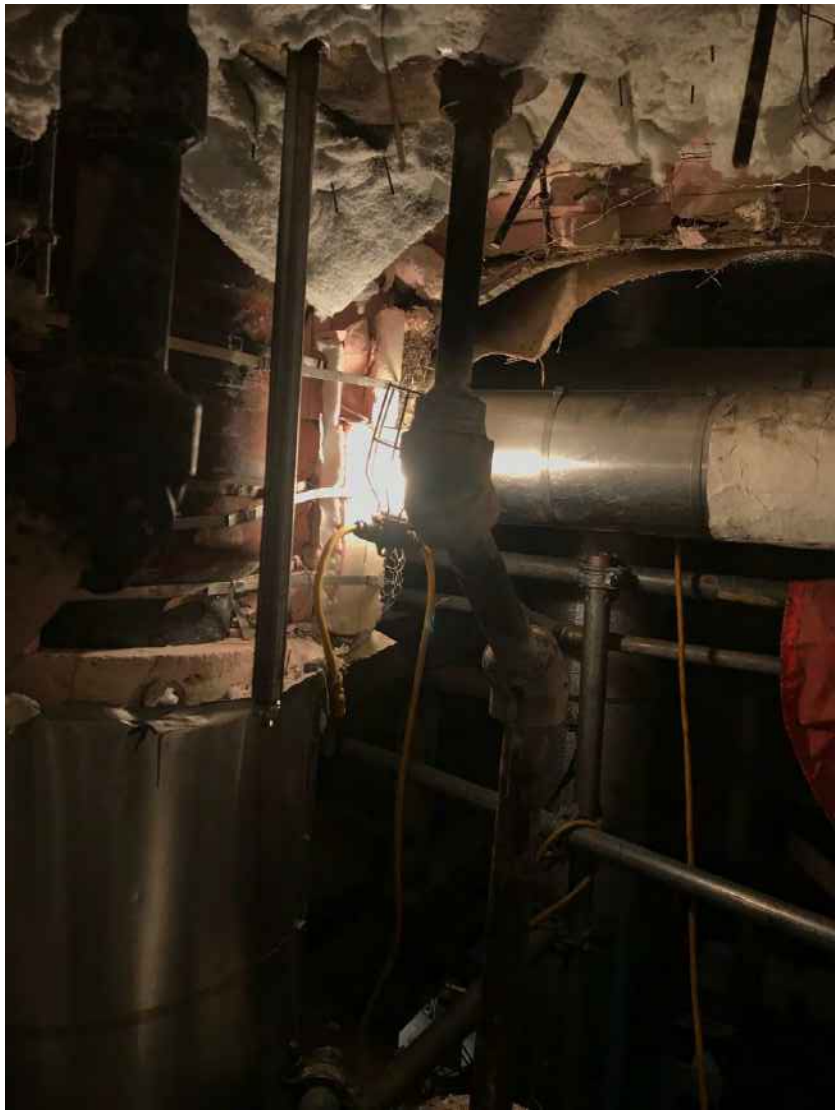
HIP Inner Cylinder Drain Piping – As Found

HIP Inner Drain Piping



HIP Inner Cylinder Drain Pipe – As Found - Removed

HIP Inner Drain Piping



HIP Inner Cylinder Drain Piping – New Configuration

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Replacement Thermowell

HIP First Stage Metal Temperature Thermowell

Replacement Thermowell

Replacement First Stage Metal Temperature Thermowell

3.2.2 Inner Cylinders

Part Description:

There are two inner cylinders, one HP and one IP (on the OEM drawings, the IP inner cylinder is referred to as the IP blade ring), these inner cylinders house the blade rings. The inner cylinders are themselves contained within the outer cylinder. There are inlet features in the HP inner cylinder on the top and bottom.

Both of the inner cylinder, upper and lower halves, were removed, cleaned and inspected. After the horizontal joint bolting was lossened, the gaps between the upper and lower halves were measured to determine the amount of casing distortion. The inner blade ring and outer cylinder locating fit areas were grit blasted and non-destructively examined. The floating HP inlet seal rings were also non-destructively and dimensionally inspected. The horizontal joint studs were ultrasonically tested.

At disassembly several of the of the horizontal joint bolts had to be destructively removed, failed ultrasonic testing or were otherwise damaged. The damaged/deficient bolting was replaced during reassembly.

Triple boiled linseed oil was applied to the horizontal parting flanges and all bolting was tightened, per OEM drawing IWE-N26-10M-7762, at reassembly using induction heating. All bolting threads and spot faces were lubricated with N-7000 anti-seize. After the bolting was tightened horizontal joint gaps were verified to be zero.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

Fit areas should be non-destructively examined.

Inner Shell Distortion

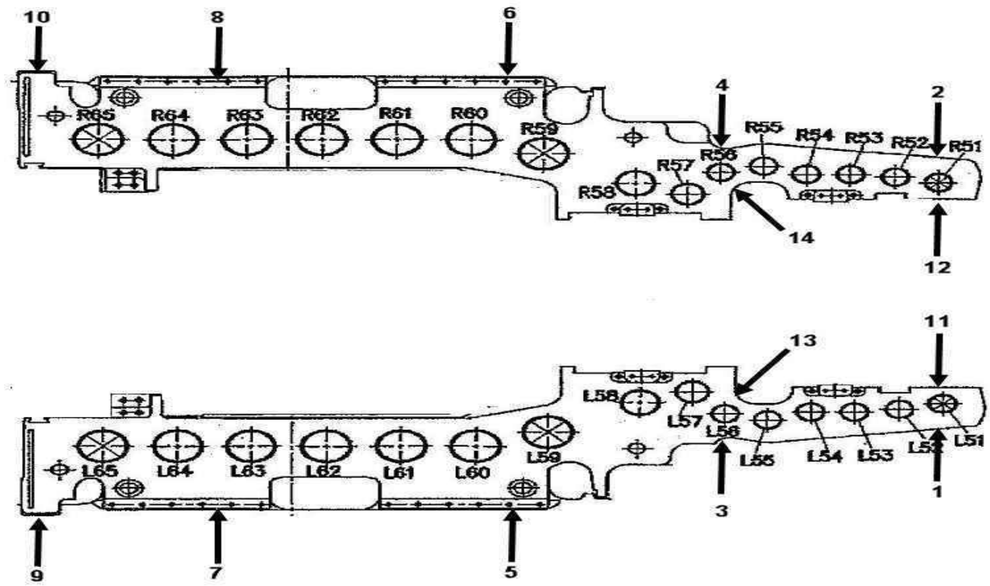
(Westinghouse Datasheet)

Horizontal Joint Gaps

HP Inner Shell

Date (m/d/y) 5/24/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial ____ Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
HP Inner Shell	1	0	2	0
	3	0	4	0
	5	0	6	0
	7	0	8	0
	9	0	10	0
	11	NA	12	NA
	13	NA	14	NA

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

Inner Shell Distortion

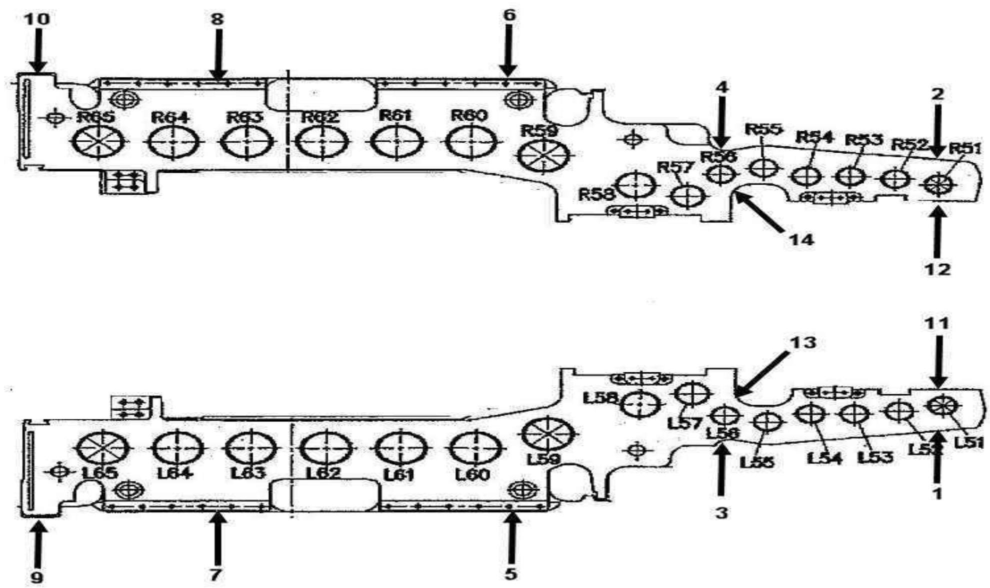
(Westinghouse Datasheet)

Horizontal Joint Gaps

HP Inner Shell

Date (m/d/y) 3/4/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



	Left Side		Right Side	
	Position	Gap	Position	Gap
HP Inner Shell	1	0	2	0
	3	0	4	0
	5	0	6	0
	7	0	8	0
	9	0	10	0
	11	0	12	0
	13	0.015	14	0.010

Bolts Tight ☒ As Found ☒

Bolts Loose ☐ As Built ☐

Comments	
Measurements taken during tops-on alignment after tightening bolts	

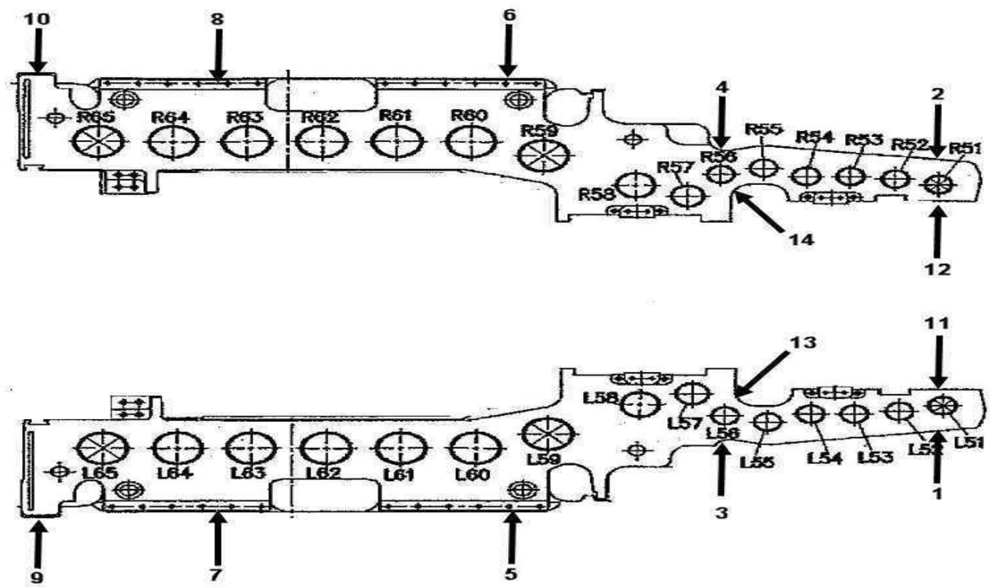
Inner Shell Distortion

(Westinghouse Datasheet)

Horizontal Joint Gaps

HP Inner Shell

Date (m/d/y)	3/4/20	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	x
				Final	



	Left Side		Right Side	
	Position	Gap	Position	Gap
HP Inner Shell	1	0	2	0
	3	0.077	4	0.070
	5	0.018	6	0.015
	7	0.008	8	0.015
	9	0	10	0
	11	0.018	12	0.018
	13	0.035	14	0.035

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments	
Measurements taken during tops-on alignment before tightening bolts	

Inner Shell Distortion

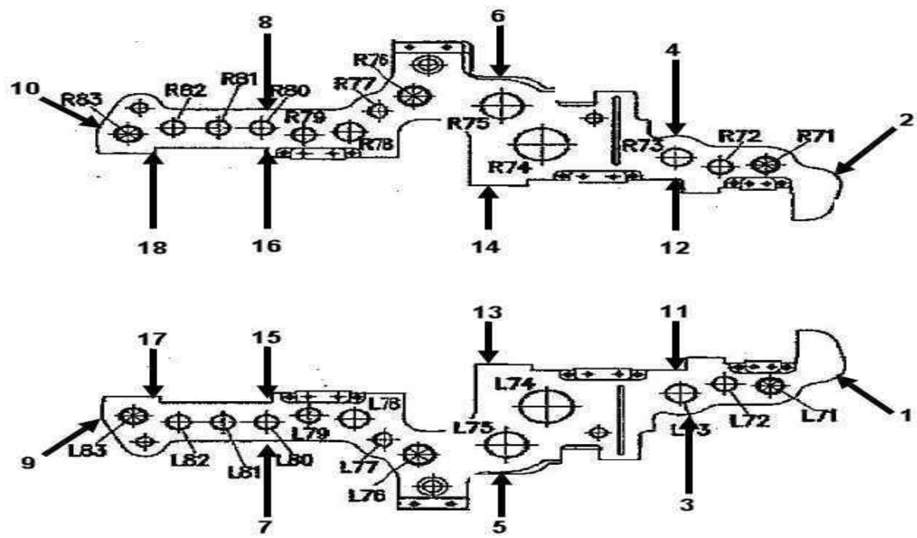
(Westinghouse Datasheet)

Horizontal Joint Gaps

IP Inner Shell

Date (m/d/y) 5/27/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial ___ Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
N2 Packing Casing	1	0	2	0
	3	0	4	0
	5	0	6	0
	7	0	8	0
	9	0	10	0
	11	NA	12	NA
	13	NA	14	NA
	15	NA	16	NA
	17	NA	18	NA

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

Inner Shell Distortion

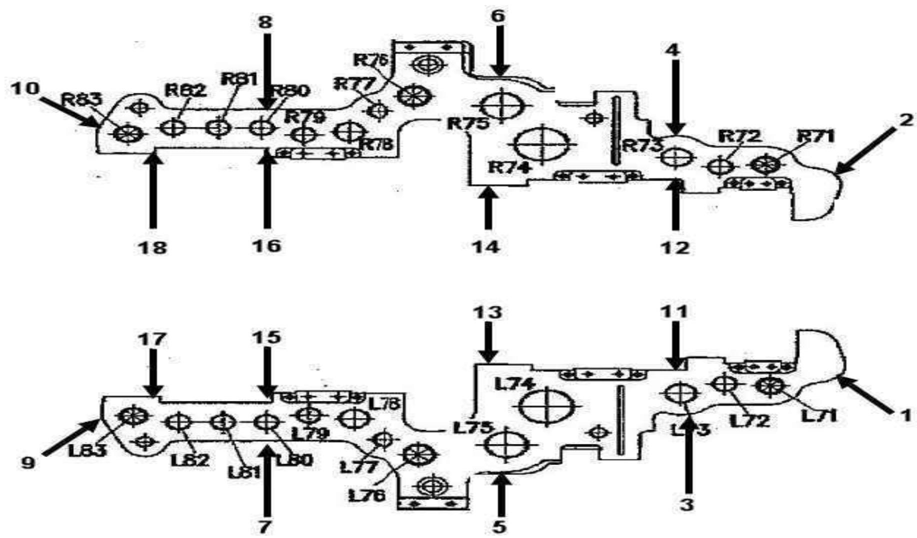
(Westinghouse Datasheet)

Horizontal Joint Gaps

IP Inner Shell

Date (m/d/y) 3/5/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x Final



	Left Side		Right Side	
	Position	Gap	Position	Gap
N2 Packing Casing	1	0.035	2	0.035
	3	0.015	4	0.017
	5	0	6	0
	7	0	8	0
	9	0	10	0
	11	0.035	12	0.022
	13	0.032	14	0.022
	15	0.005	16	0
	17	0	18	0

Bolts Tight ☒ As Found ☒

Bolts Loose ☐ As Built ☐

Comments
Measurements taken during tops-on alignment after tightening bolts Hardware not available for locations 1-4

Inner Shell Distortion

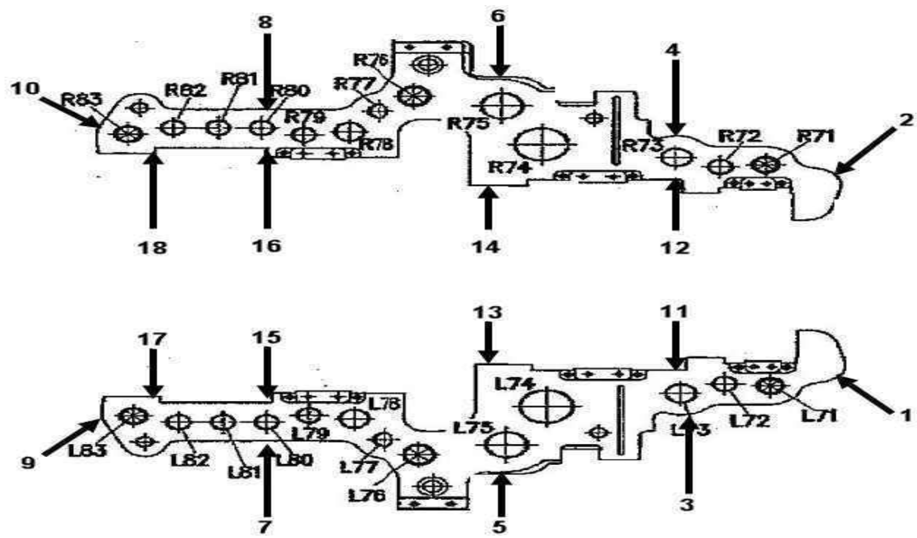
(Westinghouse Datasheet)

Horizontal Joint Gaps

IP Inner Shell

Date (m/d/y) 3/5/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



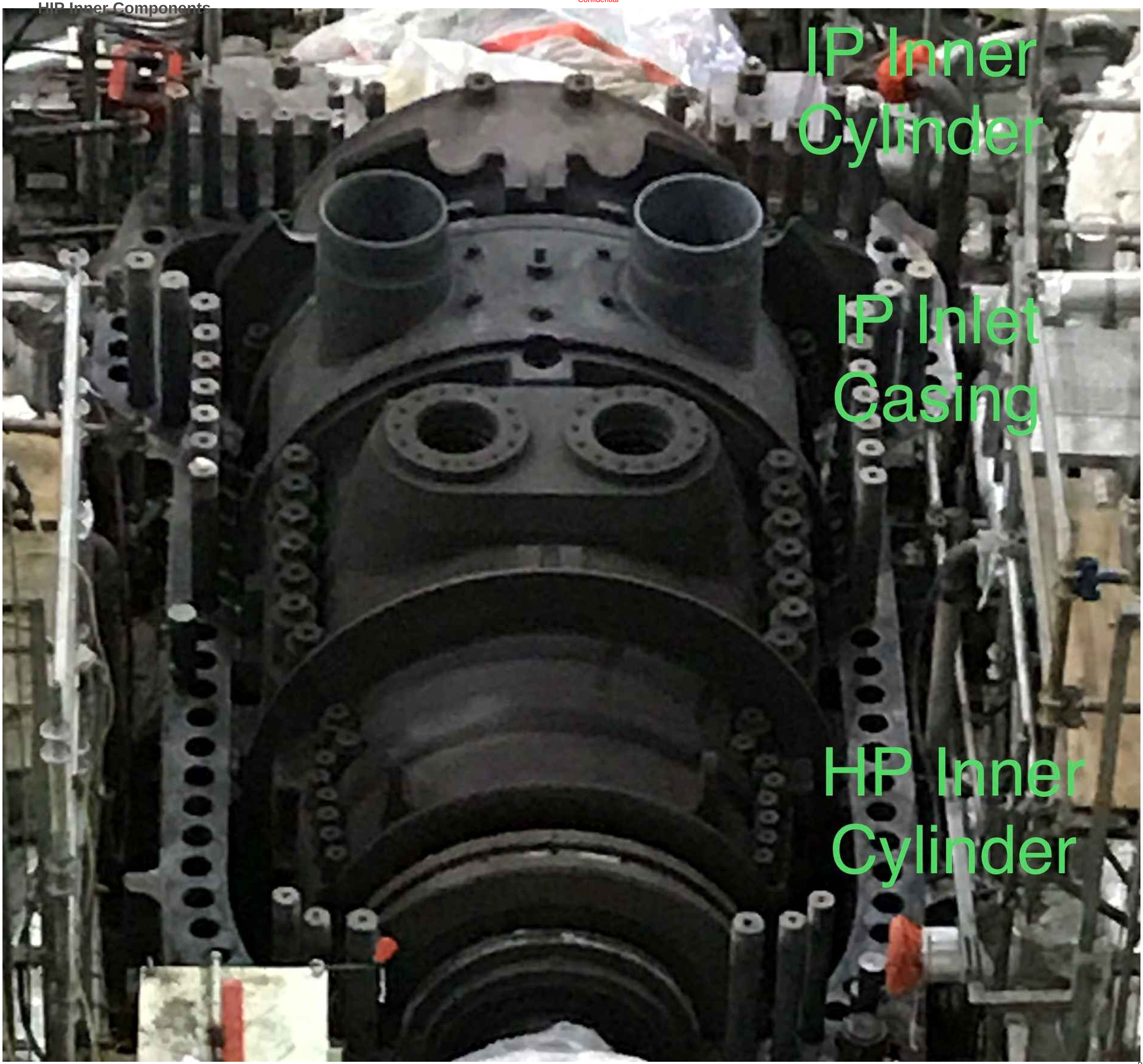
	Left Side		Right Side	
	Position	Gap	Position	Gap
N2 Packing Casing	1	0.081	2	0.093
	3	0.045	4	0.058
	5	0.012	6	0.017
	7	0.029	8	0.024
	9	0.021	10	0.014
	11	0.078	12	0.077
	13	0.062	14	0.075
	15	0.051	16	0.048
	17	0.051	18	0.038

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments
Measurements taken during tops-on alignment before tightening bolts

HIP Inner Components



3.2.3 HP Blade Rings

Part Description:

There are three HP blade rings on the governor end of the HP-P turbine. The blade rings are housed within the HP inner cylinder. Each blade ring contains partitions that direct steam flow to the rotating buckets. Interstage packing segments can be found in the inner rings of each stage. The interstage packing seals steam from leaking around the rotor body. Spill strips are caulked into the rings to seal steam from leaking around the rotating blade tips. The #1 HP blade ring consists of a two stages which are stages 1 and 2. The #2 HP blade ring is made up of three stages (stages 4-6), and the #3 HP blade ring houses the final three stages of the HP section (stages 7-9). The HP inlet nozzle is an integral part of #1 dummy ring.

The blade rings were removed grit blasted and non-destructively examined. The partitions and fit areas were examined visually and by wet florescent magnetic particle. The horizontal joint bolting, of the blade rings, was examined ultrasonically.

The caulked-in spill strips were found to be in very poor condition, especially the bottom sections. The stage 9 spill strips were replaced and machined to size

The blade rings were aligned to the rotor centerline with laser alignment. Adjustments were made to the elevation support blocks and center pins and slots. Any excessive center pin clearance was corrected by welding and grinding of the female slots.

At reassembly, the interstage packing was installed. Triple boiled linseed oil was placed on the horizontal joints and all bolting was tightened to 45 ksi. The threads of the bolting were coated with N-7000 anti-seize.

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HP Blade Ring Spill Strips

HP Blade Ring Spill Strips

HP Blade Ring Spill Strips

HP Blade Ring Spill Strips

HP Blade Ring Spill Strips

HP Blade Ring Spill Strips

HP Blade Ring Spill Strips

Confidential

HP Blade Ring Spill Strips

Confidential

HP Blade Ring Spill Strips

Confidential

HP Blade Ring Spill Strips

Stage 9 Upper Half – As Found Spill Strip Condition

HP Blade Ring Spill Strips

Stage 9 Upper Half – As Found Spill Strip Condition

3.2.4 IP Blade Rings

Part Description:

There are three IP blade rings on the generator end of the HP-IP turbine. The blade rings are housed within the IP inner cylinder. Each blade ring contains partitions that direct steam flow to the rotating buckets. Interstage packing segments can be found in the inner rings of each stage. The interstage packing seals steam from leaking around the rotor body. Spill strips are caulked into the rings to seal steam from leaking around the rotating blade tips. The #1 IP blade ring consists of a single inlet stage, which is stage 10. The #2 IP blade ring is made up of two stages (stages 11 and 12), and the #3 IP blade ring houses the final three stages of the IP section (stages 13-15).

The blade rings were removed grit blasted and non-destructively examined. The partitions and fit areas were examined visually and by wet florescent magnetic particle. The horizontal joint bolting of the blade rings was examined ultrasonically.

Several indications were found on the stage 10 blade ring partitions. Foreign object damage was found was found on all partitions. The trailing edges of stages 10-12 were very thin from solid particle erosion. All of the lower half spill strips were found in very poor condition.

A major partition weld repair was performed of the stage 10 after the linear indications were ground out. Dye penetrant testing was performed after the repair was completed to confirm that no indications were present. The spill strips were hand dressed and the blade rings were returned to service.

The blade rings were aligned to the rotor centerline with laser alignment. Adjustments were made to the elevation support blocks and center pins and slots. Any excessive center pin clearance was corrected by welding and grinding of the female slots.

At reassembly, the interstage packing was installed. Triple boiled linseed oil was placed on the horizontal joints and all bolting was tightened to 45 ksi. The threads of the bolting were coated with N-7000 anti-seize.

Recommendation Description:

The stage 11 and 12 partitions should be repaired to prevent further solid particle erosion downstream and restore design steam flow.

The spill strips should be replaced and machined to size to restore design efficiency.

It should be assumed, and planned for, that during the next outage, the stage 11 partitions will need to be repaired.

IP Blade Ring Spill Strips

IP Blade Ring Spill Strips

IP Blade Ring Spill Strips

IP Blade Ring Spill Strips

Stage 10 Spill Strips – As Found After Grit Blasting

IP Blade Ring Spill Strips

IP Blade Ring Spill Strips

IP Blade Ring Spill Strips

IP Blade Ring Spill Strips

Confidential

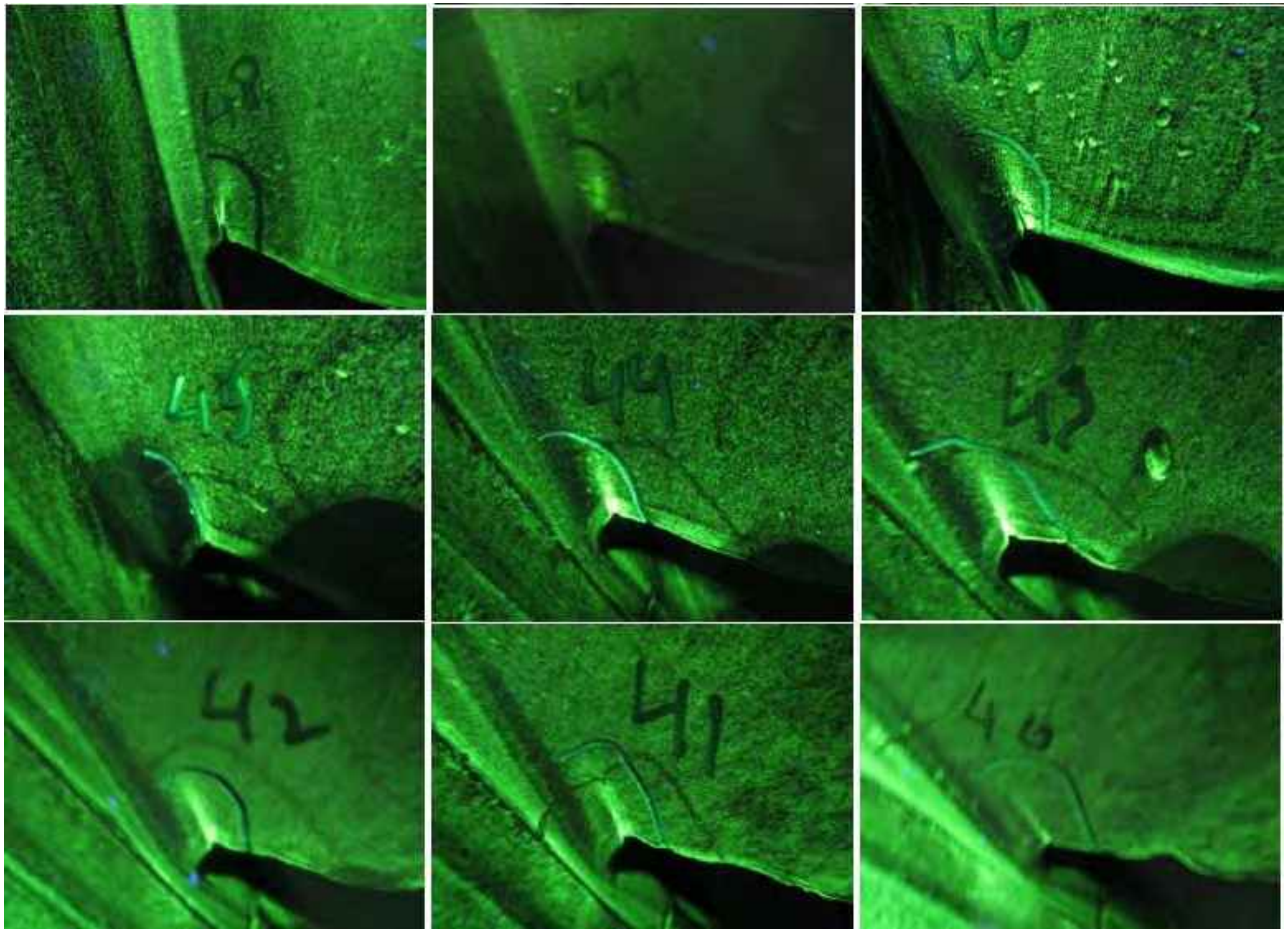
IP Blade Ring Spill Strips

IP #1 Blade Ring

Confidential

IP #1 Blade Ring

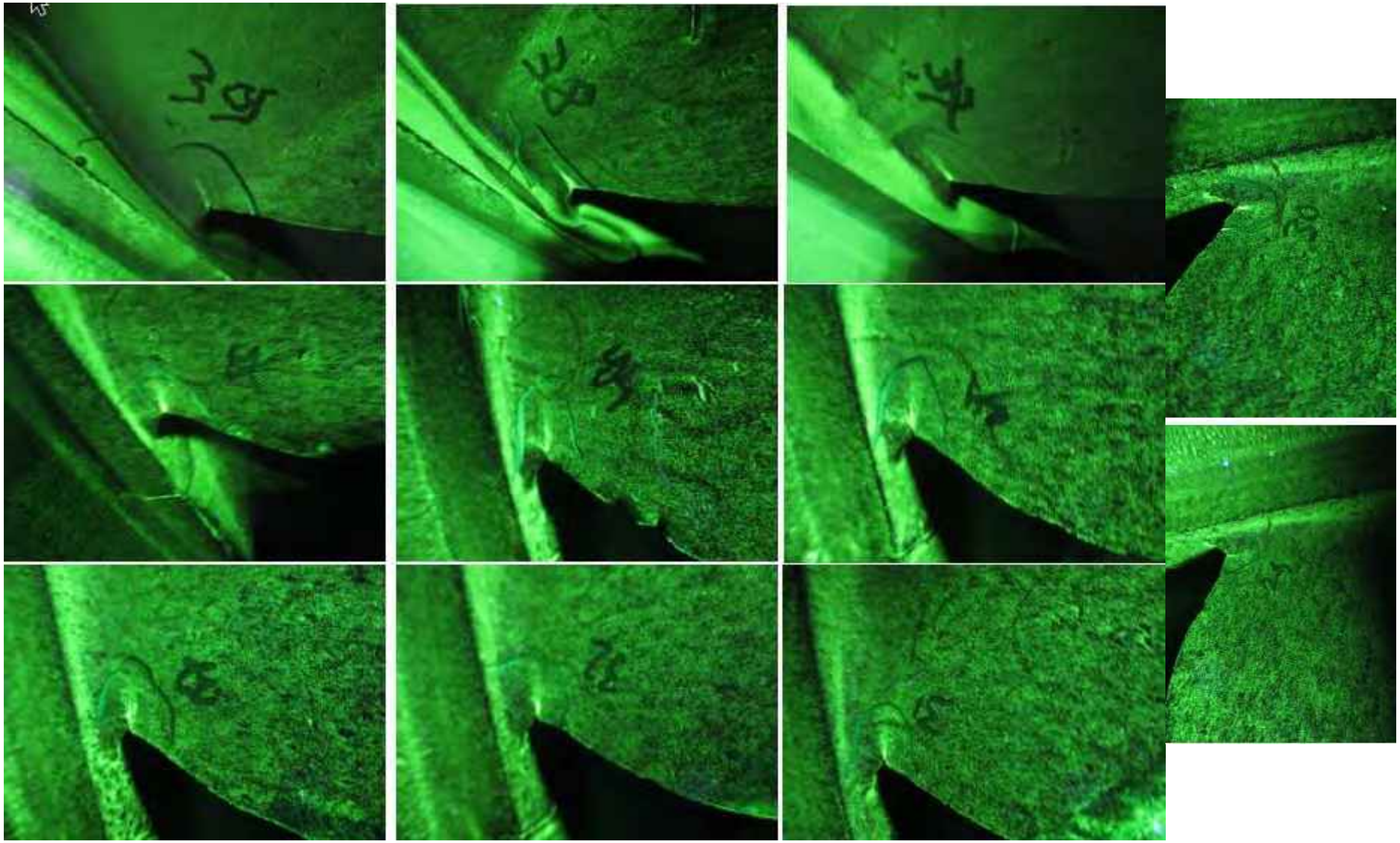
IP #1 Blade Ring



Stage 10 Partitions – Linear Indications 40-48

Confidential

IP #1 Blade Ring

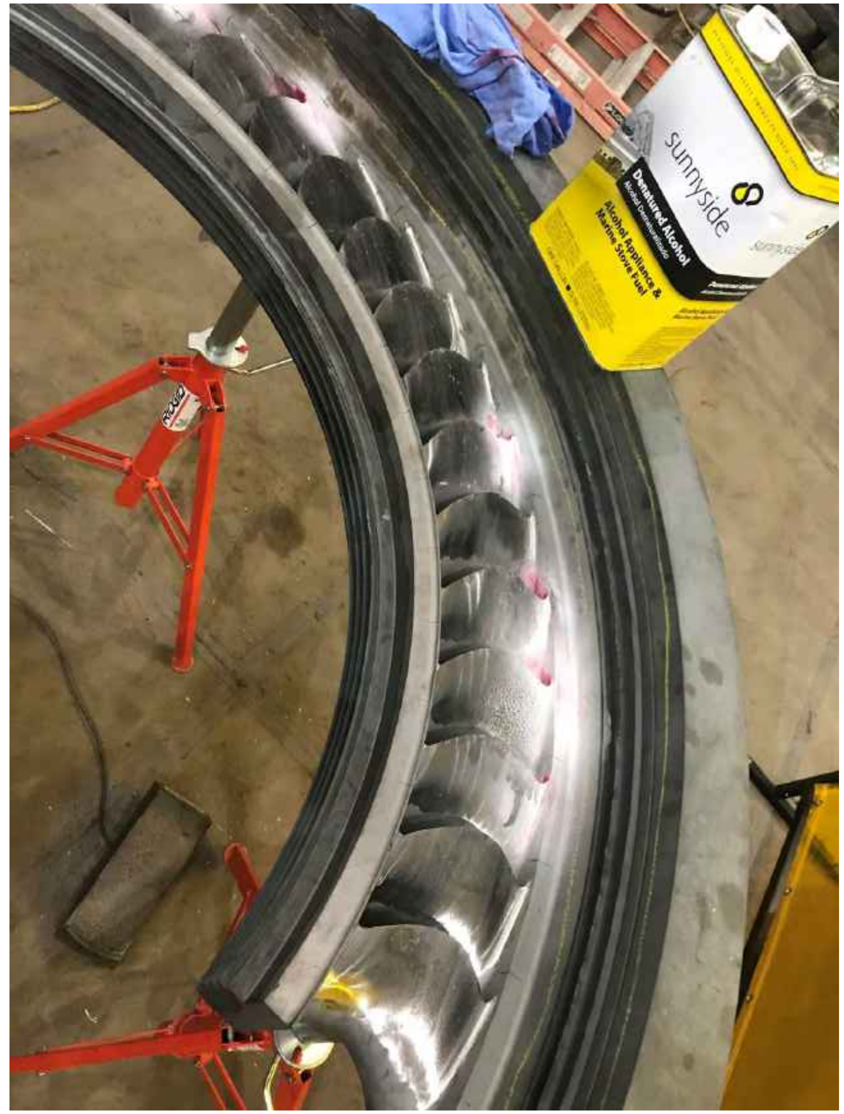


Stage 10 Partitions – Linear Indications 29-39

IP #1 Blade Ring

IP #1 Blade Ring Partition Repair

IP #1 Blade Ring



IP #1 Blade Ring Partitions Repair

3.2.5 Dummy Rings

Part Description:

There are two dummy rings inside of the HP-IP turbine. The purpose of the dummy rings is to seal steam pressure in various regions of the turbine and to balance axial forces on the rotor. The #1 dummy ring, located in the center of the turbine, houses five rows of packing. It also incorporates the HP nozzle and floating inlet seal rings for the main steam inlet pipes. There are also several rows of spill strips caulked into the inner diameter of the casing which seal the steam flow of the inlet stage rotating bucket tips. The #2 dummy ring houses three rows of packing, and is located at the turbine end of the HP-IP outer cylinder after the last stage of the HP section. The rows of packing are of a high-low tooth configuration which land on castellations machined into the rotor. Each row of packing is comprised of several segments making a ring. The segments are slid into grooves machined into the casings. The rings are held in position, relative to the rotor centerline by springs.

All of the packing segments were removed, cleaned and inspected. The hook fits of the casings were cleaned and non-destructively examined.

At disassembly it was found that row K, in the middle of the #1 dummy ring, had failed (PAC Case ER-20200621-0135). The male hook fit of several packing segments had fractured allowing the segments to come into contact with the rotor during operation. This row was replaced at reassembly and the rotor body was machined to remove hardened areas. The new segments were supplied and butt clearances were adjusted by Ethos. All other rows of packing were returned to service. The inlet stage spill strips were replaced and machined to size to restore design radial clearances.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The female packing hook fits should be non-destructively examined.

Confidential

#1 Dummy Ring Distortion

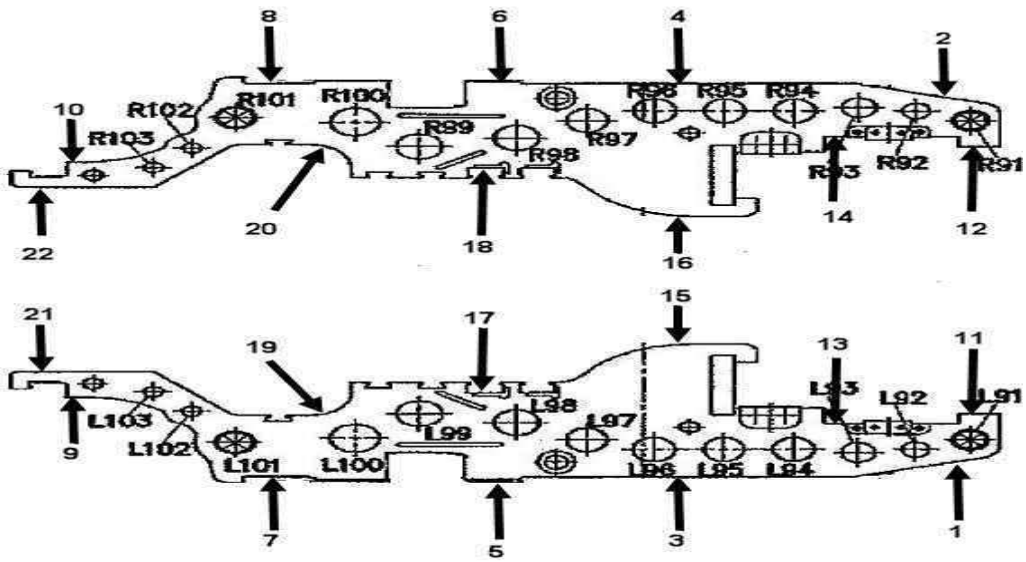
(Westinghouse Datasheet)

Horizontal Joint Gaps

N2 Packing Casing (#1 Dummy Ring)

Date (m/d/y) 5/23/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial ____ Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
N2 Packing Casing	1	0	2	0
	3	0	4	0
	5	0	6	0
	7	0	8	0
	9	0	10	0
	11		12	
	13		14	
	15		16	
	17		18	
	19		20	
	21		22	

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

#1 Dummy Ring Distortion

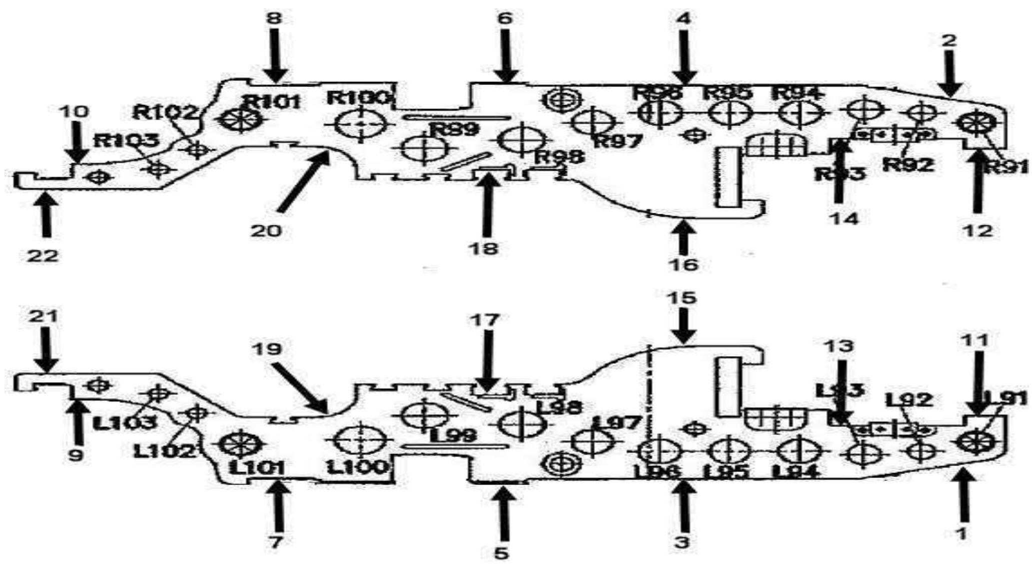
(Westinghouse Datasheet)

Horizontal Joint Gaps

N2 Packing Casing (#1 Dummy Ring)

Date (m/d/y) 3/4/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



	Left Side		Right Side	
	Position	Gap	Position	Gap
N2 Packing Casing	1	0.006	2	0.001
	3	0	4	0
	5		6	
	7	0	8	0
	9	0.021	10	0.020
	11	0.006	12	0.010
	13	0.009	14	0.010
	15	0.026	16	0.026
	17		18	
	19	0.006	20	0.003
	21	0.031	22	0.017

Bolts Tight ☒ As Found ☒

Bolts Loose ☐ As Built ☐

Comments	
Measurements taken during tops-on alignment after tightening bolts Missing hardware would not allow for the horizontal joint to be closed	

#1 Dummy Ring Distortion

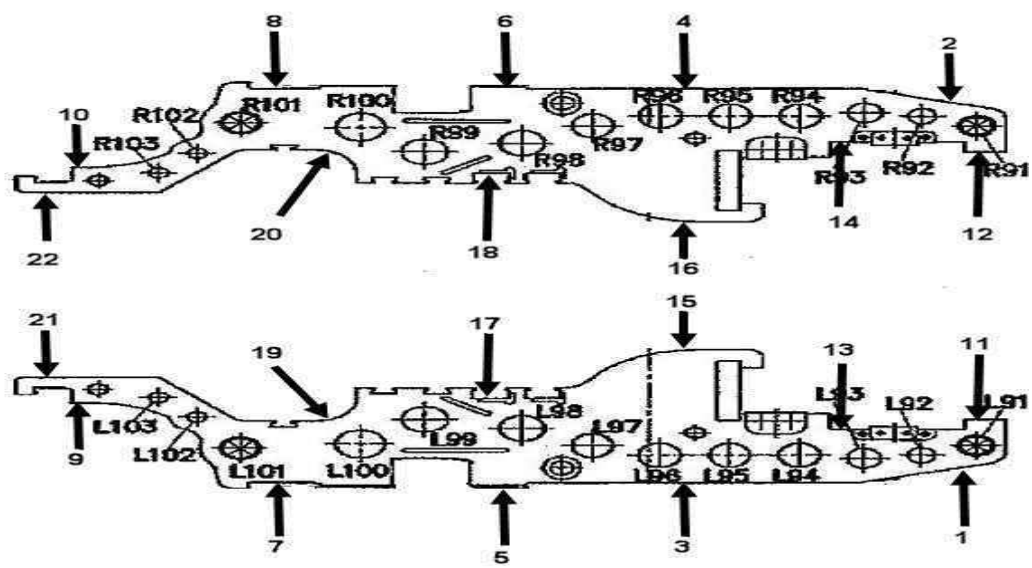
(Westinghouse Datasheet)

Horizontal Joint Gaps

N2 Packing Casing (#1 Dummy Ring)

Date (m/d/y) 3/4/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



	Left Side		Right Side	
	Position	Gap	Position	Gap
N2 Packing Casing	1	0.012	2	0.008
	3	0	4	0
	5		6	
	7	0.010	8	0.013
	9	0.021	10	0.043
	11	0.023	12	0.023
	13	0.025	14	0.021
	15	0.049	16	0.043
	17		18	
	19	0.018	20	0.013
	21	0.033	22	0.033

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments	
Measurements taken during tops-on alignment before tightening bolts	

#1 Dummy Ring Packing Failure

#1 Dummy Ring Right Side – Failed Packing Hook Fit

#1 Dummy Ring Packing Failure

#1 Dummy Ring Right Side – Row K Failed Hook Fit

#1 Dummy Ring Packing Failure

#1 Dummy Ring Left Side – Row K Hook Fit Beginning Failure

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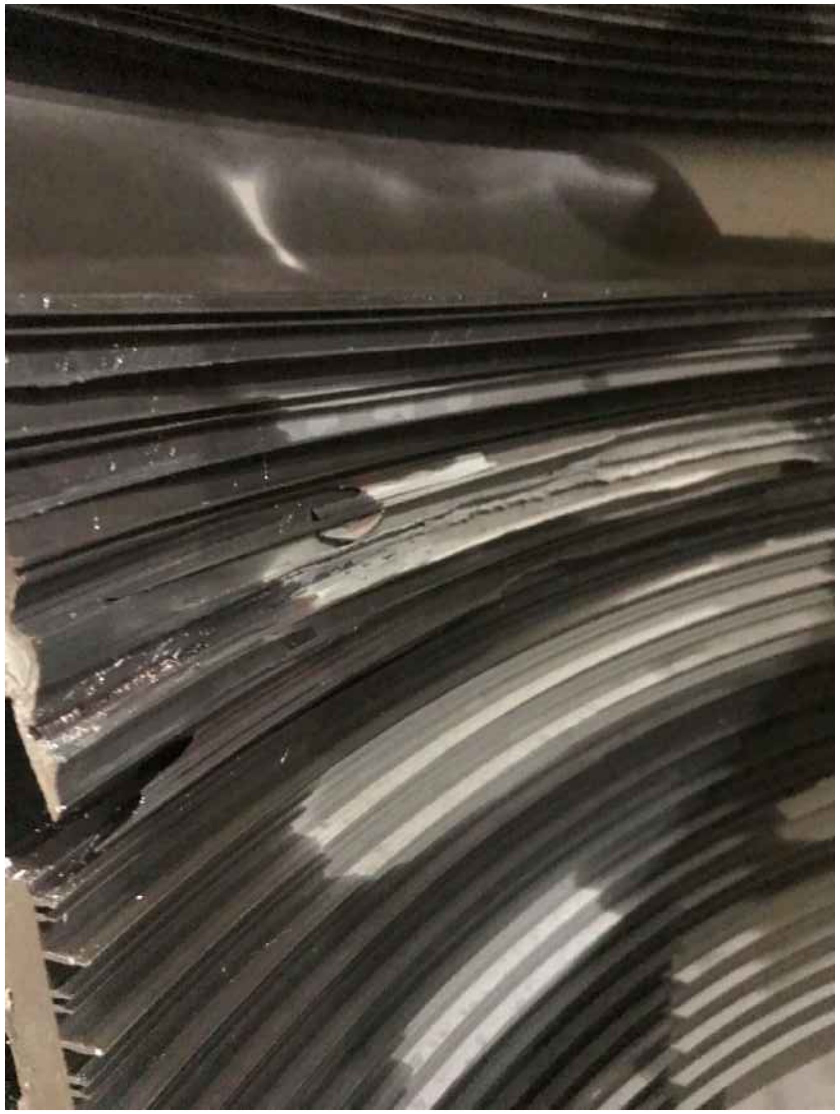
#1 Dummy Ring Packing Failure



#1 Dummy Ring – Row K Failed Packing Segments

Confidential

#1 Dummy Ring Packing Failure

#1 Dummy Ring Right Side – New Row K Packing

3.2.6 Glands

Part Description:

There are gland cases at each end of the HIP turbine to prevent steam from escaping to atmosphere around the rotor. Each end is comprised of an inner and outer gland case. There are two rows of packing in both the inner and outer gland cases on each end of the turbine. The HIP gland seals are of a high-low tooth configuration which land on castellations machined into the rotor body. Each ring is segmented and the segments slide into hook fits machined into the gland cases. The individual rows are forced inward toward the rotor centerline by springs that are mounted to the outer diameter.

The gland segments were removed, cleaned and inspected. Once the segments were removed, the hook fits in the casings were cleaned and non-destructively examined.

No deficiencies were found and the packing was reinstalled at assembly.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The female packing hook fits should be non-destructively examined.

3.3 Inlet Features

3.3.1 Main Steam Inlets

Part Description:

OEM Drawing 05310-1001

There are four main steam inlets to the HP turbine, one from each of the governor valve outlets. Two pipes enter the top and two pipes enter the bottom of the HP-IP outer cylinder. All four of the inlets enter a common annular chamber in the #1 dummy ring and pass steam, at rated conditions of 1050-degrees F and 3600 psi, through the nozzle partitions to the first stage buckets. The top pipes have flanged connections, to allow for removal of the HP-IP outer cylinder cover, and the bottom pipes are welded to the HP-IP outer cylinder base. Steam is sealed by close fitting floating rings in the HP inner cylinder and the #1 dummy ring which seal against male pipes that protrude inward toward the centerline from the outer cylinder.

The top flanged connections were unbolted and separated. The flanges were hand cleaned and non-destructively examined. After all inner components were removed the inlet pipes and floating seal rings were hand cleaned and measured for clearance. The inlet pipe trepans were not inspected during this outage.

3.3.1 Main Steam Inlets

All rings and pipes were found to be in good condition with only very minor axial scoring.

At reassembly, new gaskets were installed in the flanges and the bolting and seal rings were coated with N-7000 anti-seize. All flange bolting was prestressed per the "Bolt Tightening" table found on the OEM drawing, which gives a final torque value of 4287 ft-lbs for a pre-stress of approximately 60 ksi. The flanges were measured with feeler gages after the bolts were tightened to verify closure.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

Clearances and roundness of the seal rings and pipes should be checked.

Main Steam Seal Ring Clearances

(Westinghouse Datasheet)

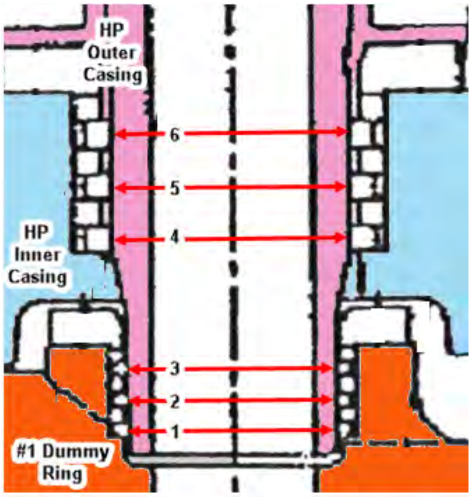
Steam Seal Rings

Radial Clearances

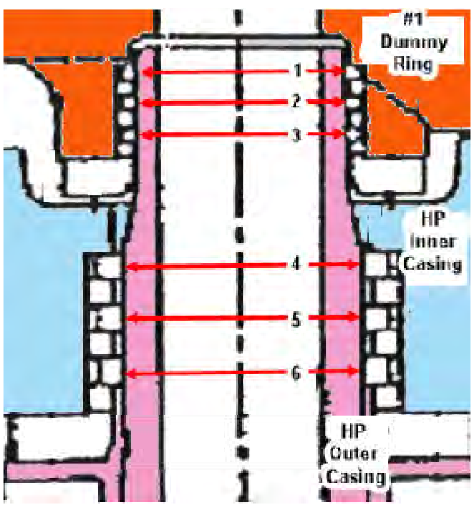
Date (m/d/y) 2/20/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial X

Final X



Upper Half



Lower Half

Left Side Upper

Ring #	Ring ID 0°	Ring ID 90°	Pipe OD 0°	Pipe OD 90°	Average Clearance
1	9.646	9.646	9.644	9.641	0.004
2	9.644	9.644	9.644	9.644	0.000
3	9.645	9.645	9.645	9.644	0.000
4	11.023	11.023	11.022	11.021	0.002
5	11.022	11.022	11.021	11.021	0.001
6	11.022	11.022	11.021	11.021	0.001

Right Side Upper

Ring #	Ring ID 0°	Ring ID 90°	Pipe OD 0°	Pipe OD 90°	Average Clearance
1	9.645	9.645	9.645	9.643	0.001
2	9.645	9.645	9.644	9.644	0.001
3	9.644	9.644	9.644	9.644	0.000
4	11.024	11.024	11.021	11.022	0.002
5	11.023	11.023	11.022	11.021	0.002
6	11.023	11.023	11.022	11.020	0.002

Left Side Lower

Ring #	Ring ID 0°	Ring ID 90°	Pipe OD 0°	Pipe OD 90°	Average Clearance
1	9.642	9.643	9.642	9.642	0.001
2	9.646	9.644	9.644	9.643	0.002
3	9.646	9.647	9.646	9.647	0.000
4	11.022	11.022	11.020	11.020	0.002
5	11.022	11.022	11.020	11.020	0.002
6	11.022	11.022	11.020	11.020	0.002

Right Side Lower

Ring #	Ring ID 0°	Ring ID 90°	Pipe OD 0°	Pipe OD 90°	Average Clearance
1	9.642	9.640	9.642	9.640	0.000
2	9.645	9.641	9.643	9.641	0.001
3	9.647	9.646	9.644	9.641	0.004
4	11.022	11.022	11.020	11.020	0.002
5	11.022	11.022	11.020	11.020	0.002
6	11.022	11.022	11.020	11.020	0.002

Comments
Rings and pipes were visually inspected and found to be in good condition.

Main Steam Inlet Pipe Pictures

Confidential

3.3.2 Reheat Steam Inlets

Part Description:

OEM Drawing 05320-1001

There are four reheat steam inlets to the IP turbine, one from each of the intercept valve outlets. Two pipes enter the top and two pipes enter the bottom. All four of the inlets enter a common annular chamber in the reheat inlet casing and pass steam, at rated conditions of 1100-degrees F and 720 psi, through the tenth stage partitions of the IP #1 blade ring to the tenth stage buckets. The top pipes have flanged connections, to allow for removal of the HP-IP outer cylinder cover, and the bottom pipes are welded to the HP-IP outer cylinder base. Steam is sealed by close fitting floating rings in the outer cylinder which seal against integral male pipes that protrude from the reheat inlet casing. The reheat inlet casing is constructed of several plates that are welded together by the OEM.

The top flanged connections were unbolted and separated. The flanges were hand cleaned and non-destructively examined. After all inner components were removed the inlet pipes and floating seal rings were hand cleaned and measured for clearance. The welds on the inlet casing were cleaned and non-destructively examined. No reportable indications were found.

Deep axial scoring was found on all of the inlet casing pipes. Both the rings and pipes were found to be extremely out of round with excessive clearances. The average radial clearances measured were found to be in excess 0f 0.075". The rings and pipes were all found to be out of round. The exact departure from design clearance could not be determined since no OEM drawing could be found that specify design clearances. The customer PMI'ed the casing and found it to be 304 SS.

The inlet flanges were found to be considerably indexed to one another. The right side flange was found to be off approximately half of a bolt hole. A great deal of effort was required align the flanges well enough to remove and reinstall the bolting.

At reassembly new gaskets were installed in the flanges and the bolting and seal rings were coated with N-7000 anti-seize. All flange bolting was prestressed per the "Bolt Tightening" table found on the OEM drawing, which gives a final torque value of 4287 ft-lbs for a pre-stress of approximately 60 ksi . The flanges were measured with feeler gages after the bolts were tightened to verify closure.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The OEM should be contacted to determine the design clearances of the floating seal rings.

New floating seal rings should be installed in the HIP outer cylinder and the pipes on the inlet casing should be welded and machined to restore roundness and design clearance.

Confidential

IP Inlet Ring Clearances

(Westinghouse Datasheet)

IP Inlet Ring Clearances

Date (m/d/y)	4/13/20	Turbine Serial Number	4465	Prepared by	D. Johnson
		Plant	Comanche	Unit	3
				Initial	
				Final	X

First Set 2/19/20

		Ring ID 0°	Ring ID 90°	Pipe OD 0°	Pipe OD 90°
Upper	Right Side	19.530	19.434	19.371	19.404
	Left Side	19.450	19.505	19.427	19.336
Lower	Right Side	19.409	19.488	19.359	19.392
	Left Side	19.457	19.474	19.327	19.435

Second Set 4/13/20

		Ring ID 0°	Ring ID 90°	Pipe OD 0°	Pipe OD 90°
Upper	Right Side	19.442	19.512	19.374	19.403
	Left Side	19.439	19.480	19.343	19.429
Lower	Right Side	19.445	19.474	19.367	19.398
	Left Side	19.454	19.464	19.344	19.425

		Average Clearance	Maximum Out of Roundness Ring	Maximum Out of Roundness Pipe
Upper	Right Side	0.092	0.096	0.033
	Left Side	0.085	0.066	0.093
Lower	Right Side	0.075	0.079	0.039
	Left Side	0.079	0.020	0.108

Comments	

Reheat Steam Inlet Pictures

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Reheat Steam Inlet Pictures

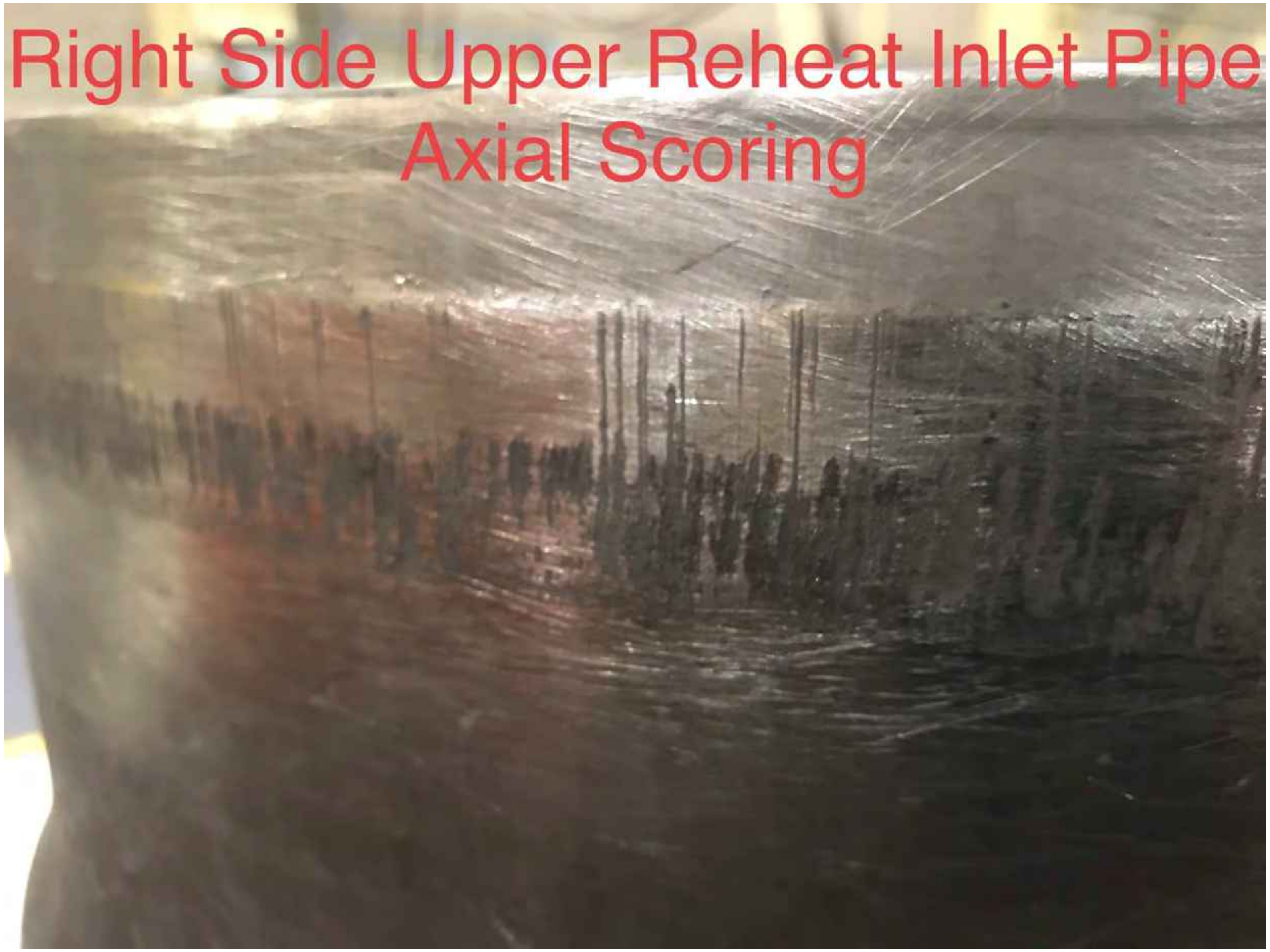
Upper Half Reheat Inlet Casing GE

Confidential

Reheat Steam Inlet Pictures

Confidential

Reheat Steam Inlet Pictures



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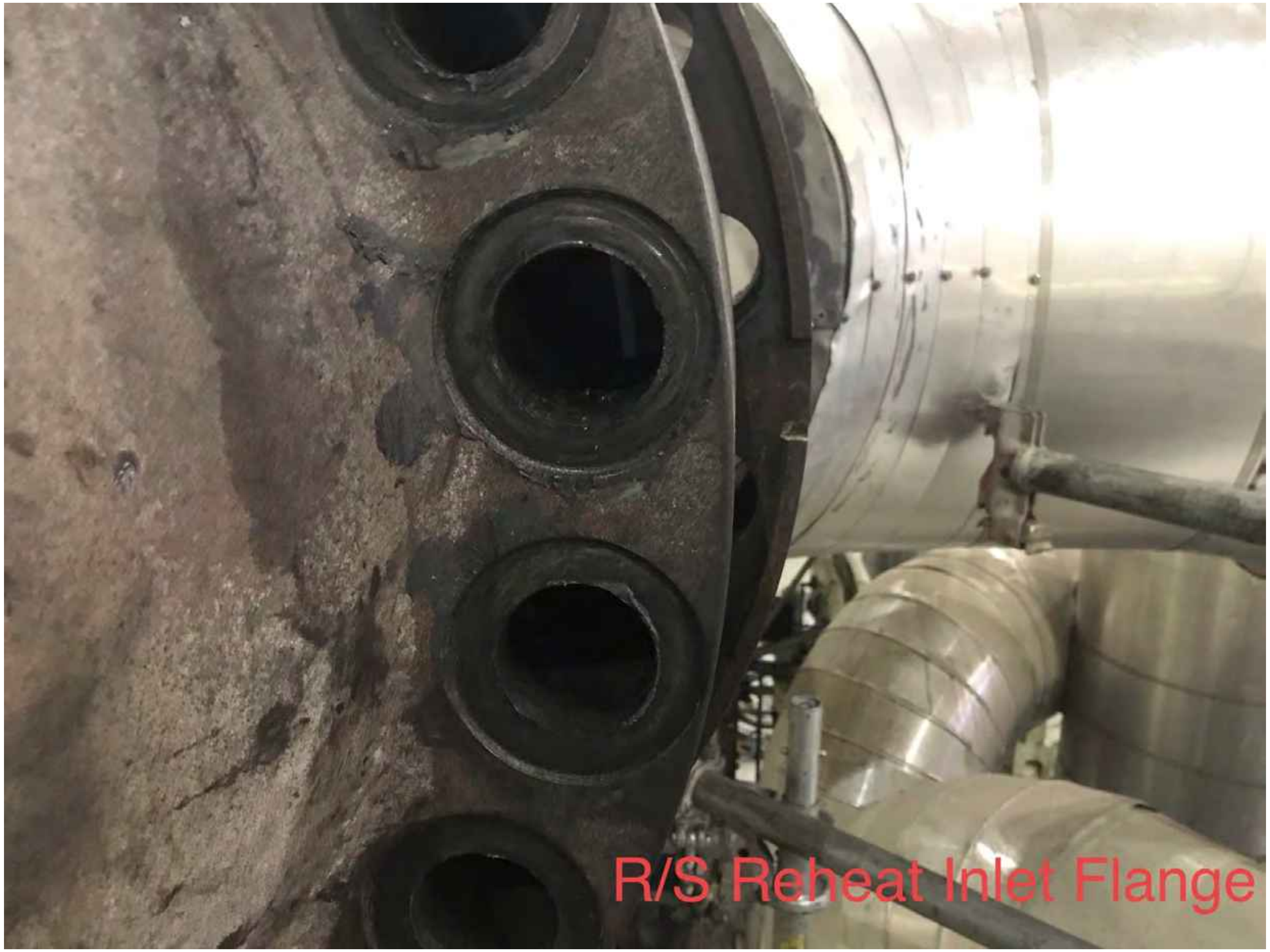
Reheat Inlet Flange Alignment

Reheat Inlet Flange Alignment

Confidential



Confidential

Reheat Inlet Flange Alignment

3.4 LP Stationary Components

3.4.1 LP Exhaust Hoods

Part Description:

Each of the LP turbines have an exhaust hood that covers the internal components and has a horizontal parting flange with the top of the condenser. Expansion bellows seal the ends of each hood to the outer gland cases by bolted vertical flanges. The exhaust hoods are aligned to the inner cylinder covers with eight "L" shaped keys which reside beneath the inner cylinder to exhaust hood expansion bellows. Steam enters the turbine through a crossover pipe that is bolted to the top center flange. There are four circular manway covers on each hood cover. It is unnecessary to enter the exhaust hood area for disassembly. There is a bearing cone extension which must be unbolted at the vertical joint, but, once the bellows and bearing cones are unbolted the hood covers can be removed.

The crossover pipe was unbolted and the top expansion bellows were removed. The "L" keys were removed and measured for clearance. The gland bellows and bearing cone extensions were unbolted at the vertical interfaces. The hoods were raised on jack bolts and removed.

The lead rupture diaphragms were hydrostatically tested. Two of the diaphragms were found to have leaks. All four of the rupture diaphragms were replaced with spares supplied by the customer. Uncatalyzed RTV 60 was used as a sealant and the bolting was tightened to 15 ksi.

At reassembly, uncatalyzed RTV 60 was applied to the horizontal parting flange and the vertical joint of the the gland expansion bellows. All bolting was tightened to 45 ksi. New crossover and manway door gaskets were supplied by the customer.

3.4.2 LP Inner Casings & Blade Rings

Part Description:

Each of the LP turbines have an inner cylinder which house dual flow blade rings and four single flow blade rings. There are six stages in each of the four flows. The flow divider/ center flow blade rings are comprised of the single first stage in each flow. The dual flow blade rings (steam chambers) have stages two through four partitions in each flow. Stages five and six are large single stage blade rings.

Steam path clearances were measured once the upper half components were removed. The inner cylinder cover and upper and lower half blade rings were removed grit blasted and non-destructively examined.

3.4.2 LP Inner Casings & Blade Rings

LPB stage six generator end had several partitions that sustained impact damage resulting from the L-1 bucket failure and subsequent liberation. This impact damage was weld repaired and blended out by Accurate Machine & Tool blade technicians.

No repairs were needed on any of the other LP internal components, besides the damaged partitions. All of the interstage packing and spill strips were in a condition that was suitable for continued service. At reassembly triple boiled linseed oil was applied to the horizontal joints, N-7000 anti-seize was used to coat bolting threads and the bolting was tightened, per OEM drawing IWE-N26-10M-7762. For all bolting, not specified on the drawing, 45 ksi prestress was applied.

LP Cylinder Distortion Checks

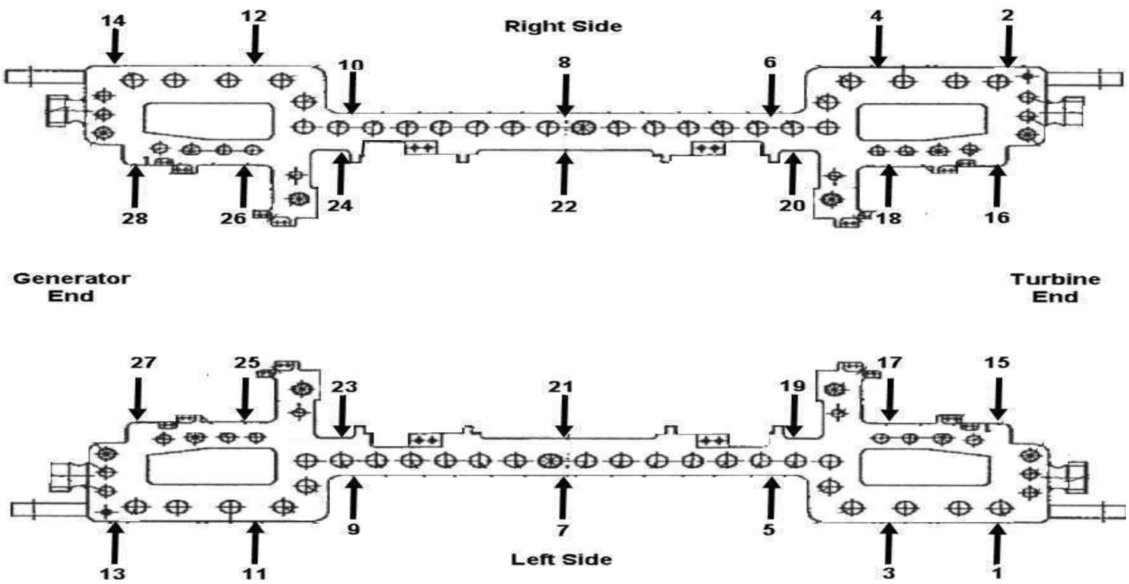
(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Inner Cylinder

Date (m/d/y) 5/16/20 Turbine Serial Number 4465 Prepared by D. Johnson

LPA Plant Comanche Unit 3 Initial ___ Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Inner Cylinder	1	0.000	2	0.030
	3	0.000	4	0.035
	5	0.000	6	0.067
	7	0.000	8	0.089
	9	0.000	10	0.065
	11	0.000	12	0.045
	13	0.000	14	0.040
	15	0.000	16	0.046
	17	NA	18	NA
	19	0.000	20	0.046
	21	NA	22	NA
	23	0.000	24	0.065
	25	NA	26	NA
	27	0.000	28	0.057

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

Confidential

LP Cylinder Distortion Checks

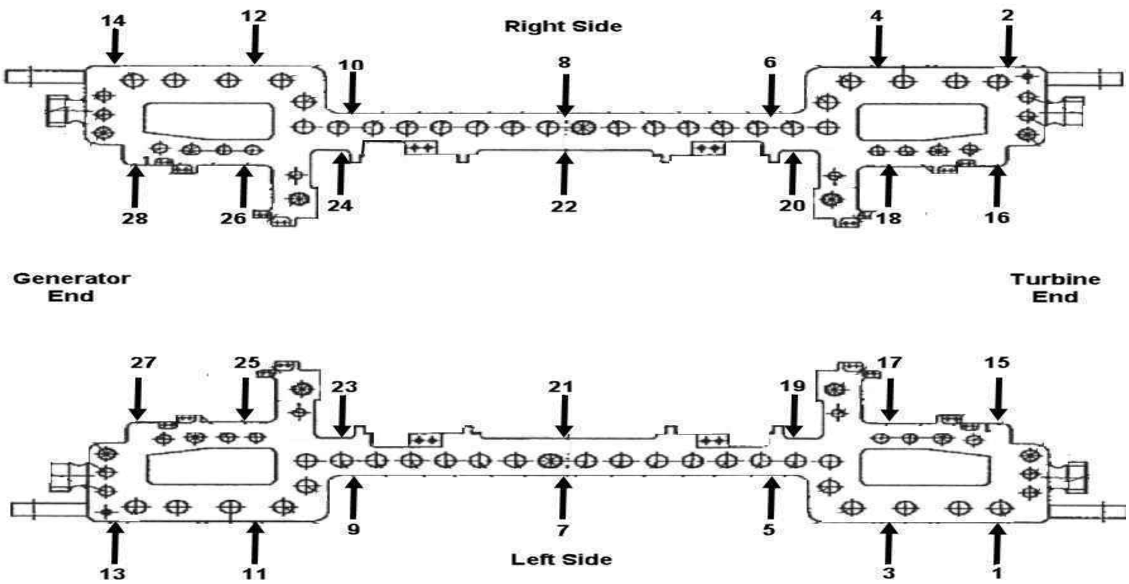
(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Inner Cylinder

Date (m/d/y) 3/9/20 Turbine Serial Number 4465 Prepared by D. Johnson

LPA Plant Comanche Unit 3 Initial Final See Note



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Inner Cylinder	1	0.017	2	0.030
	3	0.032	4	0.035
	5	0.047	6	0.067
	7	0.093	8	0.089
	9	0.044	10	0.065
	11	0.045	12	0.045
	13	0.036	14	0.040
	15	0.044	16	0.046
	17	0.046	18	0.046
	19	0.047	20	0.046
	21	0.082	22	0.067
	23	0.070	24	0.065
	25	0.075	26	0.062
	27	0.060	28	0.057

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments
Measurements taken during tops-on alignment

Confidential

LP Cylinder Distortion Checks

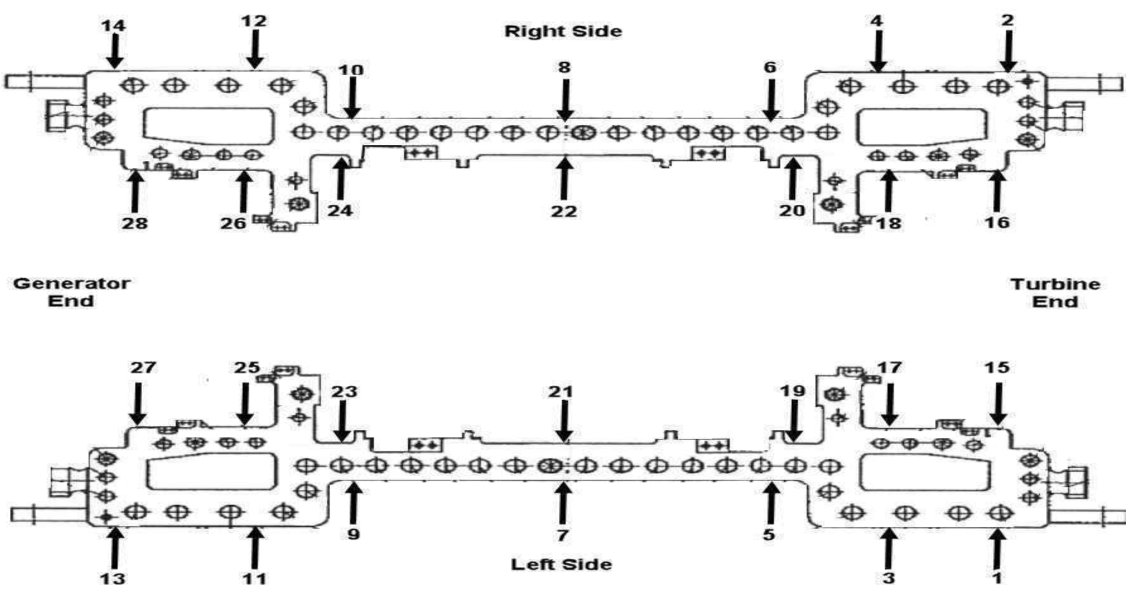
(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Inner Cylinder

Date (m/d/y) 5/12/20 Turbine Serial Number 4465 Prepared by D. Johnson

LPB Plant Comanche Unit 3 Initial ___ Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Inner Cylinder	1	0.000	2	0.000
	3	0.000	4	0.000
	5	0.000	6	0.000
	7	0.000	8	0.000
	9	0.000	10	0.000
	11	0.000	12	0.000
	13	0.000	14	0.000
	15	0.000	16	0.000
	17		18	
	19	0.000	20	0.000
	21		22	
	23	0.000	24	0.000
	25		26	
	27	0.000	28	0.000

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

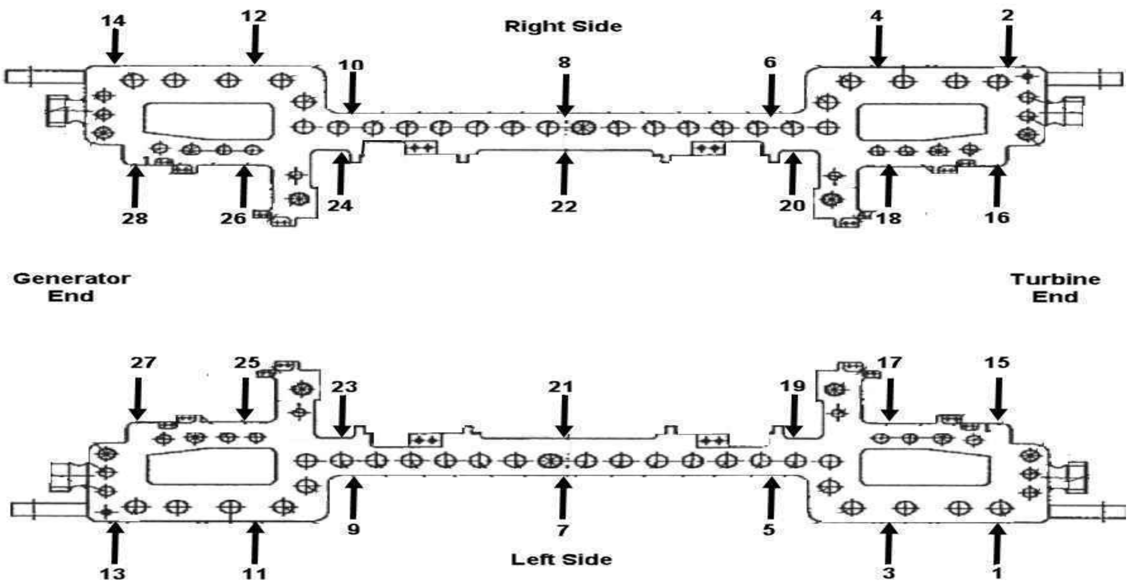
LP Cylinder Distortion Checks

(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Inner Cylinder

Date (m/d/y)	3/9/20	Turbine Serial Number	4465	Prepared by	D. Johnson
LPB	Plant	Comanche	Unit 3	Initial / Final	See Note



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Inner Cylinder	1	0.023	2	0.027
	3	0.032	4	0.027
	5	0.040	6	0.048
	7	0.104	8	0.077
	9	0.050	10	0.044
	11	0.037	12	0.044
	13	0.025	14	0.028
	15	0.038	16	0.029
	17	0.044	18	0.040
	19	0.051	20	0.058
	21	0.088	22	0.064
	23	0.036	24	0.050
	25	0.045	26	0.049
	27	0.048	28	0.036

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments
Measurements taken during tops-on alignment

Confidential

LP Cylinder Distortion Checks

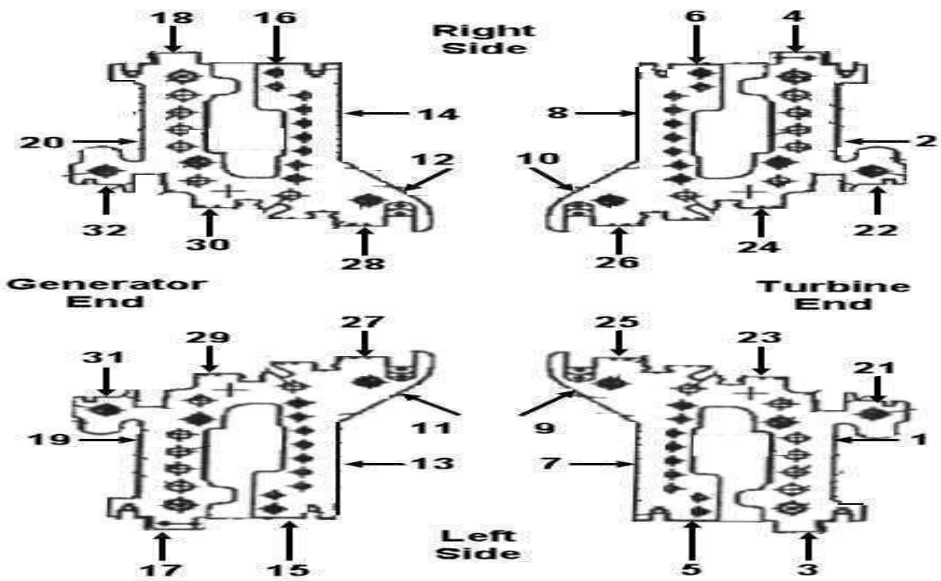
(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Dual Flow Blade Ring

Date (m/d/y) 5/15/20 Turbine Serial Number 4465 Prepared by D. Johnson

LPA Plant Comanche Unit 3 Initial ___ Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Dual Flow Blade Ring	1	0.000	2	0.000
	3	0.000	4	0.000
	5	0.000	6	0.000
	7	0.000	8	0.000
	9	0.000	10	0.000
	11	0.000	12	0.000
	13	0.000	14	0.000
	15	0.000	16	0.000
	17	0.000	18	0.000
	19	0.000	20	0.000
	21	0.000	22	0.000
	23	0.000	24	0.000
	25	0.000	26	0.000
	27	0.000	28	0.000
	29	0.000	30	0.000
	31	0.000	32	0.000

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

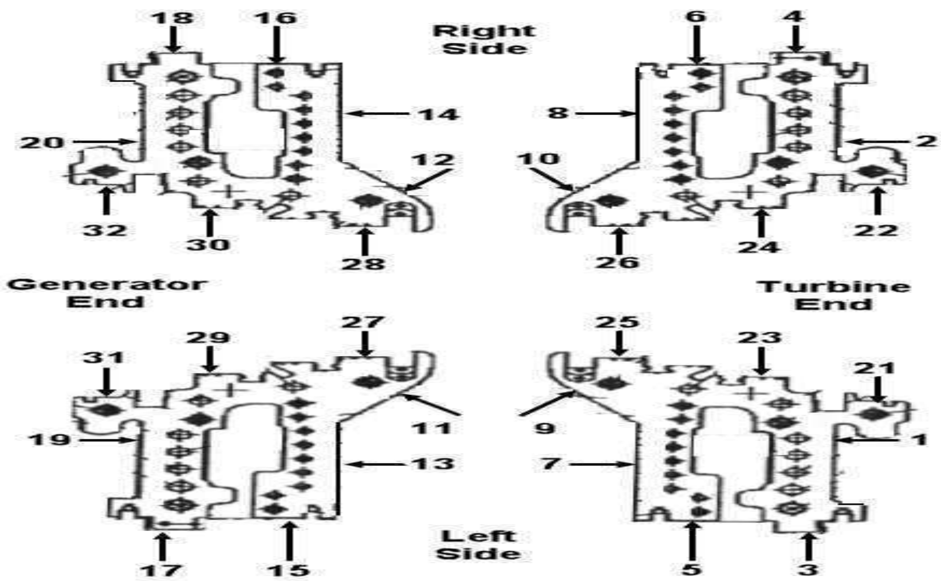
LP Cylinder Distortion Checks

(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Dual Flow Blade Ring

Date (m/d/y)	3/7/20	Turbine Serial Number	4465	Prepared by	D. Johnson
LPA	Plant	Comanche	Unit 3	Initial / Final	See Note



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Dual Flow Blade Ring	1	0.003	2	0.003
	3	0.001	4	0.002
	5	0.012	6	0.004
	7	0.019	8	0.018
	9	0.018	10	0.015
	11	0.017	12	0.016
	13	0.018	14	0.018
	15	0.008	16	0.003
	17	0.001	18	0.001
	19	0.003	20	0.003
	21	0.008	22	0.005
	23	0.010	24	0.007
	25	0.010	26	0.010
	27	0.008	28	0.010
	29	0.008	30	0.007
	31	0.005	32	0.005

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments
Measurements taken during tops-on alignment

LP Cylinder Distortion Checks

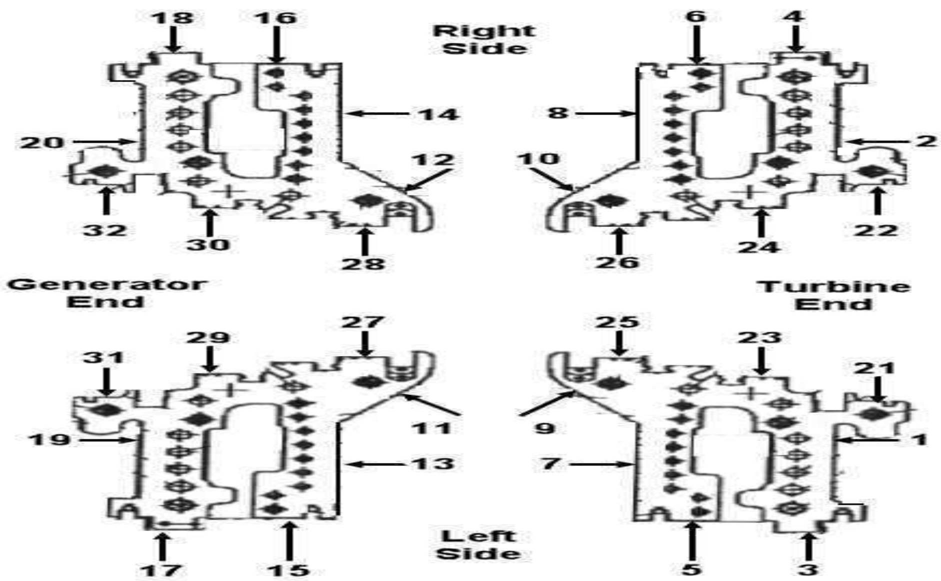
(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Dual Flow Blade Ring

Date (m/d/y) 5/11/20 Turbine Serial Number 4465 Prepared by D. Johnson

LPB Plant Comanche Unit 3 Initial
Final x



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Dual Flow Blade Ring	1	0.000	2	0.000
	3	0.000	4	0.000
	5	0.000	6	0.000
	7	0.000	8	0.000
	9	0.000	10	0.000
	11	0.000	12	0.000
	13	0.000	14	0.000
	15	0.000	16	0.000
	17	0.000	18	0.000
	19	0.000	20	0.000
	21	0.000	22	0.000
	23	0.000	24	0.000
	25	0.000	26	0.000
	27	0.000	28	0.000
	29	0.000	30	0.000
	31	0.000	32	0.000

Bolts Tight ☒ As Found ☐

Bolts Loose ☐ As Built ☒

Comments	

LP Cylinder Distortion Checks

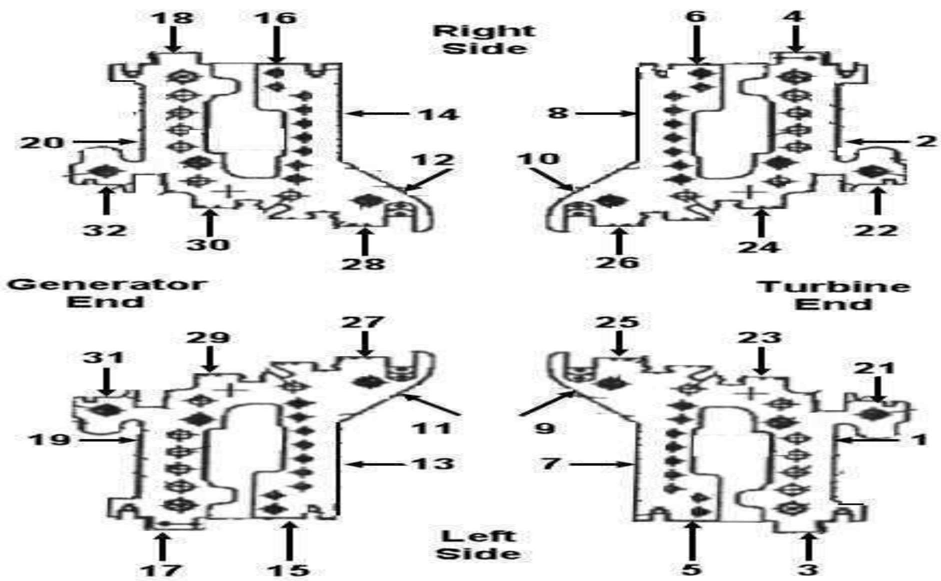
(Westinghouse Datasheet)

Horizontal Joint Gaps

LP Dual Flow Blade Ring

Date (m/d/y) 3/7/20 Turbine Serial Number 4465 Prepared by D. Johnson

LPB Plant Comanche Unit 3 Initial Final See Note



	Left Side		Right Side	
	Position	Gap	Position	Gap
LP Dual Flow Blade Ring	1	0.004	2	0.003
	3	0.000	4	0.004
	5	0.000	6	0.005
	7	0.016	8	0.013
	9	0.023	10	0.021
	11	0.025	12	0.017
	13	0.022	14	0.015
	15	0.013	16	0.013
	17	0.006	18	0.005
	19	0.009	20	0.005
	21	0.000	22	0.000
	23	0.013	24	0.006
	25	0.020	26	0.017
	27	0.020	28	0.015
	29	0.016	30	0.010
	31	0.000	32	0.000

Bolts Tight ☐ As Found ☒

Bolts Loose ☒ As Built ☐

Comments

Measurements taken during tops-on alignment

3.4.3 Crossover Pipe

Part Description:

OEM Drawing IWE-01150-8000

There are three crossover pipe sections that transfer steam from the reheat turbine exhaust to the LP turbines. Each of the sections has a horizontally oriented flange to the turbine sections and vertically oriented flanges to connect to each other. There is a spacer section on each of the vertically oriented flanges. A total of 15 gaskets are required to seal all of the flanged connections. The LP horizontally oriented flanges have expansion bellows that allow for differential expansion between the inner cylinders and the exhaust hoods. There are axially oriented expansion present on the LP "T" pipe sections.

The expansion bellows were locked in position, with threaded rods, prior to loosening the vertical joint bolting. Crossover pipe sections were removed, cleaned and visually inspected.

At reassembly, the bolting was tightened per the OEM recommended pres-srsess with customer supplied gaskets.

3.5 Pedestal Components

3.5.1 Journal Bearings

Part Description:

The nine journal bearings were disassembled and inspected during this outage. Bearings #1 and #2 are four tilt pad Waukesha bearings. Lube oil is supplied to bearings #1 and #2 via manifolds at the leading and trailing ends of each of the pads. Bearings #3 thru #8 are combined bottom tilt pad top sleeve Mitsubishi bearings with floating babbited seal rings at each axial end. Bearing #9 is a four tilt pad Mitsubishi bearing.

Bearings #1 and #2 were found with significant scoring from hard particle emission in the lube oil supply. Ultrasonic and dye penetrant inspections did not indicate any areas of disbond. One of the top pads of the #2 bearing had an area of porosity on the corner. This area of porosity had been found during the first year warranty inspection and does not appear to be getting worse. Scoring was found on the #6 bearing lower half pads. All other bearings were found to be in good condition.

Minor indications were found on the bottoms of the #4 turbine end and #5 generator end seal ring babbit surfaces with dye penetrant. No areas of disbond were found with ultrasonic testing of the seal rings. All seal rings were cleaned and reinstalled with no remedial actions taken.

3.5.1 Journal Bearings

The measured radial clearance of bearings #1 and #2 were found to be beyond the design limits. Since bearing mandrels were not available, lead wire checks were performed on bearings #3 thru #8 to determine the vertical clearance. The vertical clearance of bearings #3 thru #8 were found to be acceptable.

At reassembly the squareness of the bearings was checked to the rotor journals. All bearing support pads were contact checked and scraped, as needed, for acceptable contact to the spherical pedestal bores. At reassembly, the clearances/interferences between the top support pads to the inner bores of the pedestal covers was checked and adjusted as needed to achieve design values.

During the loss of oil event all babbit was melted from the bottom bearing pads and the rotor came into contact with the #2 bearing housing causing catastrophic damage. The damage and repairs are detailed in a separate report.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The bearings and floating seal rings should be dimensionally, ultrasonically and dye penetrant examined.

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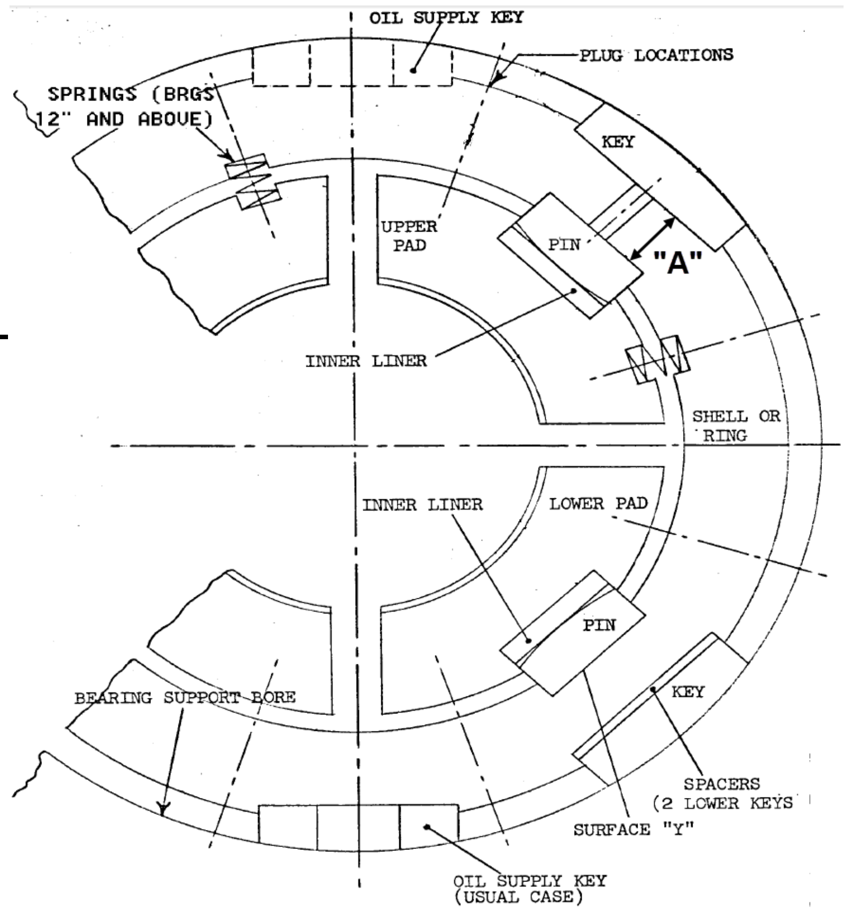
Journal Bearing Datasheets

Test Certificate

Distribution
AAZ
Issued
D. Johnson 8/30/2017
Checked
Released
Comp. dpt.
Issued by Date / Visa
QA - dpt. Date / Visa
Authority Date / Visa
Modification

Brg No 1



Note: Measurement "A" to be taken with a depth micrometer using either the rotor or mandrel

		Upper Left			Upper Right		
		Pad Up	Pad Down	Clearance	Pad Up	Pad Down	Clearance
"A" Dimension	Initial	0.474	0.500	0.026	0.471	0.498	0.027
	Recheck	0.474	0.498	0.024	0.471	0.498	0.027
	Recheck*	0.474	0.500	0.026	0.471	0.497	0.026
	Recheck*	0.475	0.501	0.026	0.471	0.497	0.026
			Final	0.026		Final	0.027

* Measurement to be taken until repeatability is established

Note: If tilt pads are equipped with springs they should be removed before taking measurements

Note: If liner is found with shims then shims may be removed and lead wire used to determine clearance. Field Engineer should be consulted in this case.

Power station designation	No. of I + T plan:	Test no:
Plant **Comanche**	Order number (WBZ)	Language E / Sheet no. 1 / Nos.of sheets 1
Denomination: Tilt Pad Bearing Clearance	Def. rep. Exec.**	Document no. IR2WH2033 / Rev.
Identification no.		
Factory*	Prior to overhaul*	
Site* 2/13/2020	After overhaul*	BHB Teil / Griff / Seite /
		FSR / MB Nr. / Beil. /

* Enter date where applicable   * * Enter cross if executed

Journal Bearing Datasheets

Test Certificate

Distribution

AAZ

Issued

D. Johnson
8/30/2017

Checked

Released

Comp. dpt.

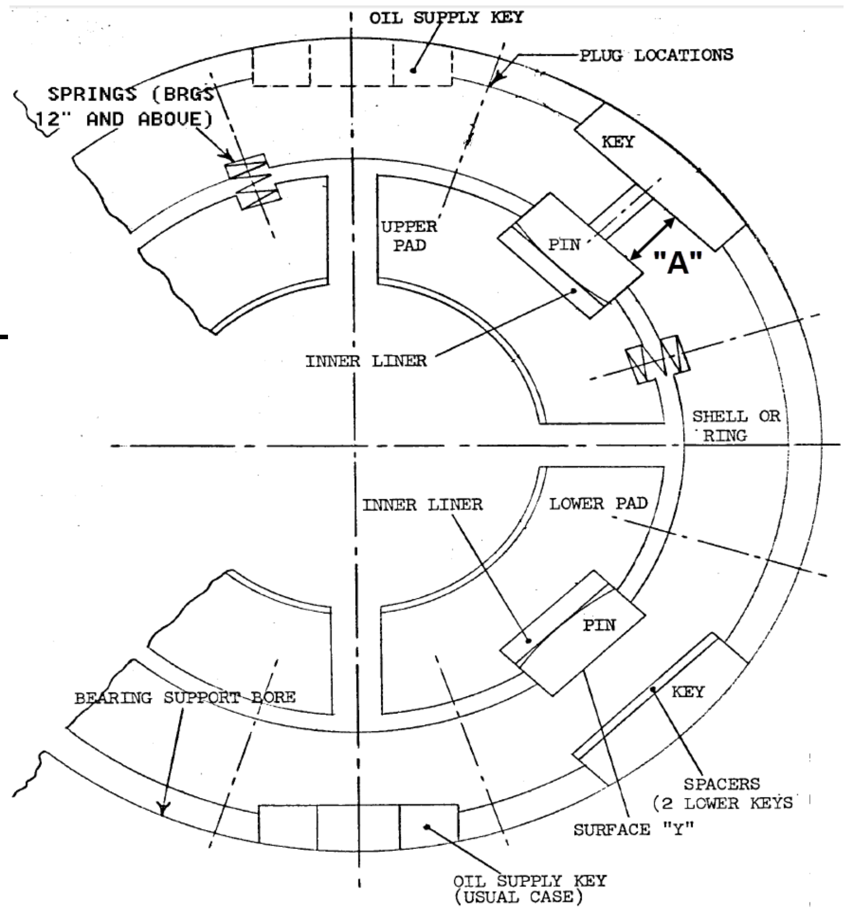
Issued by
Date / Visa

QA - dpt.
Date / Visa

Authority
Date / Visa

Modification

Brg No 2



Note: Measurement "A" to be taken with a depth micrometer using either the rotor or mandrel

		Upper Left			Upper Right		
		Pad Up	Pad Down	Clearance	Pad Up	Pad Down	Clearance
"A" Dimension	Initial	3.627	3.656	0.029	3.623	3.655	0.032
	Recheck	3.627	3.656	0.029	3.622	3.654	0.032
	Recheck*	3.627	3.656	0.029	3.622	3.654	0.032
	Recheck*	3.627	3.656	0.029	3.622	3.655	0.033
			Final	0.029		Final	0.032

* Measurement to be taken until repeatability is established

Note: If tilt pads are equipped with springs they should be removed before taking measurements

Note: If liner is found with shims then shims may be removed and lead wire used to determine clearance. Field Engineer should be consulted in this case.

Power station designation	No. of I + T plan:	Test no:	
Plant **Comanche**	Order number (WBZ)	Language E	Sheet no. 1 / Nos.of sheets 1
Denomination: Tilt Pad Bearing Clearance	Def. rep. / Exec.**	Document no. IR2WH2033	Rev.
Identification no.			
Factory*	Prior to overhaul*		
Site* 2/13/2020	After overhaul*	BHB Teil / Griff / Seite	/
* Enter date where applicable	* * Enter cross if executed	FSR / MB Nr. / Beil.	/

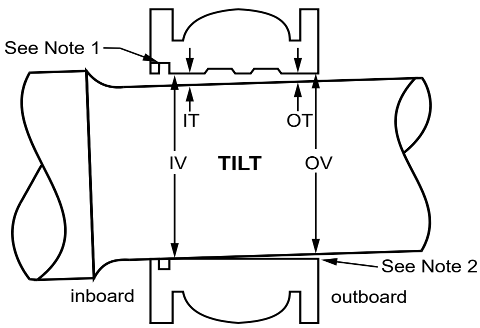
Journal Bearing Datasheets

Bearing To Journal Alignment

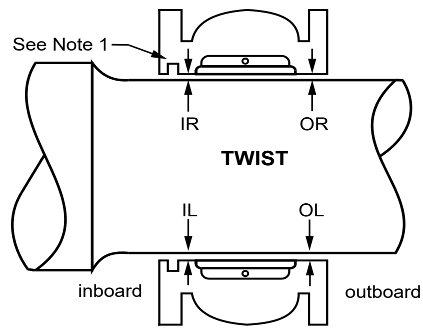
Final

For Bearings With Ball Seats

Date(m/d/y) 5/22/2020 Turbine Serial No. 4465 Prepared by J. Chirchir



ELEVATION VIEW



PLAN VIEW

ST00102

NOTE:

1. On most generator bearings, the end leakage groove is on the outboard end.
2. On hood bearings, the outboard end is set low to compensate for vacuum deflection.

TILT

Brg #	Section	Reading in Inches		Reading in Mils		Limits	Actual	Tolerance
		IV	OV	IT	OT	0.0 To	(Mils)	Check
3		17.946"	17.946"	46.0 Mils	46.0 Mils	1.8 Mils	0.0 Mils	✓
4		17.917"	17.917"	43 Mils	41 Mils	1.8 Mils	2.0 Mils	✗
5		17.917"	17.917"	42 Mils	43 Mils	1.8 Mils	1.0 Mils	✓
6		18.905"	18.905"	48 Mils	48 Mils	1.9 Mils	0.0 Mils	✓

TWIST

Brg #	Section	Readings in Mils						Tolerance Check
		IL	OL	IR	OR	Limits	Actual	
3		1737 Mils	1738 Mils	1741 Mils	1739 Mils	±5.4 Mils	1.5 Mils	✓
4		1740 Mils	1744 Mils	1739 Mils	1737 Mils	±5.4 Mils	3.0 Mils	✓
5		1741 Mils	1741 Mils	1746 Mils	1745 Mils	±5.4 Mils	0.5 Mils	✓
6		1882 Mils	1880 Mils	1886 Mils	1884 Mils	±5.7 Mils	0.0 Mils	✓

Comments

- IV & OV were calculated using the journal diameter plus the vertical clearances
- The average of IT & OT gives the vertical clearances for the bearings
- The twist measurements were taken from the bearing housings to the journals and are recorded here in mils

Journal Bearing Datasheets

Bearing Ring

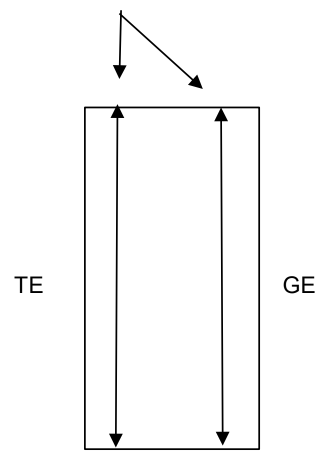
Lead Wire Clearance Check

Date(m/d/y) 5/24/2020 Turbine Serial No. 4465 Prepared By D. Johnson

Data Set As Left Unit Recorded in English - inches

Lead Wire Clearance

Location	TE	GE
1	-0.002	-0.002
2	-0.001	-0.002
3	0.015	0.024
4	0.010	0.007
5	0.008	0.016
6	0.014	0.015
7	0.022	0.008
8	0.011	0.011
9	0.000	0.000



Comments	

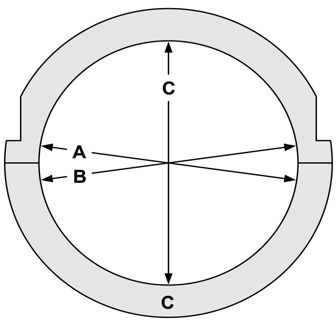
Confidential

Journal Bearing Datasheets

Bearing
Oil Ring Clearances

Date(m/d/y) 2/17/2020 Turbine Serial No. 4465 Prepared by J Chirchir

INSPECTIONS & CHECKS				CODE	
Ring Inspected	UT, PT			**X**	Work Carried Out
Journals Inspected	X			**N**	Not Done
				NA	Not Applicable
				C	See Comments
				V	Visual Inspection
				MP	Mag. Particle
				UT	Ultrasonic
				PT	Penetrant



Units Recorded in: English - inches

Location Number	Oil Rings A-Dia	Oil Rings B-Dia	Oil Rings C-Dia	Journal Dia	Clearance Average	Clearance Min.	Clearance Max.	Condition Comment
#3 TE	17.901	17.902	17.926	17.875	0.035	0.026	0.051	
#3 GE	17.906	17.906	17.923	17.875	0.037	0.031	0.048	
#4 TE	17.907	17.906	17.920	17.875	0.036	0.031	0.045	Indications found with PT
#4 GE	17.903	17.904	17.926	17.875	0.036	0.028	0.051	
#5 TE	17.901	17.902	17.921	17.875	0.033	0.026	0.046	
#5 GE	17.902	17.906	17.920	17.875	0.034	0.027	0.045	Indications found with PT
#6 TE	18.892	18.892	18.909	18.857	0.041	0.035	0.052	
#6 GE	18.891	18.889	18.905	18.857	0.038	0.032	0.048	
#7 TE	21.055	21.054	21.054	21.020	0.034	0.034	0.035	
#7 GE	21.053	21.054	21.053	21.020	0.033	0.033	0.034	
#8 TE	19.676	19.676	19.677	19.646	0.030	0.030	0.031	
#8 GE	19.682	19.672	19.677	19.646	0.031	0.026	0.036	

Comments:

Indications found on #4 TE and #5 GE rings were small and only found on the lower halves
No action was taken

Lower Half Bearings

#1 Bearing Lower Half – At Assembly

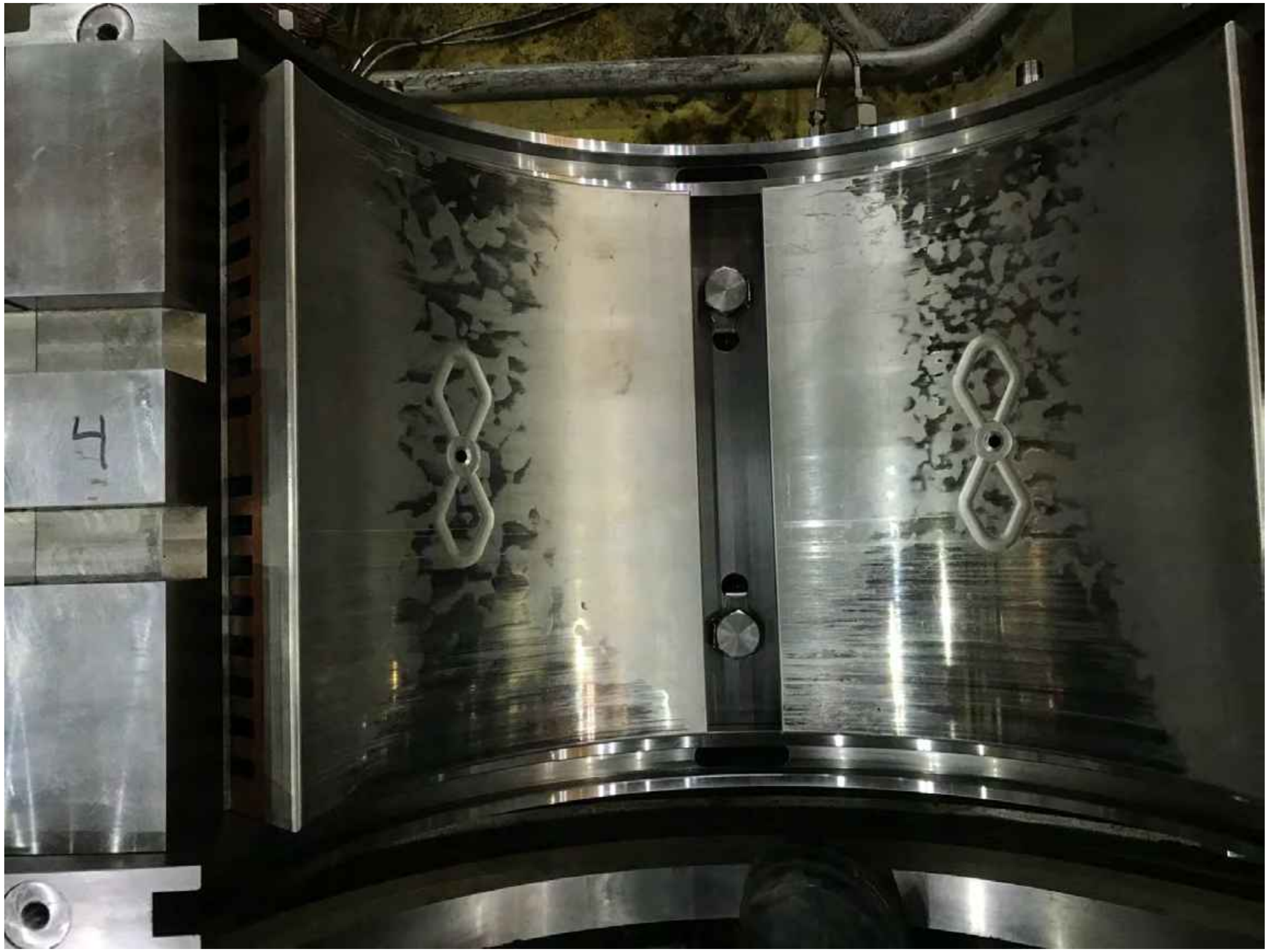
Lower Half Bearings

#2 Bearing Lower Half – At Assembly

Lower Half Bearings

#3 Bearing Lower Half – At Assembly

Lower Half Bearings



#4 Bearing Lower Half – At Assembly

Lower Half Bearings

#5 Bearing Lower Half – At Assembly

Lower Half Bearings

#6 Bearing Lower Half – At Assembly

3.5.2 Thrust Bearing

Part Description:

The thrust bearing is a self leveling Kingsbury-style leading edge lubricated babbit pad bearing. There are 16 individual pads with eight pads on both the turbine and generator ends.

The bearing was disassembled, cleaned and inspected. No deficiencies were found through ultrasonic or dye penetrant testing. At disassembly, the axial clearance was found to be 0.033" the design criteria is 0.022"-0.028".

A new oversized thrust shim was supplied by the customer and it's thickness was adjusted to reduced the amount of axial thrust clearance. At reassembly, the thrust bearing locating mechanism was tightened to lock the bearing in it's proper axial position, which set the HP-IP rotor to the OEM "K" clearance of 0.681".

During the loss of oil event the babbit on the active side pads was melted. The damage and repairs are detailed in a separate report.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The bearing pads should be ultrasonically and dye penetrant examined.

Stack checks should be performed to verify axial thrust clearance.

The flatness of the shim plates should be checked.

The screw heights of the thrust bearing locating mechanism should be adjusted so to maximize the available axial adjustment. This can be achieved by changing the thicknesses of the "ear" shims.

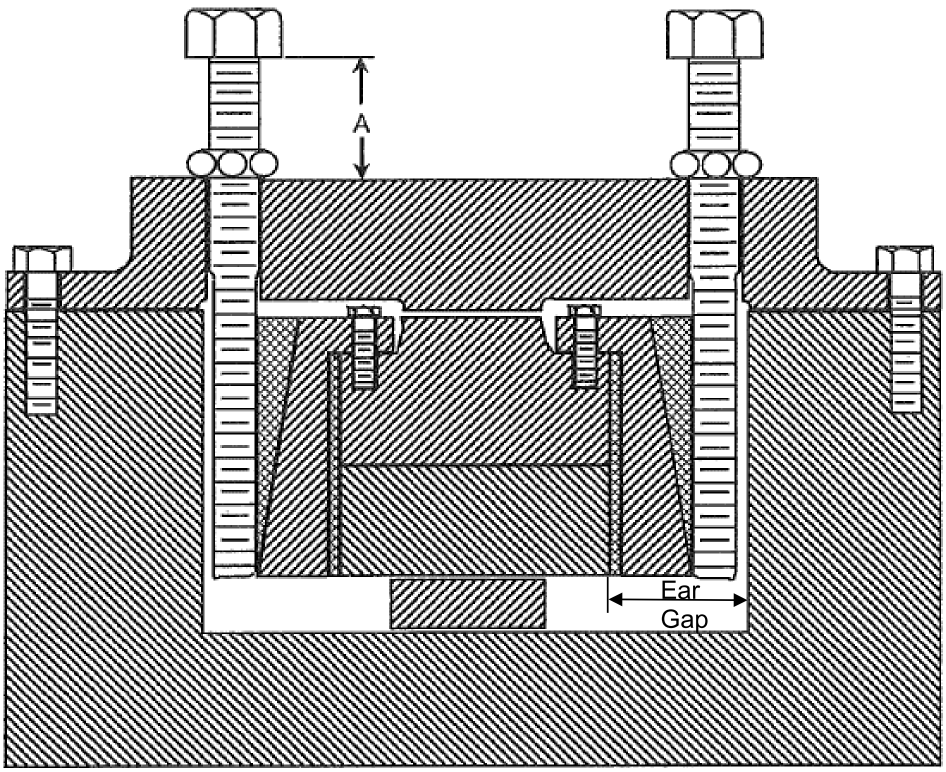
Thrust Bearing Datasheets

(Westinghouse Datasheet)

Thrust Bearing Locating Mechanism

Adjustment Screw Heights

Date (m/d/y)	5/28/20	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	
				Final	x



		Screw Height A	Ear Gap	Shim Thickness
Right Side	Gov End	3-11/64"	3.124	0.242
	Gen End	1-7/32"	3.181	0.146
Left Side	Gov End	3-1/2"	3.128	0.244
	Gen End	1-59/64"	3.176	0.133

Comments

TE Thrust Shim Thickness = 0.357"
GE Thrust Shim Thickness = 0.358"

Thrust Bearing Datasheets

Thrust Bearing
Cage Bump Check

Date(m/d/y) **5/27/2020** Turbine S/N **4465** Prepared by **D. Johnson**

Units: Final

	Cage L/S	Rotor	Cage R/S	Clearance
To GVN	0	0	0	0.028
To GEN	0.027	0	0.028	
To GVN	0	0	0	0.028
To GEN	0.027	0	0.028	

Thrust Bearing size: 21"

Shoe Area: 144.5

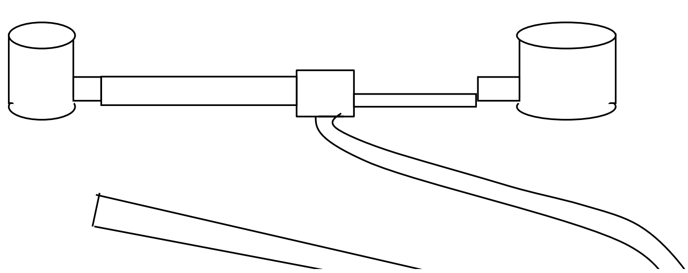
Ram size: RC-50 (0.99 in^2)

Pressure applied: 1824 psi

$$\text{Pressure} = \frac{\textbf{Shoe Area x 25}}{\textbf{2 x ram area}}$$

OD of Babbitt	Shoe Area on one side	Mfg	Style	No of shoes on one side	OD of Collar
9	40.5	Kingsbury	J-9	6	9.25
10.5	55	Kingsbury	JJ-10-1/2	6	10.69
11.25	72	Waukeshaw	Special	6	11.5
12	72	Kingsbury	JJ-12	6	12.19
15	112.5	Kingsbury	JJ-15	6	15.19
17	144.5	Kingsbury	JJ-17	6	17.25
19.625	144.5	Kingsbury	Special	6	19.88
22.5	148	Kingsbury	Special	8	22.75
22.5	228	Waukeshaw	Special	8	22.75
23	264	Kingsbury	BB-23	6	23.25
25	258	Waukeshaw	Special	8	25.25

Mechanism used to float Thrust Cage



Inspection Form Template Sheet: (a) Rev 1.0 - 04/04/2017

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Thrust Bearing Datasheets

Thrust Bearing
Cage Bump Check

Date(m/d/y) **5/27/2020** Turbine S/N **4465** Prepared by **D. Johnson**

Units: Initial Assembly

	Cage L/S	Rotor	Cage R/S	Clearance
To GVN	0	0	0	0.03
To GEN	0.030	0	0.030	
To GVN	-0.001	0	-0.001	0.031
To GEN	0.030	0	0.030	

Thrust Bearing size 21"

Shoe Area 144.5

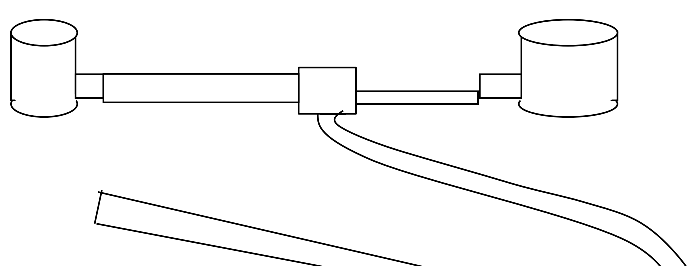
Ram size RC-50 (0.99 in^2)

Pressure applied 1824 psi

$$\textbf{Pressure} = \frac{\textbf{Shoe Area x 25}}{\textbf{2 x ram area}}$$

OD of Babbitt	Shoe Area on one side	Mfg	Style	No of shoes on one side	OD of Collar
9	40.5	Kingsbury	J-9	6	9.25
10.5	55	Kingsbury	JJ-10-1/2	6	10.69
11.25	72	Waukeshaw	Special	6	11.5
12	72	Kingsbury	JJ-12	6	12.19
15	112.5	Kingsbury	JJ-15	6	15.19
17	144.5	Kingsbury	JJ-17	6	17.25
19.625	144.5	Kingsbury	Special	6	19.88
22.5	148	Kingsbury	Special	8	22.75
22.5	228	Waukeshaw	Special	8	22.75
23	264	Kingsbury	BB-23	6	23.25
25	258	Waukeshaw	Special	8	25.25

Mechanism used to float Thrust Cage



Inspection Form Template Sheet: (a) Rev 1.0 - 04/04/2017

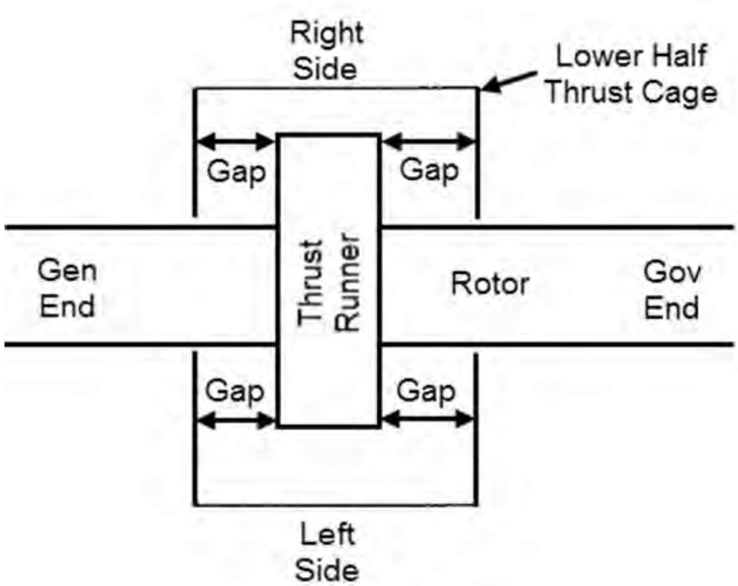
Thrust Bearing Datasheets

Thrust Bearing

Thrust Housing Squareness

Date(m/d/y) 5/25/2020 Turbine S/N 4465 Prepared by D. Johnson

Units: English - inches



	Gaps	
	Gov End	**Gen End**
Left Side	**5.408**	**5.337**
Right Side	**5.408**	**5.340**

Note: To be measured before removal of thrust bearing locating mechanism

Inspection Form Template Sheet: (a) Rev 1.0 - 04/04/2017

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Thrust Bearing Datasheets

Straddle Thrust Bearing
Stack Check

Date(m/d/y) 4/20/2020 Turbine Serial No. 4465 Prepared by J Chirchir

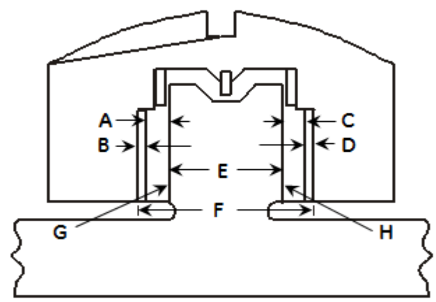
Data set As Left Units Recorded in English - inches

INSPECTIONS & CHECKS				CODE	
Ball Contact Check	NA	Runner Inspection	X	X	Work Carried Out
Ball Pinch Check	NA	Wear Device Inspection	NA	N	Not Done
Ball Torque Check	NA	Screens and Orifices	NA	NA	Not Applicable
Parallelism Check	X	Thermocouples Calib.	N	C	See Comments
Thrust Plate Inspection	X	Seal Rings Inspection	NA	V	Visual Inspection
Babbitt Inspection	UT, PT			MP	Mag. Particle
				UT	Ultrasonic
				PT	Penetrant

Applicable Figure: Select

Type I

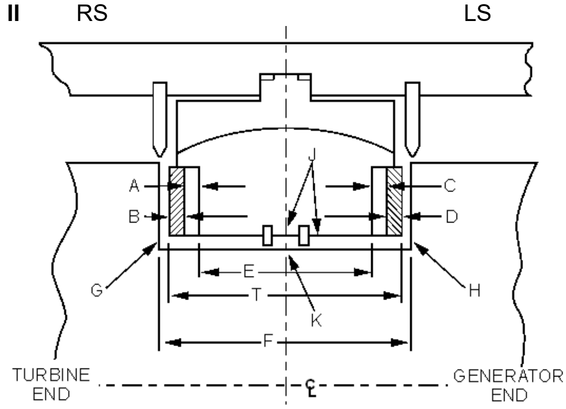
TE



THRUST BEARING DATA

"A" Bearing	TE	5.238
"B" Shim Plate	TE	0.357
"C" Bearing	GE	5.237
"D" Shim Plate	GE	0.353
"E" Rotor		3.623
"T" Total		14.808
"F" Casing		14.844

Type II RS LS



THRUST CLEARANCE

Clearance (F minus T)	0.036
Clearance (By float)	0.033
Difference	0.003
Stack Check	✗

RUNOUT (TIR)

G	
H	

SEAL RING CLEARANCES (if applicable)

	Turbine End				Generator End		
	0°	90°	Out of Round		0°	90°	Out of Round
Seal Diameter (J)	NA						
Rotor Diameter (K)	NA				NA	NA	0.000
Clearance	NA						

Comments

F Upper = 14.844"
F Lower = 14.844"
Clr. Westinghouse Method 0.031"

D309202 Sheet: (a) Rev 1.0 - 02/17/2016 GE Power Services Proprietary Information

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Thrust Bearing Datasheets

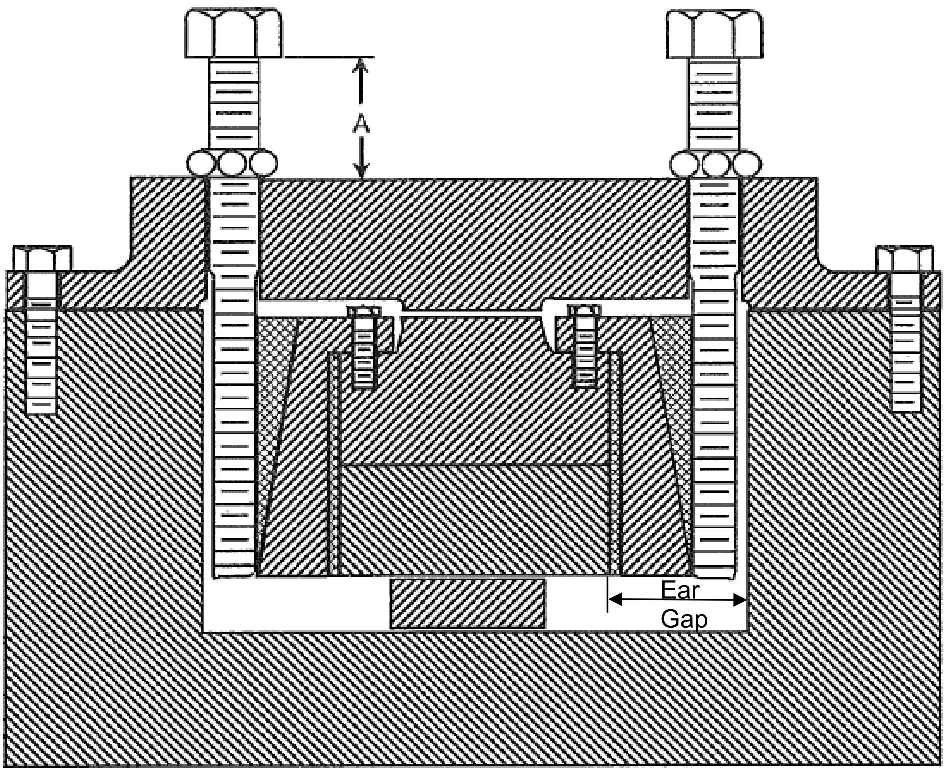
(Westinghouse Datasheet)

Thrust Bearing Locating Mechanism

Adjustment Screw Heights

Date (m/d/y) 2/14/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



		Screw Height A	Ear Gap	Shim Thickness
Right Side	Gov End	2-23/64"	3.187	0.242
	Gen End	1-5/64"	3.102	0.146
Left Side	Gov End	3-1/16"	3.192	0.244
	Gen End	1-13/64"	3.094	0.133

Comments

TE Thrust Shim Thickness = 0.357"
GE Thrust Shim Thickness = 0.353"

Thrust Bearing Datasheets

(Westinghouse Datasheet)

Thrust Bearing Clearance

Date (m/d/y) 2/13/20 Turbine Serial Number 4465 Prepared by J Chirchir

Plant Comanche Unit 3 Initial X
Final

Rotor Thrust Forward:

			Left Side	Right Side
SEM	5.135	N1 Gland Reference	1.049	1.050
Indicator	0	B Coupling "L" Reference	4.618	4.707

Rotor Thrust Aft:

			Left Side	Right Side
SEM	5.17	N1 Gland Reference	1.082	1.083
Indicator	0.033	B Coupling "L" Reference	4.651	4.740

Rotor Thrust Forward:

			Left Side	Right Side
SEM	5.135	N1 Gland Reference*	1.049	1.050
Indicator	0	B Coupling "L" Reference*	4.651	4.740

Rotor Thrust Aft:

			Left Side	Right Side
SEM	0.035	N1 Gland Reference*	0.033	0.033
Indicator	0.033	B Coupling "L" Reference*	0.033	0.033

* Only necessary if indicator measurements do not agree with hard measurements

Comments		
	k =0.645	Thrust clr = 0.033
Design	k =0.681	Design clr = 22 - 28 mils

3.5.3 Rotor Journals

Part Description:

Each of the rotors have two journals that ride in babbited bearings. Once the rotors were removed the journals were cleaned and the outer diameters were measured. Some minor scoring was found on the HP-IP rotor at journals #1 and #2. At reassembly, the journals were strap lapped with 220 grit emery paper to remove surface imperfections.

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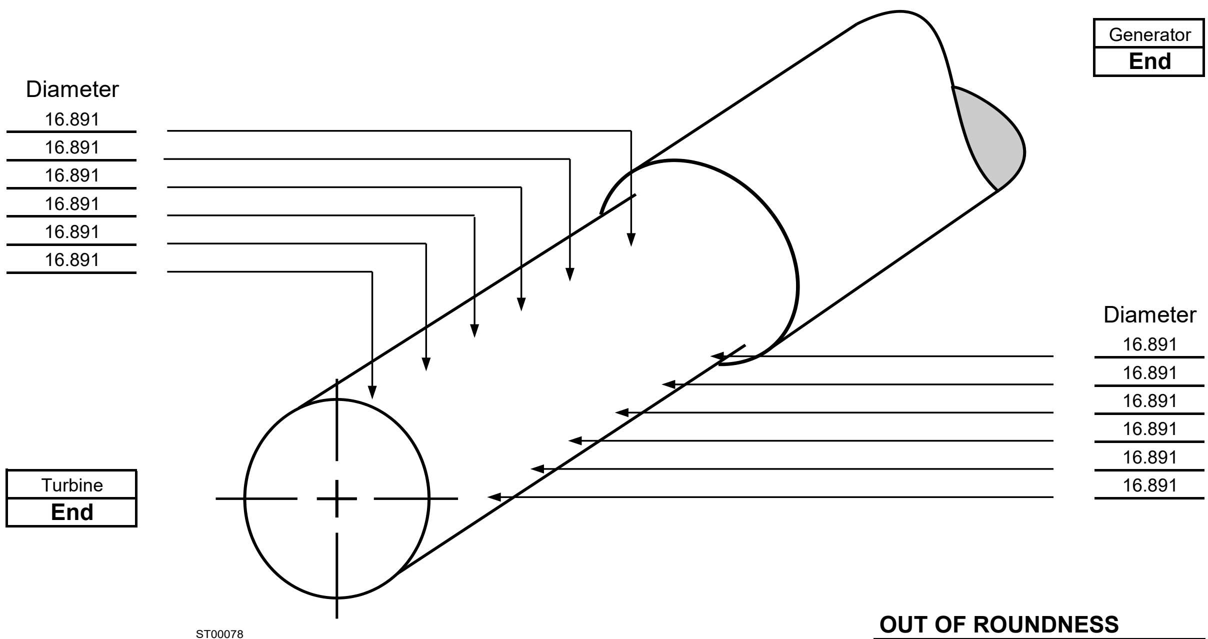
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 2/14/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #1 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



JOURNAL SIZES

	0º	90º	All
Maximum	16.891	16.891	16.891
Minimum	16.891	16.891	16.891
Difference	0.000	0.000	
Average	16.891	16.891	16.891

OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
16.891	16.891	0.000
16.891	16.891	0.000
16.891	16.891	0.000
16.891	16.891	0.000
16.891	16.891	0.000
16.891	16.891	0.000

Comments:

Oil Deflector Journal Diameter = 18.464"

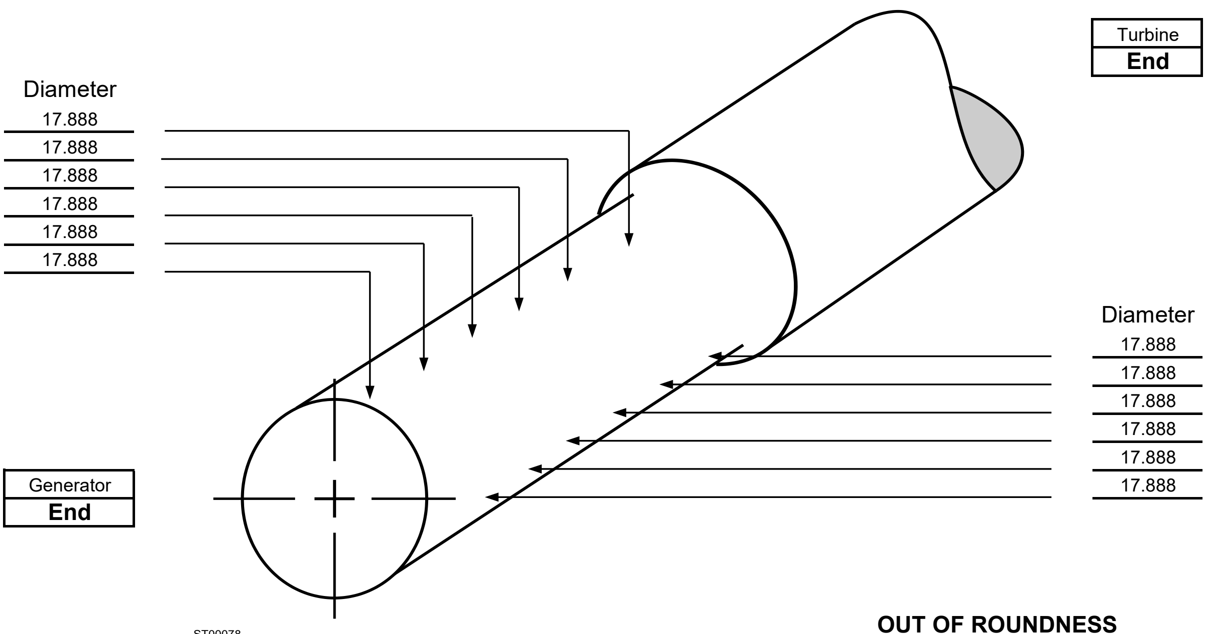
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 2/14/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #2 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
17.888	17.888	0.000
17.888	17.888	0.000
17.888	17.888	0.000
17.888	17.888	0.000
17.888	17.888	0.000
17.888	17.888	0.000

JOURNAL SIZES

	0º	90º	All
Maximum	17.888	17.888	17.888
Minimum	17.888	17.888	17.888
Difference	0.000	0.000	
Average	17.888	17.888	17.888

Comments:

Oil Deflector Journal Diameter = 19.488"

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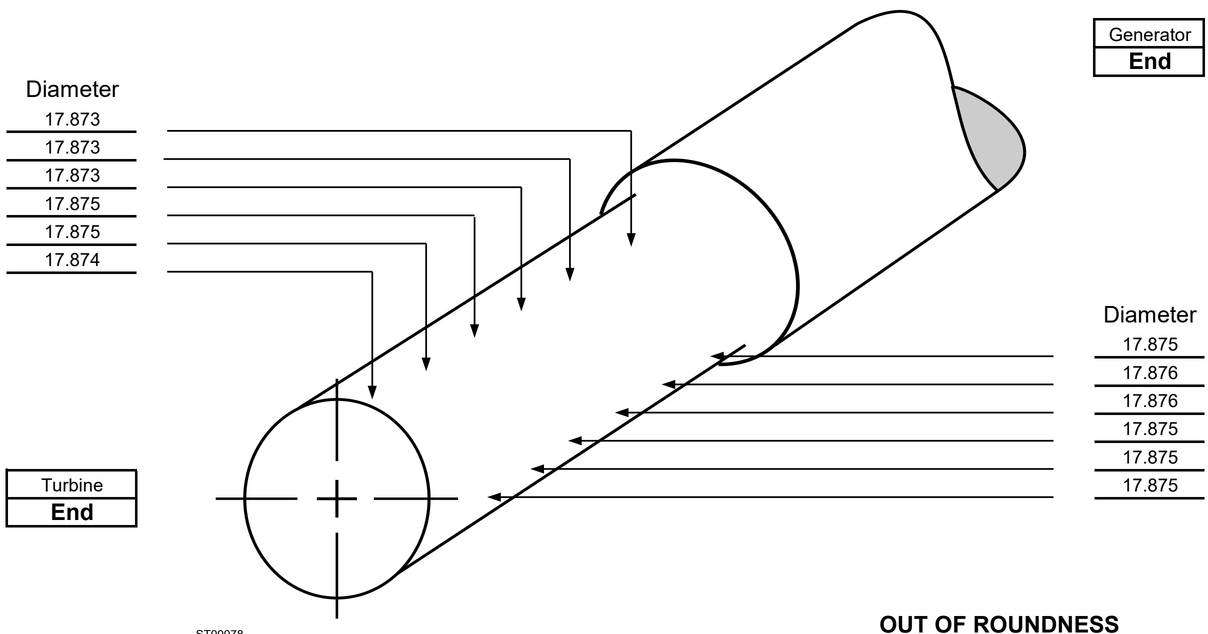
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 2/14/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #3 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



JOURNAL SIZES

	0º	90º	All
Maximum	17.875	17.876	17.876
Minimum	17.873	17.875	17.873
Difference	0.002	0.001	0.001
Average	17.874	17.875	17.875

OUT OF ROUNDNESS

Diameters		**Out of**
0º	**90º**	**Round**
17.873	17.875	-0.002
17.873	17.876	-0.003
17.873	17.876	-0.003
17.875	17.875	0.000
17.875	17.875	0.000
17.874	17.875	-0.001

Comments:

Oil Deflector Journal Diameter = 19.487"

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Journal Diameters

Rotor Journal Condition

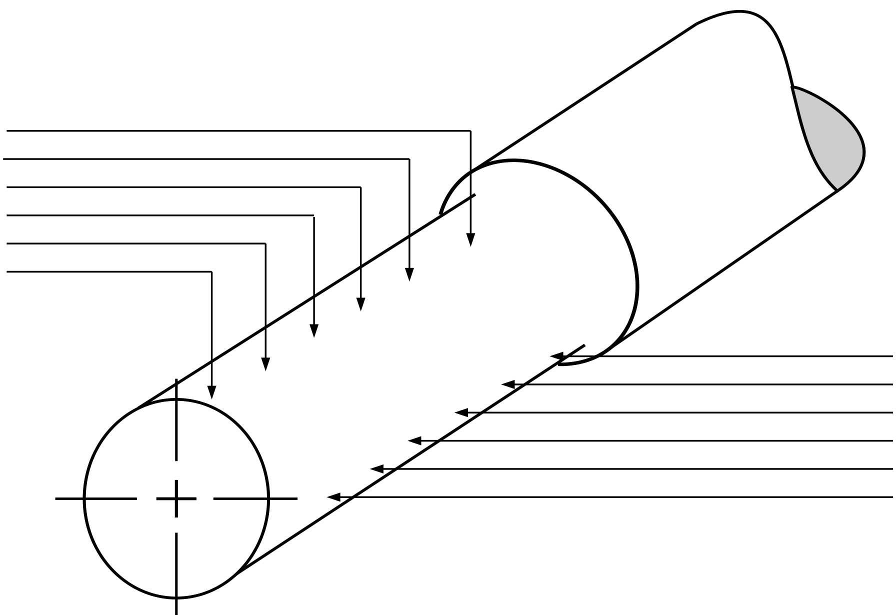
Date(m/d/y) 2/14/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #4 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**

Diameter
17.876
17.875
17.875
17.875
17.875
17.874

Turbine
End



Diameter
17.876
17.875
17.875
17.875
17.875
17.874

Generator
End

ST00078

JOURNAL SIZES

	0º	90º	All
Maximum	17.876	17.876	17.876
Minimum	17.874	17.874	17.874
Difference	0.002	0.002	0.000
Average	17.875	17.875	17.875

OUT OF ROUNDNESS

Diameters 0º	Diameters 90º	Out of Round
17.876	17.876	0.000
17.875	17.875	0.000
17.875	17.875	0.000
17.875	17.875	0.000
17.875	17.875	0.000
17.874	17.874	0.000

Comments:

Oil Deflector Journal Diameter = 19.487"

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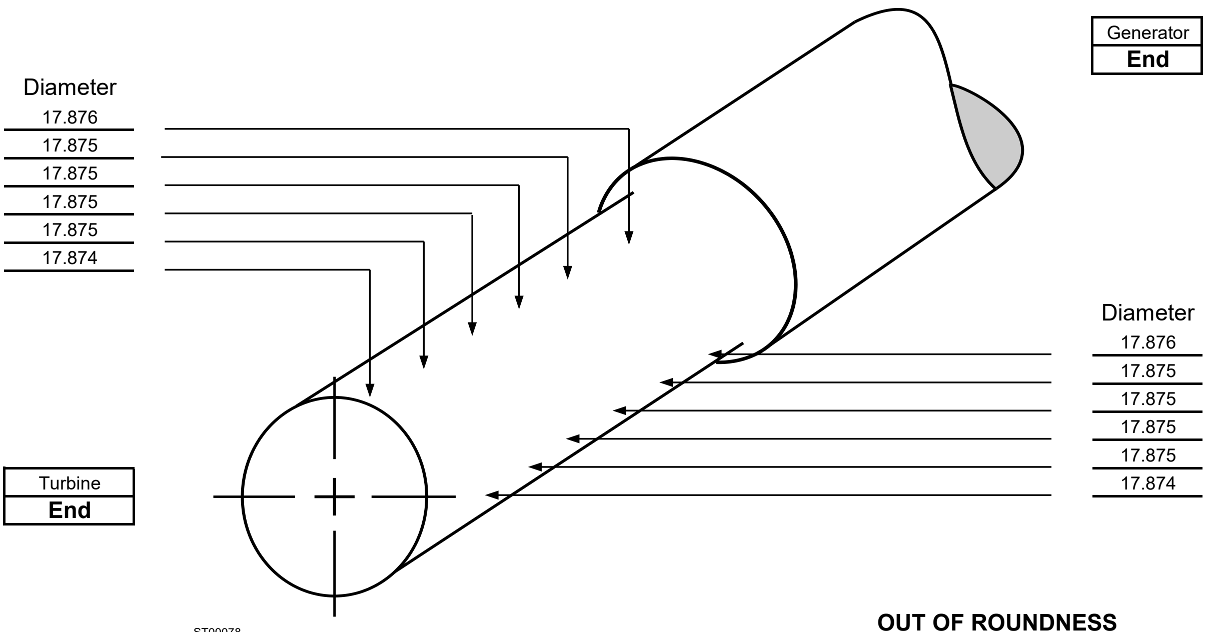
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 1/26/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #5 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



JOURNAL SIZES

	0º	90º	All
Maximum	17.876	17.876	17.876
Minimum	17.874	17.874	17.874
Difference	0.002	0.002	0.000
Average	17.875	17.875	17.875

OUT OF ROUNDNESS

Diameters		Out of Round
0º	**90º**	
17.876	17.876	0.000
17.875	17.875	0.000
17.875	17.875	0.000
17.875	17.875	0.000
17.875	17.875	0.000
17.874	17.874	0.000

Comments:

Oil Deflector Journal Diameter = 19.490"

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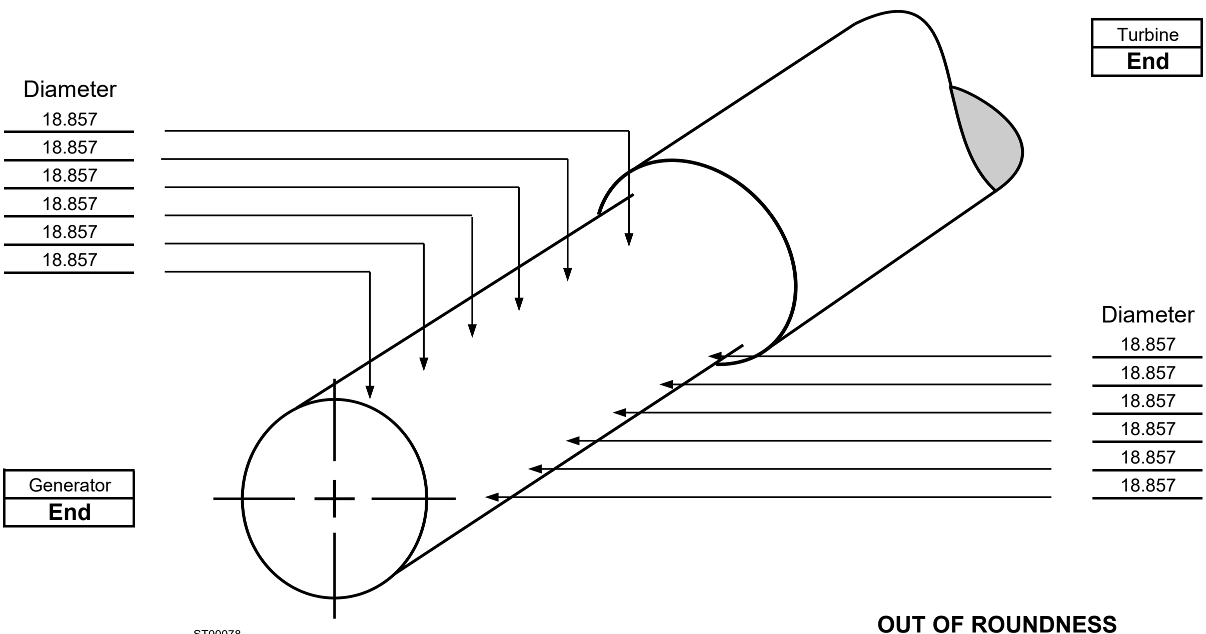
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 1/26/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #6 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



JOURNAL SIZES

	0º	90º	All
Maximum	18.857	18.857	18.857
Minimum	18.857	18.857	18.857
Difference	0.000	0.000	
Average	18.857	18.857	18.857

OUT OF ROUNDNESS

Diameters		Out of
0º	**90º**	**Round**
18.857	18.857	0.000
18.857	18.857	0.000
18.857	18.857	0.000
18.857	18.857	0.000
18.857	18.857	0.000
18.857	18.857	0.000

Comments:

Oil Deflector Journal Diameter = 20.473"

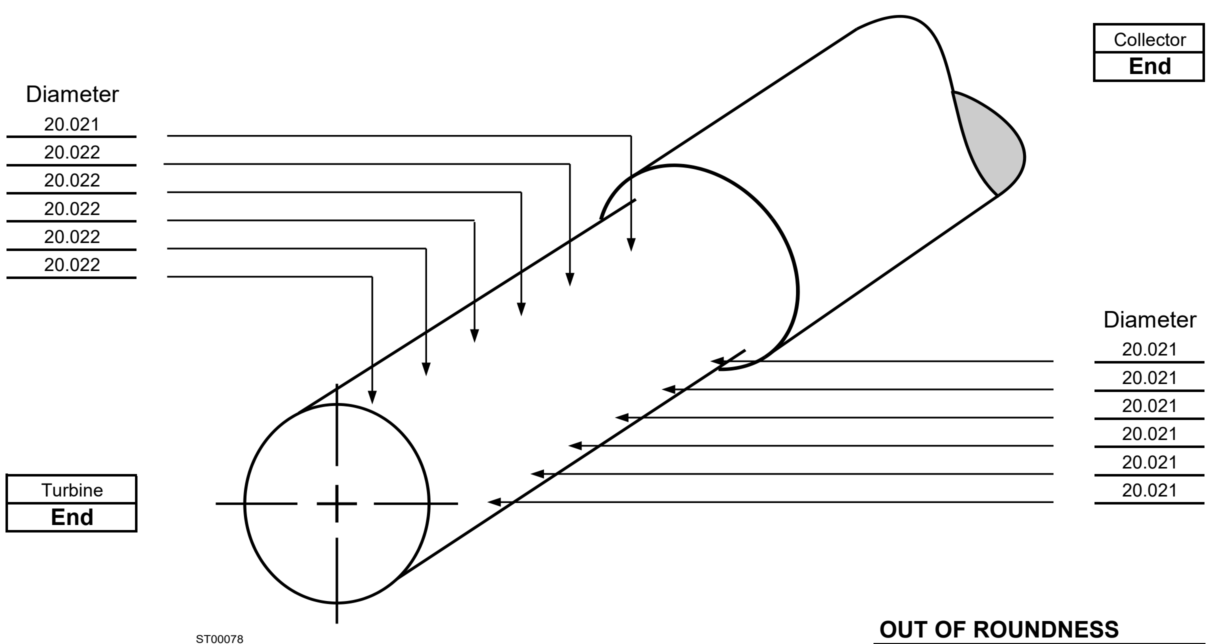
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 2/26/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #7 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



JOURNAL SIZES

	0º	90º	All
Maximum	20.022	20.021	20.022
Minimum	20.021	20.021	20.021
Difference	0.001	0.000	0.001
Average	20.022	20.021	20.021

OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
20.021	20.021	0.000
20.022	20.021	0.001
20.022	20.021	0.001
20.022	20.021	0.001
20.022	20.021	0.001
20.022	20.021	0.001

Comments:

Outer Oil Deflector Journal Diameter = 22.592"
Inner Oil Deflector Journal Diameter = 21.018"
Inner Oil Deflector Journal Diameter = 22.594"

Confidential

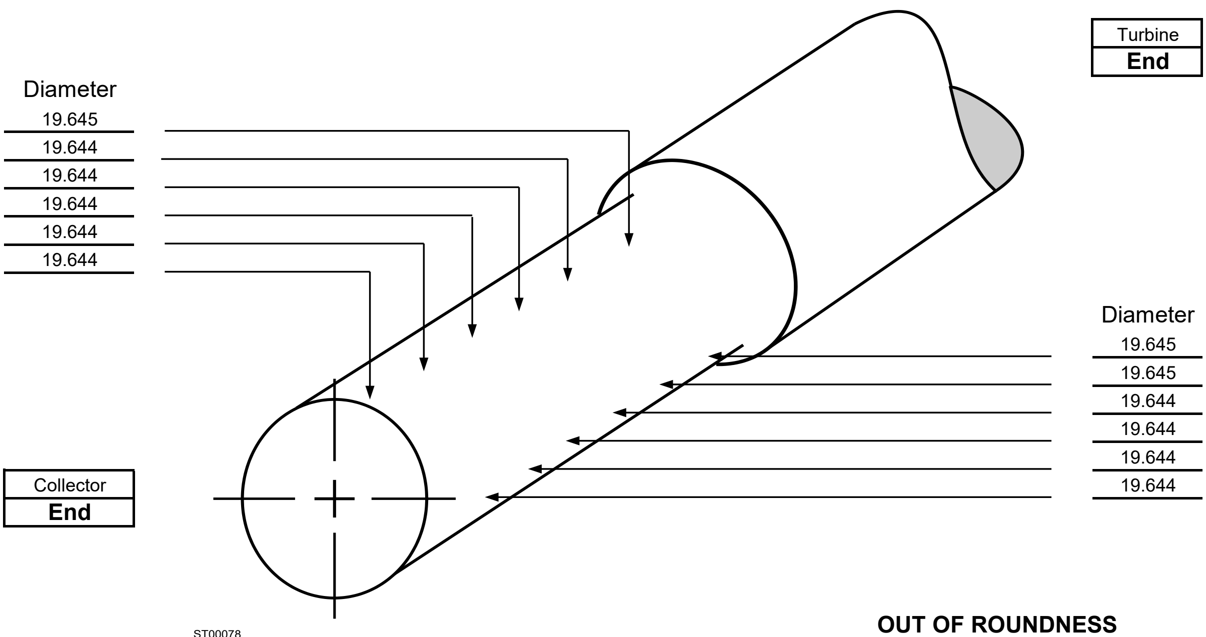
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 2/26/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #8 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



JOURNAL SIZES

	0º	90º	All
Maximum	19.645	19.645	19.645
Minimum	19.644	19.644	19.644
Difference	0.001	0.001	0.000
Average	19.644	19.644	19.644

OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
19.645	19.645	0.000
19.644	19.645	-0.001
19.644	19.644	0.000
19.644	19.644	0.000
19.644	19.644	0.000
19.644	19.644	0.000

Comments:

Outer Oil Deflector Journal Diameter = 21.215"
Inner Oil Deflector Journal Diameter = 21.021"
Inner Oil Deflector Journal Diameter = 22.594"

Confidential

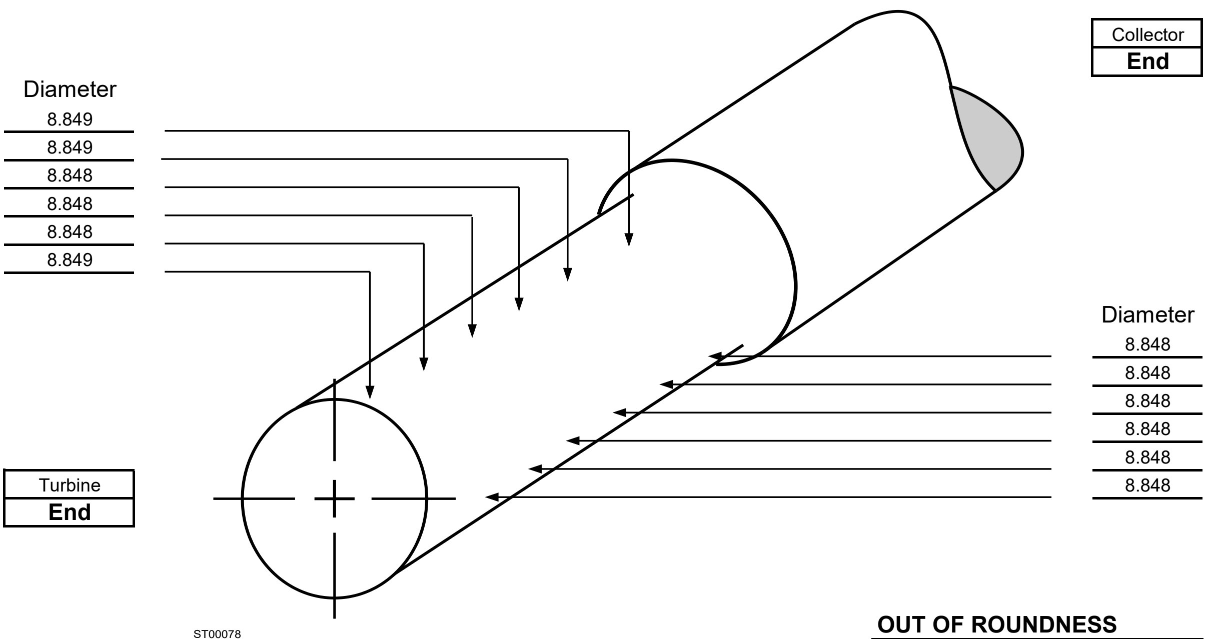
Journal Diameters

Rotor Journal Condition

Date(m/d/y) 2/27/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Journal Number #9 Units Recorded in: English - inches

NOTE: **Include digital pictures to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.**



JOURNAL SIZES

	0º	90º	All
Maximum	8.849	8.848	8.849
Minimum	8.848	8.848	8.848
Difference	0.001	0.000	0.001
Average	8.849	8.848	8.848

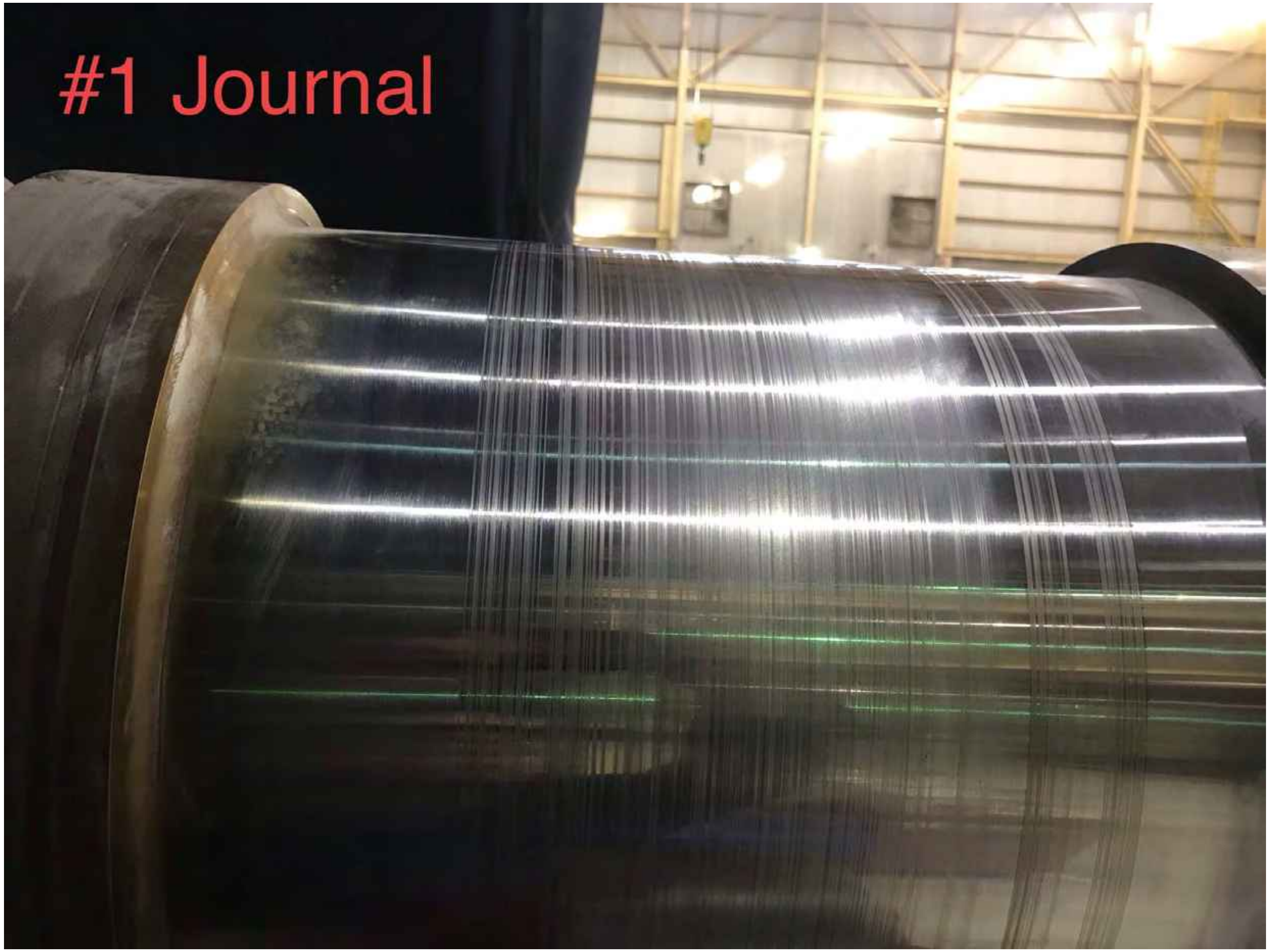
OUT OF ROUNDNESS

Diameters		Out of
0º	**90º**	**Round**
8.849	8.848	0.001
8.849	8.848	0.001
8.848	8.848	0.000
8.848	8.848	0.000
8.848	8.848	0.000
8.849	8.848	0.001

Comments:

Inboard Oil Deflector Journal Diameter = 9.920"
Outboard Oil Deflector Journal Diameter = 9.921"

Journal Pictures



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Journal Pictures

3.5.4 Couplings

Part Description:

There are three bolted couplings that transmit power between the various turbine rotating components. For the purposes of this report they will be referred to as "A" (HP-IP Rotor to LPA Rotor), "B" (LPA Rotor to LPB Rotor) and "C" (LPB Rotor to Generator Rotor). Couplings A and B have solid female-female spacers and coupling C has a male-male "bull gear" which acts as both the turning gear interface and a spacer. Each coupling and spacer has male-female rabbet fits to align the centerlines of the rotors. The couplings are bolted together using SKF expansion sleeve bolting.

The coupling bolts were loosened, the couplings were separated and the spacers were removed. Once the rotors were removed and placed in stands, the couplings were cleaned and inspected. The flatness, rabbet fit clearances and coupling bolt sleeve clearances were measured.

At reassembly the coupling bolts were tightened per SKF drawings 13112-14. After the coupling bolts were tightened concentricity was measured.

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Coupling Datasheets

Coupling Inspection

Date(m/d/y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Rotor Identification ______ Coupling A

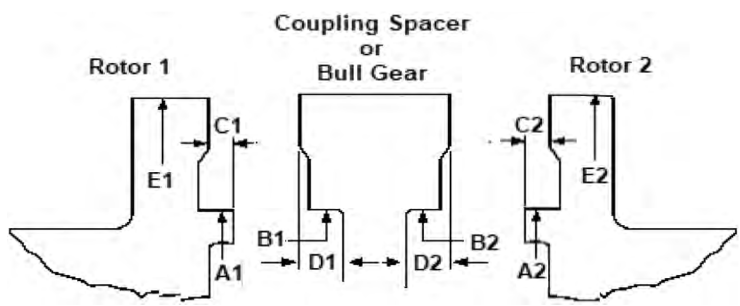
(Turbine End or Generator End)

INSPECTIONS & CHECKS				CODE	
Bolt Covers & Screws	**NA**	Coupling Runouts	**X**	**X**	Work Carried Out
Lockplates	**NA**	Bolt Extension Measurements	**NA**	**N**	Not Done
Coupling Bolts/Studs	**V, MP, UT**			**NA**	Not Applicable
Coupling Mating Surface	**V**			**C**	See Comments
Rabbet	**X**			**V**	Visual Inspection
Dimensional Checks	**X**			**MP**	Mag. Particle
Coupling Flatness	**X**			**UT**	Ultrasonic
				PT	Penetrant

Rotor 1: HP-IP

Rotor 2: LPA

Coupling Spacer or Bull Gear
(Circle One)



Spacer Thickness = 1.477"

COUPLING DIMENSIONAL CHECKS Readings in Inches

	Location	Position Number 1 0°	2 45°	3 90°	4 135°
Rotor 1	Male Rabbet O.D. (A1)	18.028	18.029	18.028	18.028
	Female Rabbet I.D. (B1)	18.031	18.031	18.030	18.031
	Rabbet Interference (A1-B1)	-0.003	-0.002	-0.002	-0.003
	Male Rabbet Length (C1)	0.237	0.238	0.238	0.238
	Female Rabbet Depth (D1)	0.433	0.434	0.434	0.434
	Coupling O.D. (E1)	33-3/8"	33-3/8"	33-3/8"	33-3/8"
Rotor 2	Male Rabbet O.D. (A2)	18.028	18.028	18.028	18.028
	Female Rabbet I.D. (B2)	18.030	18.030	18.030	18.030
	Rabbet Interference (A2-B2)	-0.002	-0.002	-0.002	-0.002
	Male Rabbet Length (C2)	0.232	0.232	0.232	0.232
	Female Rabbet Depth (D2)	0.432	0.432	0.432	0.432
	Coupling O.D. (E2)	33-13/32"	33-13/32"	33-13/32"	33-13/32"

** Rabbet Interference - Positive value means there is an interference fit.

Comments:

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Coupling Datasheets

Coupling Inspection

Date(m/d/y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

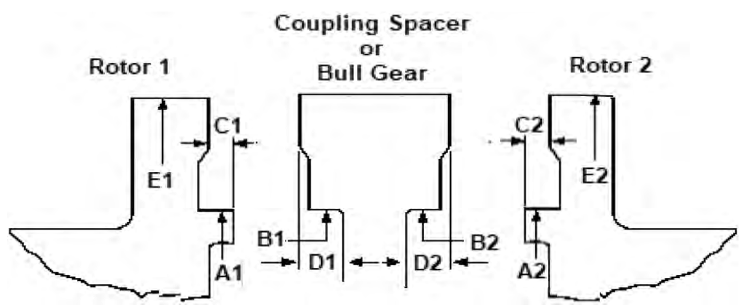
Rotor Identification ______ Coupling B
(Turbine End or Generator End)

INSPECTIONS & CHECKS				CODE	
Bolt Covers & Screws	**NA**	Coupling Runouts	**X**	**X**	Work Carried Out
Lockplates	**NA**	Bolt Extension Measurements	**NA**	**N**	Not Done
Coupling Bolts/Studs	**V, MP, UT**			**NA**	Not Applicable
Coupling Mating Surface	**V**			**C**	See Comments
Rabbet	**X**			**V**	Visual Inspection
Dimensional Checks	**X**			**MP**	Mag. Particle
Coupling Flatness	**X**			**UT**	Ultrasonic
				PT	Penetrant

Rotor 1: LPA

Rotor 2: LPB

Coupling Spacer or Bull Gear
(Circle One)



Spacer Thickness = 1.300"

COUPLING DIMENSIONAL CHECKS Readings in Inches

	Location	Position Number 1 0°	2 45°	3 90°	4 135°
Rotor 1	Male Rabbet O.D. (A1)	23.697	23.697	23.697	23.697
	Female Rabbet I.D. (B1)	23.700	23.700	23.700	23.700
	Rabbet Interference (A1-B1)	-0.003	-0.003	-0.003	-0.003
	Male Rabbet Length (C1)	0.235	0.235	0.235	0.235
	Female Rabbet Depth (D1)	0.437	0.438	0.437	0.437
	Coupling O.D. (E1)	42-15/16"	42-15/16"	42-15/16"	42-15/16"
Rotor 2	Male Rabbet O.D. (A2)	23.697	23.697	23.697	23.697
	Female Rabbet I.D. (B2)	23.700	23.700	23.700	23.700
	Rabbet Interference (A2-B2)	-0.003	-0.003	-0.003	-0.003
	Male Rabbet Length (C2)	0.237	0.237	0.237	0.237
	Female Rabbet Depth (D2)	0.429	0.429	0.429	0.429
	Coupling O.D. (E2)	42-15/16"	42-15/16"	42-15/16"	42-15/16"

** Rabbet Interference - Positive value means there is an interference fit.

Comments:

Coupling Datasheets

Coupling Inspection

Date(m/d/y) 2/11/2020 Turbine Serial No. 4465 Prepared by D.Johnson

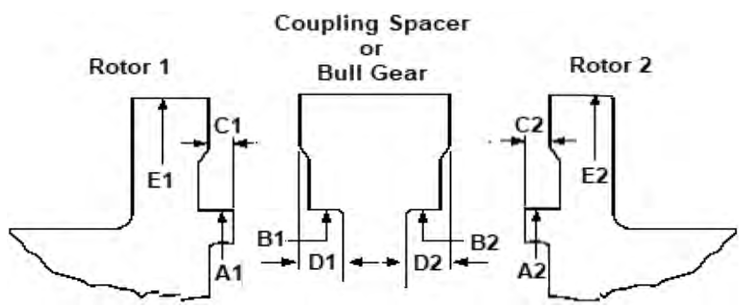
Rotor Identification ______ Coupling C
(Turbine End or Generator End)

INSPECTIONS & CHECKS				CODE	
Bolt Covers & Screws	NA	Coupling Runouts	X	X	Work Carried Out
Lockplates	NA	Bolt Extension Measurements	NA	N	Not Done
Coupling Bolts/Studs	V, MP, UT			NA	Not Applicable
Coupling Mating Surface	V			C	See Comments
Rabbet	X			V	Visual Inspection
Dimensional Checks	X			MP	Mag. Particle
Coupling Flatness	X			UT	Ultrasonic
				PT	Penetrant

Rotor 1: LPB

Rotor 2: Generator

Coupling Spacer or Bull Gear
(Circle One)



Spacer Thickness = 4.523"

COUPLING DIMENSIONAL CHECKS Readings in Inches

	Location	Position Number 1 0°	2 45°	3 90°	4 135°
Rotor 1	Male Rabbet O.D. (A1)	24.677	24.679	24.679	24.679
	Female Rabbet I.D. (B1)	24.680	24.680	24.680	24.680
	Rabbet Interference (A1-B1)	-0.003	-0.001	-0.001	-0.001
	Male Rabbet Length (C1)	0.237	0.237	0.237	0.237
	Female Rabbet Depth (D1)	0.437	0.437	0.437	0.437
	Coupling O.D. (E1)	42-1/2"	42-1/2"	42-1/2"	42-1/2"
Rotor 2	Male Rabbet O.D. (A2)	24.678	24.679	24.677	24.679
	Female Rabbet I.D. (B2)	24.683	24.683	24.683	24.683
	Rabbet Interference (A2-B2)	-0.005	-0.004	-0.006	-0.004
	Male Rabbet Length (C2)	0.238	0.238	0.238	0.238
	Female Rabbet Depth (D2)	0.356	0.356	0.356	0.355
	Coupling O.D. (E2)	42-1/2"	42-1/2"	42-1/2"	42-1/2"

** Rabbet Interference - Positive value means there is an interference fit.

Comments:

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Coupling Datasheets

Coupling Bolt Assembly Data

Date(m,d,y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

COUPLING A Bolt Type Hydraulic Sleeve
(Conventional / Hydraulic)

STUD	COUPLING HOLE DIAMETER			STUD/SLEEVE DIAMETER		CLEARANCE		
HOLE	TB. SIDE	GEAR/SPACER	GEN. SIDE	TB. SIDE	GEN. SIDE	TB. SIDE	GEAR/SPACER	GEN. SIDE
1 (M)	2.756 "	2.756 "	2.757 "	2.753 "	2.753 "	0.003 "	0.003 "	0.004 "
2	2.756 "	2.756 "	2.757 "	2.753 "	2.753 "	0.003 "	0.003 "	0.004 "
3	2.756 "	2.756 "	2.757 "	2.753 "	2.753 "	0.003 "	0.003 "	0.004 "
4	2.756 "	2.756 "	2.756 "	2.753 "	2.753 "	0.003 "	0.003 "	0.003 "
5	2.756 "	2.756 "	2.757 "	2.753 "	2.753 "	0.003 "	0.003 "	0.004 "
6	2.756 "	2.756 "	2.757 "	2.753 "	2.753 "	0.003 "	0.003 "	0.004 "
7	2.756 "	2.756 "	2.756 "	2.753 "	2.753 "	0.003 "	0.003 "	0.003 "
8	2.756 "	2.756 "	2.756 "	2.753 "	2.753 "	0.003 "	0.003 "	0.003 "
9	2.756 "	2.756 "	2.756 "	2.753 "	2.753 "	0.003 "	0.003 "	0.003 "
10	2.756 "	2.757 "	2.756 "	2.753 "	2.753 "	0.003 "	0.004 "	0.003 "
11	2.756 "	2.756 "	2.756 "	2.753 "	2.753 "	0.003 "	0.003 "	0.003 "
12	2.756 "	2.756 "	2.757 "	2.753 "	2.753 "	0.003 "	0.003 "	0.004 "
13	2.756 "	2.756 "	2.756 "	2.753 "	2.753 "	0.003 "	0.003 "	0.003 "
14	2.756 "	2.757 "	2.757 "	2.753 "	2.753 "	0.003 "	0.004 "	0.004 "
15	2.756 "	2.756 "	2.757 "	2.753 "	2.753 "	0.003 "	0.003 "	0.004 "
16	2.756 "	2.757 "	2.756 "	2.753 "	2.753 "	0.003 "	0.004 "	0.003 "
17								
18								
19								
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31								
32								

Comments:

Confidential

Coupling Datasheets

Coupling Bolt Assembly Data

Date(m,d,y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

COUPLING B Bolt Type Hydraulic Sleeve
(Conventional / Hydraulic)

STUD	COUPLING HOLE DIAMETER			STUD/SLEEVE DIAMETER		CLEARANCE		
HOLE	TB. SIDE	GEAR/SPACER	GEN. SIDE	TB. SIDE	GEN. SIDE	TB. SIDE	GEAR/SPACER	GEN. SIDE
1 (M)	2.756 "	2.756 "	2.757 "	2.754 "	2.754 "	0.002 "	0.002 "	0.003 "
2	2.757 "	2.756 "	2.756 "	2.754 "	2.754 "	0.003 "	0.002 "	0.002 "
3	2.757 "	2.756 "	2.756 "	2.754 "	2.754 "	0.003 "	0.002 "	0.002 "
4	2.756 "	2.756 "	2.757 "	2.754 "	2.754 "	0.002 "	0.002 "	0.003 "
5	2.757 "	2.757 "	2.757 "	2.753 "	2.753 "	0.004 "	0.004 "	0.004 "
6	2.757 "	2.757 "	2.756 "	2.754 "	2.754 "	0.003 "	0.003 "	0.002 "
7	2.756 "	2.757 "	2.756 "	2.754 "	2.754 "	0.002 "	0.003 "	0.002 "
8	2.756 "	2.757 "	2.757 "	2.754 "	2.754 "	0.002 "	0.003 "	0.003 "
9	2.757 "	2.756 "	2.757 "	2.753 "	2.754 "	0.004 "	0.002 "	0.003 "
10	2.757 "	2.757 "	2.756 "	2.754 "	2.753 "	0.003 "	0.003 "	0.003 "
11	2.756 "	2.756 "	2.757 "	2.754 "	2.754 "	0.002 "	0.002 "	0.003 "
12	2.756 "	2.756 "	2.756 "	2.754 "	2.754 "	0.002 "	0.002 "	0.002 "
13	2.756 "	2.756 "	2.757 "	2.754 "	2.754 "	0.002 "	0.002 "	0.003 "
14	2.756 "	2.757 "	2.757 "	2.753 "	2.754 "	0.003 "	0.003 "	0.003 "
15	2.757 "	2.756 "	2.757 "	2.754 "	2.754 "	0.003 "	0.002 "	0.003 "
16	2.756 "	2.756 "	2.757 "	2.754 "	2.754 "	0.002 "	0.002 "	0.003 "
17	2.757 "	2.756 "	2.757 "	2.754 "	2.754 "	0.003 "	0.002 "	0.003 "
18	2.756 "	2.757 "	2.757 "	2.754 "	2.753 "	0.002 "	0.003 "	0.004 "
19	2.756 "	2.756 "	2.756 "	2.754 "	2.754 "	0.002 "	0.002 "	0.002 "
20	2.756 "	2.756 "	2.757 "	2.753 "	2.754 "	0.003 "	0.002 "	0.003 "
21								
22								
23								
24								
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31								
32								

Comments:

Coupling Datasheets

Coupling Bolt Assembly Data

Date(m,d,y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

COUPLING C Bolt Type Hydraulic Sleeve
(Conventional / Hydraulic)

STUD	COUPLING HOLE DIAMETER			STUD/SLEEVE DIAMETER		CLEARANCE		
HOLE	TB. SIDE	GEAR/SPACER	GEN. SIDE	TB. SIDE	GEN. SIDE	TB. SIDE	GEAR/SPACER	GEN. SIDE
1 (M)	3.152 "	3.151 "	3.150 "	3.148 "	3.148 "	0.004 "	0.003 "	0.002 "
2	3.152 "	3.151 "	3.150 "	3.148 "	3.148 "	0.004 "	0.003 "	0.002 "
3	3.151 "	3.151 "	3.150 "	3.148 "	3.148 "	0.003 "	0.003 "	0.002 "
4	3.151 "	3.151 "	3.150 "	3.148 "	3.148 "	0.003 "	0.003 "	0.002 "
5	3.152 "	3.150 "	3.149 "	3.148 "	3.148 "	0.004 "	0.002 "	0.001 "
6	3.151 "	3.151 "	3.150 "	3.148 "	3.148 "	0.003 "	0.003 "	0.002 "
7	3.152 "	3.151 "	3.150 "	3.148 "	3.148 "	0.004 "	0.003 "	0.002 "
8	3.151 "	3.151 "	3.150 "	3.148 "	3.148 "	0.003 "	0.003 "	0.002 "
9	3.151 "	3.150 "	3.150 "	3.148 "	3.148 "	0.003 "	0.002 "	0.002 "
10	3.151 "	3.151 "	3.150 "	3.148 "	3.148 "	0.003 "	0.003 "	0.002 "
11	3.151 "	3.151 "	3.150 "	3.148 "	3.148 "	0.003 "	0.003 "	0.002 "
12	3.151 "	3.150 "	3.150 "	3.148 "	3.148 "	0.003 "	0.002 "	0.002 "
13	3.151 "	3.151 "	3.149 "	3.148 "	3.148 "	0.003 "	0.003 "	0.001 "
14	3.152 "	3.150 "	3.150 "	3.148 "	3.148 "	0.004 "	0.002 "	0.002 "
15	3.151 "	3.150 "	3.150 "	3.148 "	3.148 "	0.003 "	0.002 "	0.002 "
16	3.151 "	3.151 "	3.150 "	3.148 "	3.148 "	0.003 "	0.003 "	0.002 "
17	3.151 "	3.150 "	3.149 "	3.148 "	3.148 "	0.003 "	0.002 "	0.001 "
18	3.151 "	3.151 "	3.149 "	3.148 "	3.148 "	0.003 "	0.003 "	0.001 "
19								
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32								

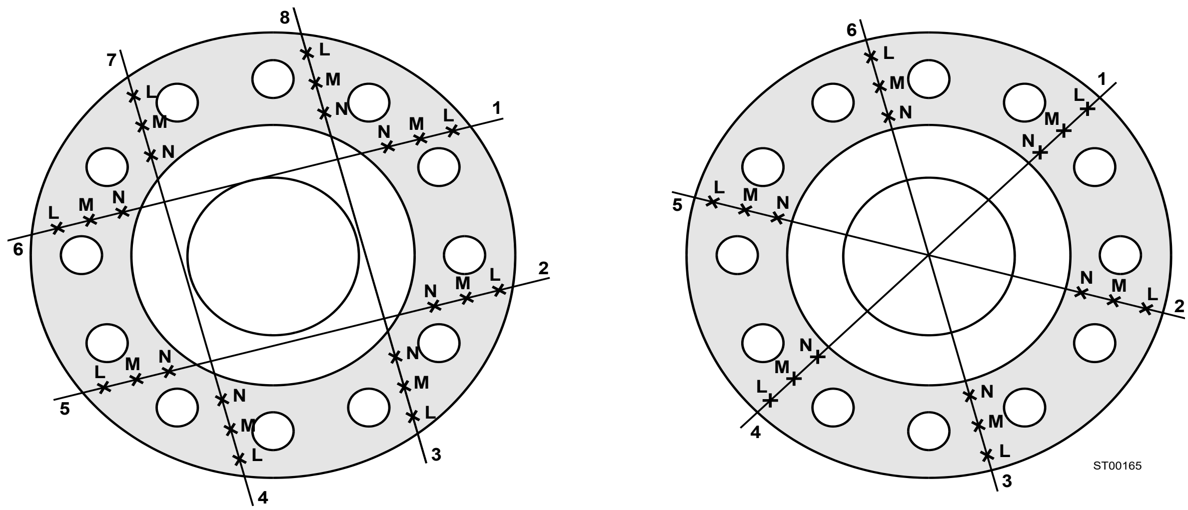
Comments:

Coupling Datasheets

Coupling Flatness Check

Date(m/d/y) 2/15/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Coupling A Coupling O.D. 33-3/8"



MALE RABBET **FEMALE RABBET**

Location HP-IP GE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	0.000	0.000	0.000
8	0.000	0.000	0.000

Location A Cplg Spacer TE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	NA	NA	NA
8	NA	NA	NA

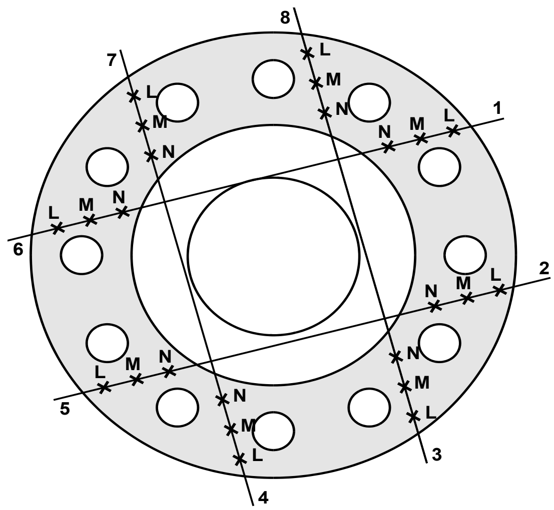
Comments	

Coupling Datasheets

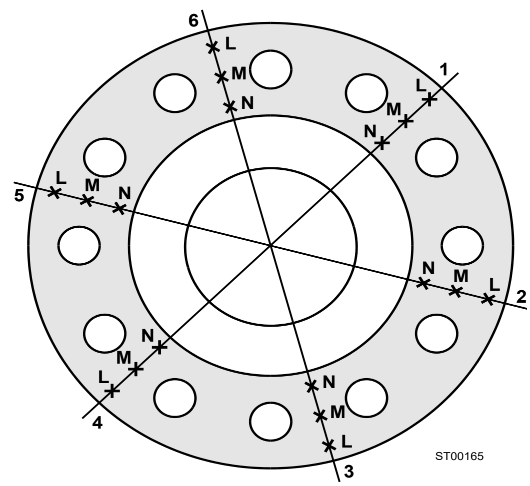
Coupling Flatness Check

Date(m/d/y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Coupling A Coupling O.D. 33-3/8"



MALE RABBET



FEMALE RABBET

Location LPA TE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	0.000	0.000	0.000
8	0.000	0.000	0.000

Location A Cplg Spacer GE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	NA	NA	NA
8	NA	NA	NA

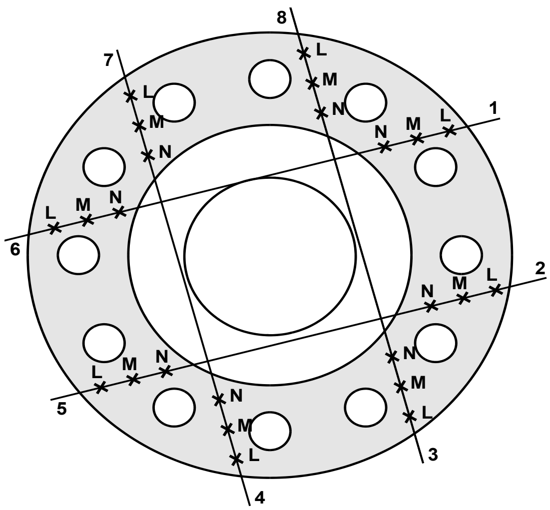
Comments	

Coupling Datasheets

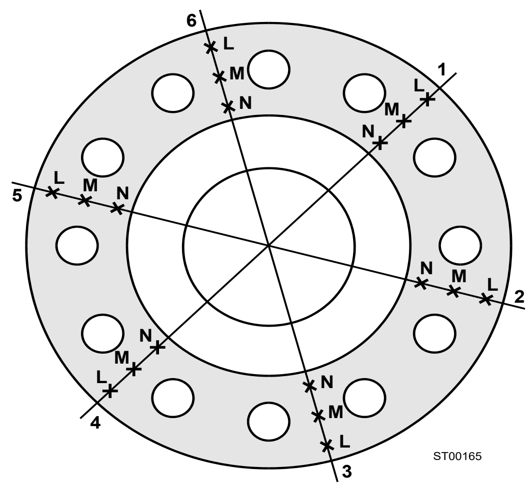
Coupling Flatness Check

Date(m/d/y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Coupling B Coupling O.D. 42-15/16"



MALE RABBET



FEMALE RABBET

Location LPA GE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	0.000	0.000	0.000
8	0.000	0.000	0.000

Location B Cplg Spacer TE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	NA	NA	NA
8	NA	NA	NA

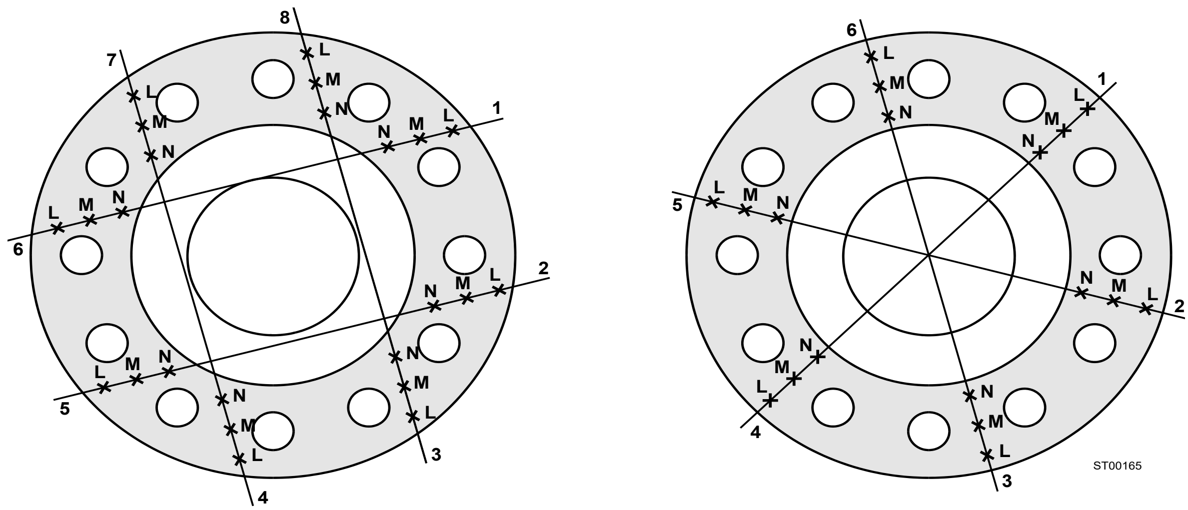
Comments	

Coupling Datasheets

Coupling Flatness Check

Date(m/d/y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Coupling B Coupling O.D. 42-15/16"



MALE RABBET

FEMALE RABBET

Location LPB TE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	0.000	0.000	0.000
8	0.000	0.000	0.000

Location B Cplg Spacer GE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.003	0.000	0.000
2	0.003	0.000	0.000
3	0.001	0.000	0.000
4	0.003	0.000	0.000
5	0.002	0.000	0.000
6	0.002	0.000	0.000
7	NA	NA	NA
8	NA	NA	NA

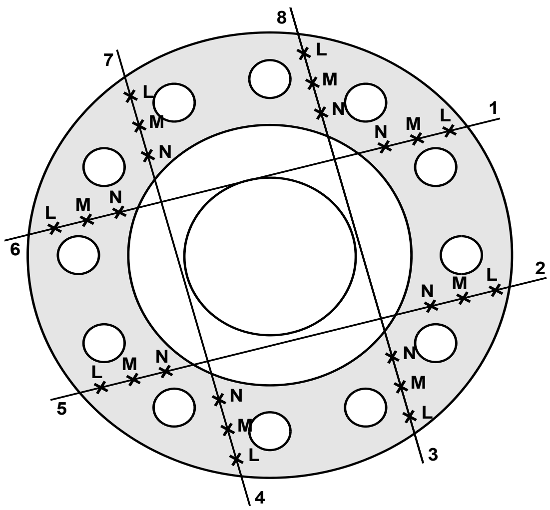
Comments	

Coupling Datasheets

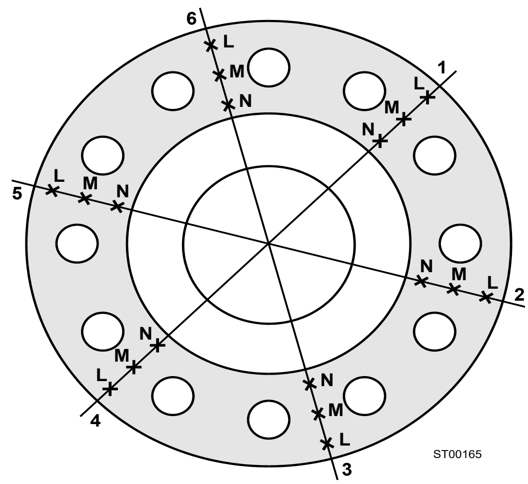
Coupling Flatness Check

Date(m/d/y) 2/11/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Coupling C Coupling O.D. 42-1/2"



MALE RABBET



FEMALE RABBET

Location Bull Gear TE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	0.000	0.000	0.000
8	0.000	0.000	0.000

Location LPB GE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	NA	NA	NA
8	NA	NA	NA

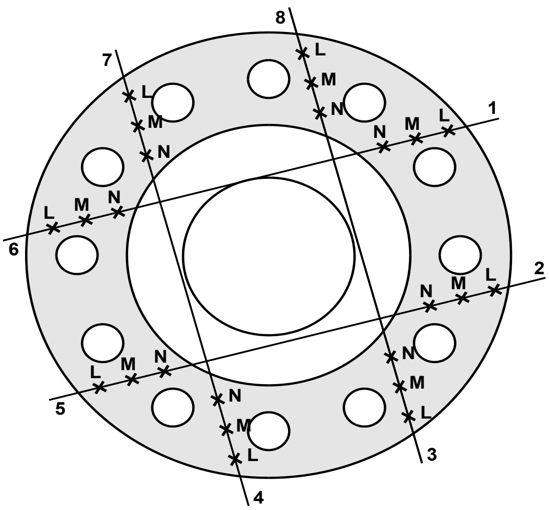
Comments

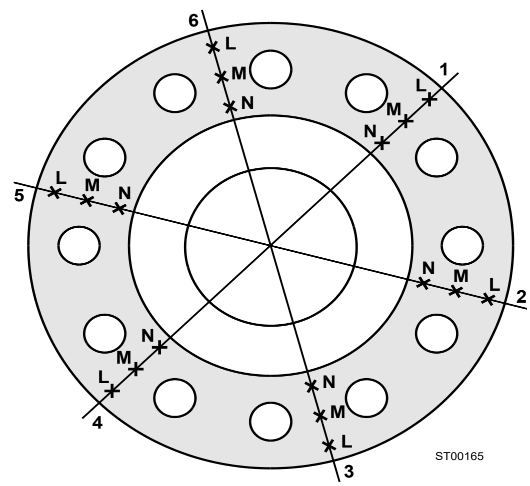
Coupling Datasheets

Coupling Flatness Check

Date(m/d/y) 2/15/2020 Turbine Serial No. 4465 Prepared by D. Johnson

Coupling C Coupling O.D. 42-1/2"





Location Bull Gear GE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	0.000	0.000	0.000
8	0.000	0.000	0.000

Location Generator TE
(TE or GE)

Readings in mils using feeler gauge

	L	M	N
1	0.000	0.000	0.000
2	0.000	0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	0.000
5	0.000	0.000	0.000
6	0.000	0.000	0.000
7	NA	NA	NA
8	NA	NA	NA

Comments	

3.5.5 Oil Deflectors

Part Description:

The oil deflectors were removed, cleaned and inspected. Radial clearance measurements were found to be within acceptable limits for continued service without repairs.

At reassembly the deflectors were aligned to the rotors and installed with vertical joint gaskets provided by the customer.

During the loss of oil event the rotors came into contact with the oil deflectors causing substantial damage to the lower halves. The damage and repairs are detailed in separate report.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The oil deflectors should be dimensionally and visually examined.

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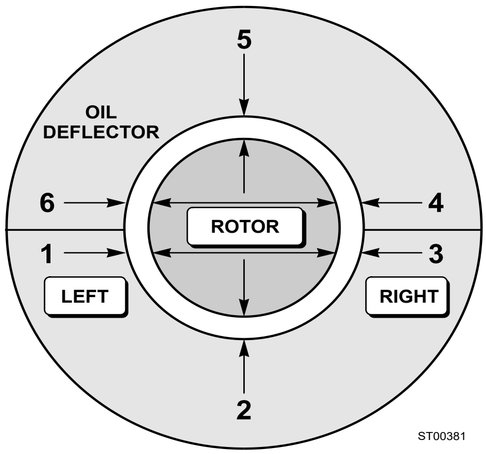
Oil Deflector Datasheets

Oil Deflector
Alignment

Date (m,d,y) 5/26/2020 Turbine Serial No. 4465 Prepared by J. Chirchir



Deflector Location	POSITION (Mils)						CLEARANCE			IDEAL POSITION		
	1	2	3	4	5	6	Median	Min.	Max	Top	Bottom	Sides
T1	20	11	19	26	33	26	23	11	33	29	15	23
T2*	19	10	19	23	26	16	19	10	26	24	12	19
T3	18	10	18	11	28	17	18	10	28	25	13	16
T4	20	11	20	15	24	18	19	11	24	23	12	18
T5	20	10	21	21	26	16	21	10	26	24	12	20
T6	20	11	20	22	32	22	21	11	32	29	14	21
TG Inner	63	55	82	93	76	23	70	23	93	87	44	65
TG Outer*	25	22	26	25	51	37	26	22	51	49	24	28
T7	23	10	23	24	35	25	24	10	35	30	15	24
T8	20	10	19	21	32	22	21	10	32	28	14	21
T9 IB	8	6	15	9	14	9	9	6	15	13	7	10
T9 OB	8	6	8	13	11	8	8	6	13	11	6	9

Comments

* It was necessary to modify the vertical joint bolts to allow for proper adjustment.
- Data taken on various dates.

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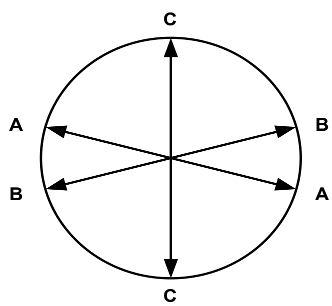
Oil Deflector Datasheets

Oil Deflector Clearances

Date(m/d/y) 2/18/2020 Turbine Serial No. 4465 Prepared by D. Johnson

INSPECTIONS & CHECKS			CODE	
Teeth Inspected	V		**X**	Work Carried Out
Journals Inspected	V		**N**	Not Done
Drain Holes Inspected	X		**NA**	Not Applicable
Inspect for Rubs	V		**C**	See Comments
			V	Visual Inspection
			MP	Mag. Particle
			UT	Ultrasonic
			PT	Penetrant



Data Set As Found

Units Recorded In English - inches

Location Number	Oil Deflector A-Dia	Oil Deflector B-Dia	Oil Deflector C-Dia	Journal Dia	Clearance Average	Clearance Min.	Clearance Max.	Condition Comment
#1	19.525	19.524	19.537	19.488	0.053	0.042	0.073	
#2	18.506	18.507	18.537	18.464	0.044	0.041	0.047	
#3	19.530	19.528	19.534	19.487	0.044	0.041	0.047	
#4	19.526	19.531	19.528	19.487	0.041	0.039	0.044	
#5	19.531	19.530	19.533	19.490	0.041	0.040	0.043	
#6	20.516	20.515	20.531	20.473	0.048	0.042	0.058	
TG	22.304	22.303	22.310	22.245	0.061	0.058	0.065	
#7	22.623	22.664	22.642	22.593	0.050	0.030	0.071	
#8	21.256	21.275	21.266	21.215	0.051	0.041	0.060	
#9 IB	9.941	9.941	9.941	9.920	0.021	0.021	0.021	
#9 OB	9.941	9.940	9.941	9.921	0.020	0.019	0.020	

Comments:

3.5.6 Coupling Guards

Part Description:

Each of the three couplings have guard assemblies to reduce windage friction. The assemblies are supported at the horizontal joints and have relatively close fitting ends. They are shimmed at the horizontal joints, as needed, to align them, radially, to the rotor journals.

Fabrication welds on the LPA the LPB guard were found cracked. The cracked welds were repaired by the customer.

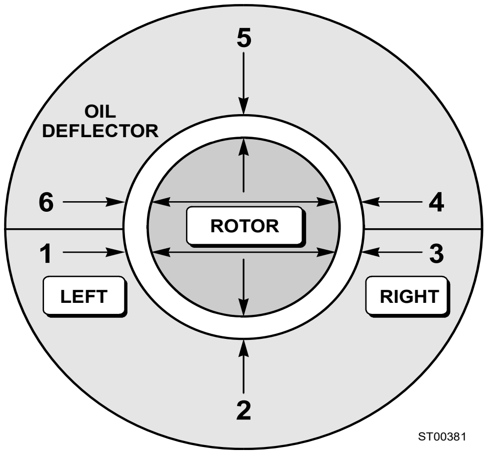
At reassembly the radial clearances of the guard were measured and adjusted as needed.

During the loss of oil event, the rotors came into contact with the guards resulting in substantial damage to the bottom sections. The damage and repairs are detailed in a separate report.

D309302 Coupling Guard Alignment

Coupling Guard
Alignment

Date (m,d,y) 5/23/2020 Turbine Serial No. 4465 Prepared by D. Johnson



Guard Location	POSITION (Mils)						CLEARANCE			IDEAL POSITION		
	1	2	3	4	5	6	Median	Min.	Max	Top	Bottom	Sides
A TE	25	32	87	92	62	25	47	25	92	63	31	57
A GE	38	42	80	86	62	38	52	38	86	69	35	61
B TE	18	28	96	115	123	50	73	18	123	101	50	70
B GE	28	12	69	76	78	47	58	12	78	60	30	55
C TE	80	130	75	60	95	65	78	60	130	150	75	70
C GE	NA	NA	NA	270	360	255	270	255	360			

Comments	

Confidential

Coupling Guards - Cracked Welds

Coupling Guards - Cracked Welds

3.6 Alignment/Clearances

3.6.1 Coupling Alignment

Part Description:

The rotor couplings were aligned, per OEM drawing N26-R10-8784. The bearings were adjusted as needed to achieve acceptable alignment. After the couplings were aligned and the coupling bolts tightened, concentricity measurements were taken. All measurements were accepted by the customer with no remedial action necessary.

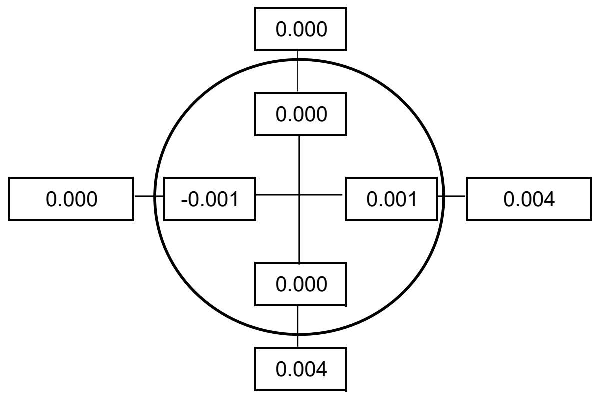
Coupling Alignment Datasheets

Alignment
Couplings

Date	4/7/2020	Turbine Serial No.	4465	Prepared by	D. Johnson
Coupling	A	Data set:	As Left	ERP Project ID	
				Units recorded in	English - Inches

Alignment Readings

Position	Top	Left	Bottom	Right
Rim	0.000	0.000	0.004	0.004
Face 0º	1.313	1.312	1.313	1.315
Face 90º	1.299	1.299	1.301	1.301
Face 180º	1.302	1.302	1.302	1.302
Face 270º	1.287	1.286	1.287	1.288
Average	1.300	1.299	1.301	1.301
Relative	0.000	-0.001	0.000	0.001



Sweep Diameter

33.386"

Check	Face	Rim
Top + Bottom =	0.000	0.004
Right + Left =	0.000	0.004
Difference =	0.000	0.000

Indicator Mounted on	Indicator Reading on
Turbine End	Generator End

Comments	

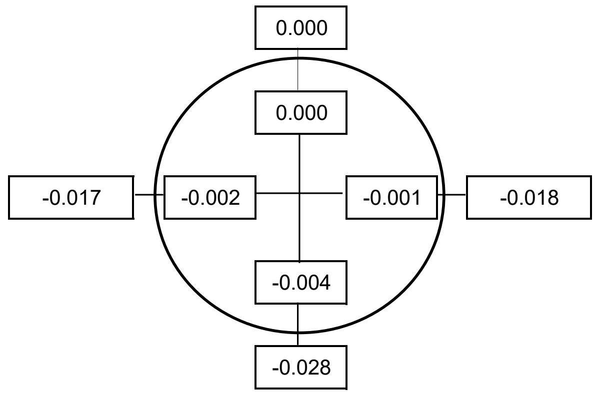
Coupling Alignment Datasheets

Alignment
Couplings

Date	1/30/2020	Turbine Serial No.	4465	Prepared by	
Coupling	A	Data set:	As Found	ERP Project ID	
				Units recorded in	English - Inches

Alignment Readings

Position	Top	Left	Bottom	Right
Rim	0.000	-0.017	-0.028	-0.018
Face 0º	1.441	1.437	1.436	1.440
Face 90º	1.509	1.506	1.506	1.509
Face 180º	1.495	1.495	1.490	1.492
Face 270º	1.662	1.659	1.660	1.661
Average	1.527	1.524	1.523	1.526
Relative	0.000	-0.002	-0.004	-0.001



Check	Face	Rim
Top + Bottom =	-0.004	-0.028
Right + Left =	-0.004	-0.035
Difference =	0.000	0.007

Sweep Diameter

33.386"

Indicator Mounted on	Indicator Reading on
Turbine End	Generator End

Comments

The #1 and #2 tilt pad bearings were not wedged when readings were taken.

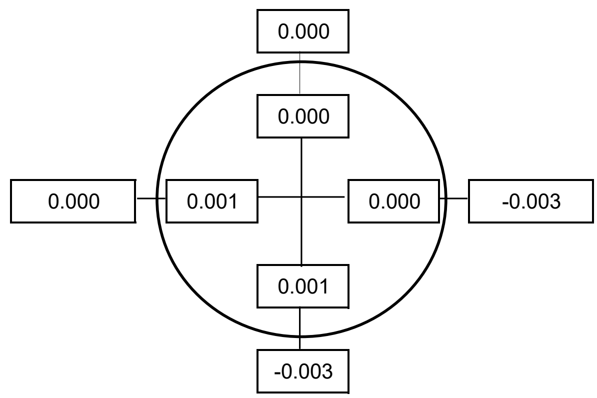
Coupling Alignment Datasheets

Alignment
Couplings

Date	4/6/2020	Turbine Serial No.	4465	Prepared by	D. Johnson
Coupling	B	Data set:	As Left	ERP Project ID	
				Units recorded in	English - Inches

Alignment Readings

Position	Top	Left	Bottom	Right
Rim	0.000	0.000	-0.003	-0.003 *
Face 0º	1.696	1.696	1.695	1.695
Face 90º	1.693	1.693	1.690	1.690
Face 180º	1.712	1.714	1.715	1.713
Face 270º	1.692	1.694	1.697	1.695
Average	1.698	1.699	1.699	1.698
Relative	0.000	0.001	0.001	0.000



Check	Face	Rim
Top + Bottom =	0.001	-0.003
Right + Left =	0.001	-0.003
Difference =	0.000	0.000

Sweep Diameter

42.913"

Indicator Mounted on	Indicator Reading on
Turbine End	Generator End

Comments

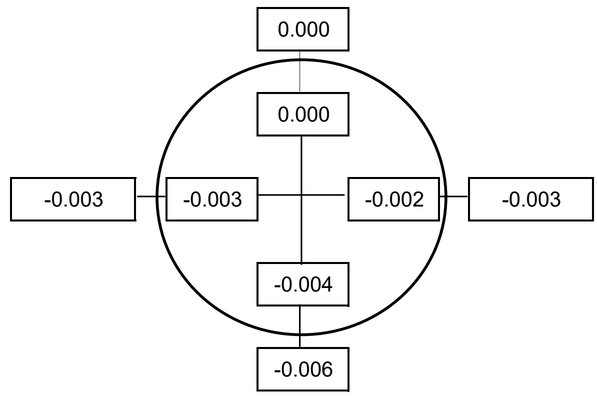
Coupling Alignment Datasheets

Alignment
Couplings

Date	2/3/2020	Turbine Serial No.	4465	Prepared by	D. Johnson
Coupling	B	Data set:	As Found	ERP Project ID	
				Units recorded in	English - Inches

Alignment Readings

Position	Top	Left	Bottom	Right
Rim	0.000	-0.003	-0.006	-0.003 *
Face 0º	1.054	1.051	1.050	1.053
Face 90º	1.040	1.037	1.039	1.042
Face 180º	1.044	1.042	1.041	1.043
Face 270º	1.031	1.027	1.025	1.024
Average	1.042	1.039	1.039	1.041
Relative	0.000	-0.003	-0.004	-0.002



Check	Face	Rim
Top + Bottom =	-0.004	-0.006
Right + Left =	-0.005	-0.006
Difference =	0.001	0.000

Sweep Diameter

42.913"

Indicator Mounted on	Indicator Reading on
Turbine End	Generator End

Comments

* Rim readings were taken using a straight edge and then interpreted as dial indicator readings. LPB was measured to be 0.003" higher than LPA with the sides even.

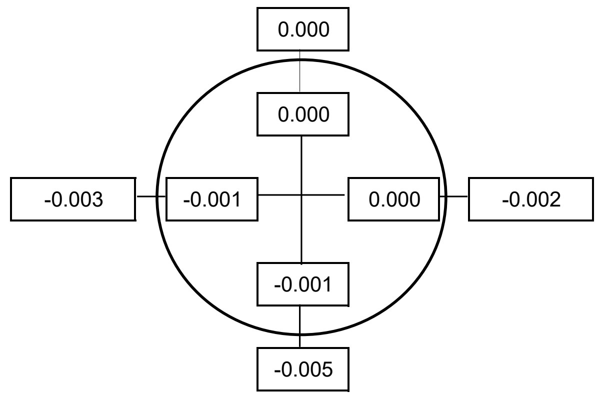
Coupling Alignment Datasheets

Alignment
Couplings

Date	5/16/2020	Turbine Serial No.	4465	Prepared by	D. Johnson
Coupling	C	Data set:	As Left	ERP Project ID	
				Units recorded in	English - Inches

Alignment Readings

Position	Top	Left	Bottom	Right
Rim	0.000	-0.003	-0.005	-0.002 *
Face 0º	4.278	4.277	4.277	4.278
Face 90º	4.275	4.274	4.273	4.274
Face 180º	4.273	4.272	4.271	4.272
Face 270º	4.269	4.268	4.269	4.270
Average	4.274	4.273	4.272	4.273
Relative	0.000	-0.001	-0.001	0.000



Check	Face	Rim
Top + Bottom =	-0.001	-0.005
Right + Left =	-0.001	-0.005
Difference =	0.000	0.000

Sweep Diameter

44.75"

Indicator Mounted on	Indicator Reading on
Turbine End	Generator End

Comments

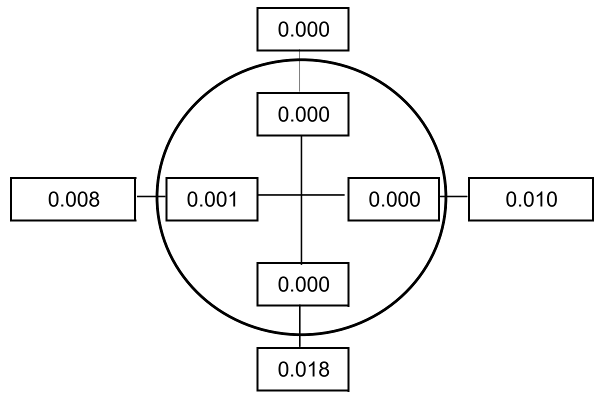
Coupling Alignment Datasheets

Alignment
Couplings

Date	2/3/2020	Turbine Serial No.	4465	Prepared by	D. Johnson
Coupling	C	Data set:	As Found	ERP Project ID	
				Units recorded in	English - Inches

Alignment Readings

Position	Top	Left	Bottom	Right	
Rim	0.000	0.008	0.018	0.010	*
Face 0º	4.691	4.693	4.690	4.690	
Face 90º	4.671	4.671	4.671	4.671	
Face 180º	4.539	4.539	4.538	4.538	
Face 270º	4.531	4.531	4.531	4.531	
Average	4.608	4.609	4.608	4.608	
Relative	0.000	0.001	0.000	0.000	



Check	Face	Rim
Top + Bottom =	0.000	0.018
Right + Left =	0.000	0.018
Difference =	-0.001	0.000

Sweep Diameter

42.5"

Indicator Mounted on
Turbine End

Indicator Reading on
Generator End

Comments	

Coupling Alignment Datasheets

Rotor Radial Position

Multiple Conditions

Date(m/d/y) Various   Turbine Serial No. 4465   Prepared by D. Johnson

Units Recorded in: English - inches

LOCATION	2011 Disassembly			2020 Disassembly			2020 Assembly		
	Date: Various			Date: Various			Date: Various		
T1 Oil Bore	5.527		5.532	5.531		5.532	6.317		6.321
		5.529			5.528			6.324	
N1 Gland Bore				0.675		0.658	0.673		0.657
					0.661			0.673	
N3 Gland Bore				0.676		0.680	0.668		0.681
					0.663			0.665	
T2 Oil Bore	4.592		4.660	4.590		4.664	4.586		4.671
		4.656			4.653			4.651	
T3 Oil Bore	4.019		4.050	4.019		4.049	4.016		4.050
		4.042			4.045			4.038	
N4 Gland Bore				0.658	`	0.675	0.647		0.668
					0.671			0.657	
N5 Gland Bore				0.656		0.682	0.669		0.660
					0.660			0.677	
T4 Oil Bore	4.038		4.031	4.027		4.042	4.021		4.048
		4.042			4.042			4.037	
T5 Oil Bore	4.028		4.043	4.017		4.050	4.412		4.456
		4.031			4.027			4.415	
N6 Gland Bore				0.659		0.678	0.659		0.652
					0.650			0.677	
N7 Gland Bore				0.648		0.677	0.655		0.667
					0.667			0.672	
T6 Oil Bore	4.731		4.717	4.722		4.725	4.723		4.726
		4.734			4.730			4.734	
TG Oil Bore	7.972		8.019	7.966		8.022	7.961		8.026
		7.969			7.949			7.967	
T7 Oil Bore	12.530		12.527	12.528		12.530	12.529		12.527
		12.510			12.505			12.502	
T8 Oil Bore	13.213		13.217	13.212		13.214	13.212		13.214
		13.195			13.188			13.188	
T9 Inboard (Brg In)				3.800		3.802	3.801		3.803
					3.786			3.788	
T9 Outboard (Brg In)				3.800		3.798	3.802		3.798
					3.788			3.787	
T9 Inboard (Brg Out)				3.793		3.802	3.799		3.800
					3.721			3.719	
T9 Outboard (Brg Out)				3.791		3.797	3.798		3.799
					3.708			3.733	

3.6.2 Steam Path Internal Clearances

Part Description:

The steam path was aligned using laser alignment. A tops-on/tops-off approach was used to quantify the amounts of ellipticity and shell movement between the bolted and unbolted conditions. Internal components were adjusted as needed for alignment. Elevation support block thicknesses were manipulated for vertical changes and centering pin slots were welded and ground to make horizontal changes and reduce transverse movement. Several of the LP outer glands were moved to align them to the rotor centerline by adjustment of eccentric dowels on the gland vertical faces.

A copy of the laser alignment report can be found in the appendix portion of this report.

HP-IP Steam Path Clearances

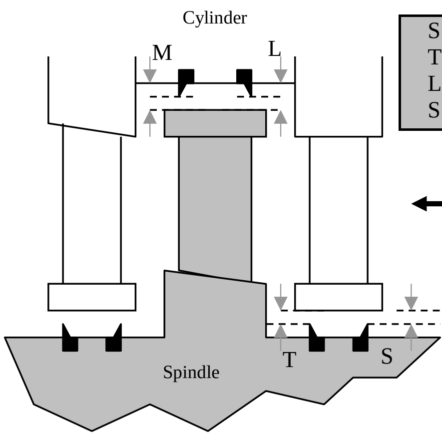
(Westinghouse Datasheet)

Reaction Blade Seal Clearances

HP-IP Radial

Date (m/d/y) 5/22/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



S & L are Inlet Seals
T & M are Outlet Seals
L & M are Outer Seals
S & T are Inner Seals

Steam flow

INITIAL
FINAL X

SECTION
H.P. X
I.P.
L.P.

"K" READING
0.68

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"S"				"T"				"L"				"M"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
9									0.040	0.037	0.040	0.037	0.040	0.037	0.040	0.037
8									0.030	0.031	0.035	0.031	0.025	0.031	0.025	0.031
7									0.025	0.031	0.030	0.031	0.025	0.031	0.035	0.031
6																
5																
4																
3																
2																
1									0.043	0.024	0.035	0.024	0.040	0.024	0.030	0.024
10																
11																
12																
13																
14																
15																

Comments

Blades of stages 7-9 were replaced during the outage and the stage 1 spill strips were replaced.

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HP-IP Steam Path Clearances

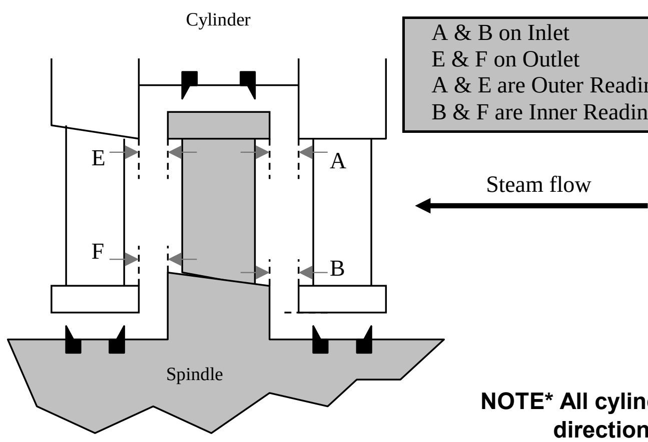
(Westinghouse Datasheet)

Reaction Blade Clearances

HP-IP Axial

Date (m/d/y) 5/21/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



A & B on Inlet
E & F on Outlet
A & E are Outer Readings
B & F are Inner Readings

INITIAL
FINAL X

SECTION
H.P. X
I.P. X
L.P.

"K" READING
0.685

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"A"				"B"				"E"				"F"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
9	0.686	0.665	0.686	0.665					n/a		n/a					
8	0.702	0.581	0.704	0.581					0.515	0.469	0.517	0.469				
7	0.701	0.681	0.697	0.681					0.349	0.398	0.350	0.398				
6																
5																
4																
3																
2																
1																
10																
11																
12																
13																
14																
15																

Comments

Blades of stages 7-9 were replaced during the outage.

HP-IP Steam Path Clearances

(Westinghouse Datasheet)

High/Low Packing Clearances

Axial/Radial

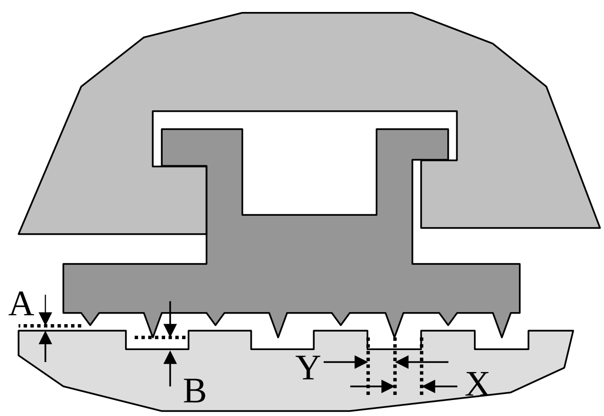
Date (m/d/y) 5/22/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3

Initial ____
Final X

"K" Reading
H.P. X
Design 0.68

Gen. End



Gov. End

	ROW	*ACTUALS* Left Side "A"	"B"	"X"	"Y"	Right Side "A"	"B"	"X"	"Y"	*DESIGN* "X" Mils	"Y" Mils	Radial Mils
Turbine End Outer Gland	**A**											
	B											
Turbine End Inner Gland	**C**											
	D											
Dummy Ring	**E**											
	F											
	G											
N2 Packing Casing	**H**											
	I											
	J											
	K	0.030	0.025	0.180	0.370	0.025	0.020	0.175	0.400	0.331	0.213	0.024
	L											
Generator End Inner Gland	**N**											
	O											
Generator End Outer Gland	**P**											
	Q											

Notes * All Packing, Glands, Dummy Rings, Cylinders and Blade Rings to be wedged in direction of steam flow.

Comments
Row K was the only row of packing replaced. It was necessary to scrape the left side teeth in order to establish proper radial clearances.

HP-IP Steam Path Clearances

(Westinghouse Datasheet)

HIP Spindle Float

Date (m/d/y)	5/21/20	Turbine Serial Number	4465	Prepared by	C Mack
	Plant	Comanche	Unit 3	Initial	
				Final	X

Rotor Set on K: 0.681

			Left Side	Right Side
SEM	5.148	N1 Gland Reference	**1.064**	**1.064**
Indicator	0.174	A Coupling "L" Reference	**4.604**	**4.715**

Rotor Thrust Forward:

			Left Side	Right Side
SEM		N1 Gland Reference	**0.927**	**0.928**
Indicator	0	A Coupling "L" Reference	**4.487**	**4.579**

Restrictions:
Spill strip 1R of HP

Rotor Thrust Aft:

			Left Side	Right Side
SEM		N1 Gland Reference*	**1.273**	**1.273**
Indicator		A Coupling "L" Reference*	**4.834**	**4.925**

Restrictions:
Dummy Ring Bade 1 Looking Down The Train

Total Float or Difference

N1 Gland Reference	**0.346**
L Reference	**0.347**
Indicator	**0.348**

Total Float or Travel from "K" Forward	**0.117**	**Design**	**0.177**	**Diff.**	**-0.060**
Total Float or Travel from "K" Aft	**0.230**	**Design**	**0.213**	**Diff.**	**0.017**

Comments	

HP-IP Steam Path Clearances

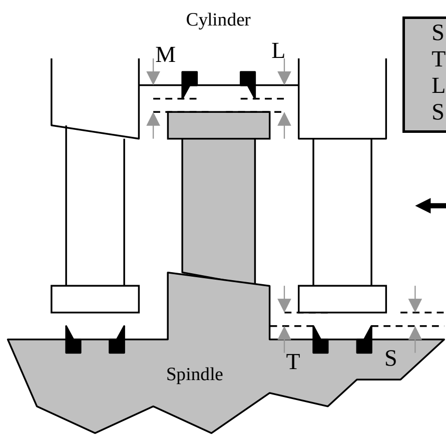
(Westinghouse Datasheet)

Reaction Blade Seal Clearances

HP-IP Radial

Date (m/d/y) 2/14/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



S & L are Inlet Seals
T & M are Outlet Seals
L & M are Outer Seals
S & T are Inner Seals

Steam flow

INITIAL X
FINAL

SECTION
H.P. X
I.P. X
L.P.

"K" READING
0.645

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"S"				"T"				"L"				"M"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
9	0.022	0.024	0.027	0.024					0.035	0.037	bent	0.037				
8	0.025	0.024	0.046	0.024					0.036	0.031	0.021	0.031				
7	0.025	0.024	0.040	0.024					0.032	0.031	0.035	0.031				
6	0.037	0.024	0.039	0.024					0.043	0.024	0.048	0.024				
5	0.037	0.024	0.035	0.024					0.046	0.024	0.048	0.024				
4	0.043	0.024	0.036	0.024					0.043	0.024	0.044	0.024				
3	0.020	0.024	0.039	0.024					0.034	0.024	0.049	0.024				
2	0.014	0.024	0.034	0.024					0.025	0.024	0.040	0.024				
1	n/a		n/a						0.026	0.024	0.046	0.024				
10	n/a		n/a						0.046	0.037	0.059	0.037				
11	0.021	0.024	0.054	0.024					0.039	0.039	0.061	0.039				
12	0.030	0.024	0.056	0.024					0.030	0.033	0.053	0.033				
13	0.041	0.024	0.049	0.024					0.054	0.039	0.069	0.039				
14	0.035	0.024	0.048	0.024					0.051	0.047	0.056	0.047				
15	0.034	0.024	0.046	0.024					0.053	0.053	0.053	0.053				

Comments

Confidential

HP-IP Steam Path Clearances

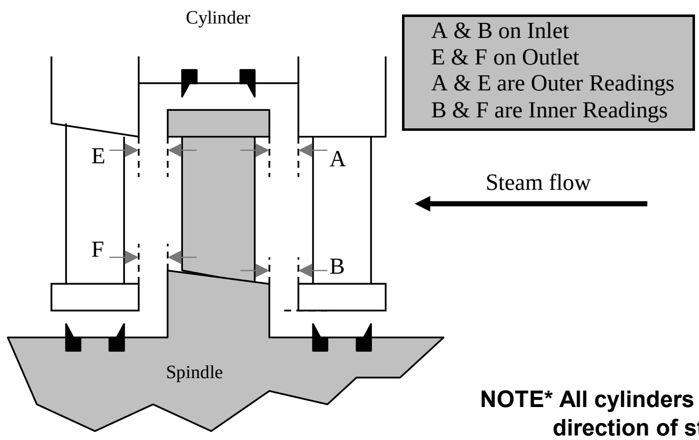
(Westinghouse Datasheet)

Reaction Blade Clearances

HP-IP Axial

Date (m/d/y) 2/13/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



INITIAL X
FINAL

SECTION
H.P. X
I.P. X
L.P.

"K" READING
0.645

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"A"				"B"				"E"				"F"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
9			0.645	0.665			0.451	0.469							n/a	n/a
8			0.671	0.681			0.466	0.469							0.365	0.358
7			0.665	0.681			0.465	0.469							0.300	0.287
6			0.690	0.705			0.555	0.469							0.893	0.886
5			0.635	0.645			0.470	0.469							0.290	0.287
4			0.685	0.705			0.471	0.469							0.285	0.287
3			0.648	0.681			0.436	0.469							0.276	0.287
2			0.638	0.681			0.437	0.469							0.316	0.287
1			0.645	0.681			0.446	0.469							0.301	0.287
10			1.042	1.043			0.411	0.413							0.750	0.752
11			1.045	1.043			0.395	0.413							0.768	0.752
12			1.266	1.319			0.368	0.413							1.630	1.594
13			0.977	0.965			0.482	0.531							0.791	0.752
14			1.035	1.043			0.467	0.531							0.790	0.752
15			1.381	1.378			0.477	0.531							n/a	n/a

Comments

HP-IP Steam Path Clearances

(Westinghouse Datasheet)

High/Low Packing Clearances

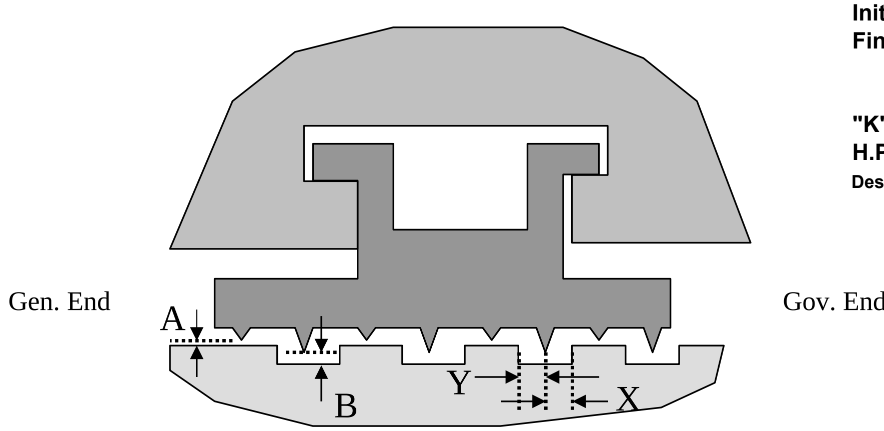
Axial/Radial

Date (m/d/y) 2/14/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3

Initial X
Final

"K" Reading
H.P. 0.65
Design 0.68



	ROW	ACTUALS								DESIGN		
		Left Side				Right Side				"X" Mils	"Y" Mils	Radial Mils
		"A"	"B"	"X"	"Y"	"A"	"B"	"X"	"Y"			
Turbine End Outer Gland	A	0.035		0.310	0.266	0.021		0.321	0.352	0.291	0.311	0.030
	B	0.026		0.331	0.384	0.011		0.340	0.267	0.291	0.311	0.020
Turbine End Inner Gland	C	0.030		0.305	0.284	0.015		0.309	0.287	0.291	0.311	0.020
	D	0.028		0.287	0.292	0.016		0.325	0.280	0.291	0.311	0.020
Dummy Ring	E	0.029		0.225	0.209	0.020		0.235	0.191	0.213	0.213	0.024
	F	0.025		0.235	0.198	0.021		0.237	0.186	0.213	0.213	0.024
	G	0.031		0.215	0.211	0.024		0.231	0.189	0.213	0.213	0.024
N2 Packing Casing	H	0.021		0.321	0.206	0.020		0.306	0.208	0.331	0.213	0.024
	I	0.020		0.326	0.204	0.022		0.324	0.208	0.331	0.213	0.024
	J	0.036		0.321	0.211	0.019		0.300	0.210	0.331	0.213	0.024
	K									0.331	0.213	0.024
	L	0.026		0.318	0.225	0.021		0.327	0.220	0.331	0.213	0.024
Generator End Inner Gland	N	0.029				0.014		0.497	0.315	0.429	0.390	0.020
	O	0.030				0.023		0.492	0.325	0.429	0.390	0.020
Generator End Outer Gland	P	0.034				0.037		0.505	0.326	0.429	0.390	0.020
	Q	0.037				0.042		0.515	0.310	0.429	0.390	0.030

Notes * All Packing, Glands, Dummy Rings, Cylinders and Blade Rings to be wedged in direction of steam flow.

Comments	
Row K was damaged and unable to be measured	

LPA Steam Path Datasheets

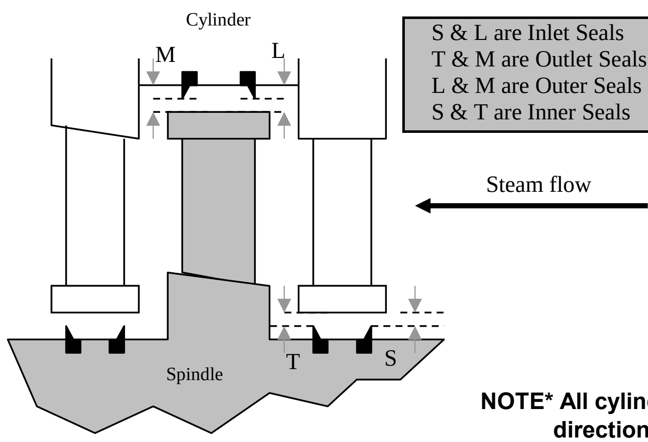
(Westinghouse Datasheet)

Reaction Blade Seal Clearances

LP Radial

Date (m/d/y) 5/5/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



INITIAL ___
FINAL X

SECTION
H.P. ___
I.P. ___
L.P. A

"K" READING
1.190

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"S"				"T"				"L"				"M"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE													0.315	0.307	0.320	0.307
5 TE	0.107	0.083	0.095	0.083	0.115	0.083	0.095	0.083	0.108	0.150	0.110	0.150	0.105	0.150	0.110	0.150
4 TE	0.071	0.071	0.073	0.071	0.061	0.071	0.095	0.071	0.106	0.098	0.140	0.098	0.106	0.098	0.135	0.098
3 TE	0.045	0.059	0.081	0.059	0.057	0.059	0.090	0.059	0.061	0.087	0.107	0.087	0.060	0.087	0.096	0.087
2 TE	0.047	0.055	0.077	0.055	0.044	0.055	0.082	0.055	0.045	0.055	0.087	0.055	0.045	0.055	0.081	0.055
1 TE	0.091	0.091		0.091			0.119		0.046	0.063	0.076	0.063	0.042	0.063	0.080	0.063
1 GE		0.091		0.091	0.093	0.091	0.102	0.091	0.054	0.063	0.070	0.063	0.053	0.063	0.070	0.063
2 GE	0.041	0.055	0.086	0.055	0.055	0.055	0.087	0.055	0.055	0.055	0.075	0.055	0.055	0.055	0.071	0.055
3 GE	0.055	0.059	0.067	0.059	0.055	0.059	0.071	0.059	0.086	0.067	0.135	0.067	0.070	0.067	0.077	0.067
4 GE	0.072	0.071	0.085	0.071	0.075	0.071		0.071	0.116	0.098	0.117	0.098	0.111	0.098	0.120	0.098
5 GE	0.085	0.083	0.090	0.083	0.064	0.083	0.115	0.083	0.100	0.150	0.170	0.150	0.105	0.150	0.157	0.150
6 GE									0.276	0.307	0.327	0.307				

Comments

Confidential

LPA Steam Path Datasheets

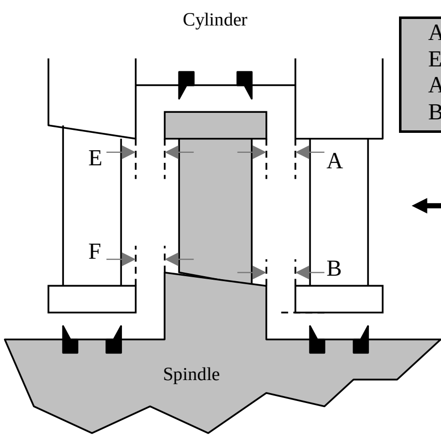
(Westinghouse Datasheet)

Reaction Blade Clearances

LP Axial

Date (m/d/y) 5/5/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



A & B on Inlet
E & F on Outlet
A & E are Outer Readings
B & F are Inner Readings

Steam flow

INITIAL ____
FINAL X

SECTION
H.P. ____
I.P. ____
L.P. A

"K" READING
1.189

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"A"				"B"				"E"				"F"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE	1.730	1.744		1.744	1.146	1.201	1.122	1.201			1.705		2.108		2.109	
5 TE	1.472	1.453	1.442	1.453	1.353	0.965	1.204	0.965	3.035		3.030		1.014	1.004	1.020	1.004
4 TE	1.840	2.063	1.856	2.063	1.066	1.122	1.079	1.122	2.935		2.080		1.010	1.201	0.994	1.701
3 TE	1.155	1.181	2.717	1.181	0.991	1.043	1.015	1.043	2.748		1.168		0.900	1.043	0.894	1.043
2 TE	1.144	1.189	1.078	1.189	0.990	1.043	1.023	1.043	1.244		1.174		0.987	1.122	0.958	1.122
1 TE	1.143	1.189	1.190	1.189	1.004	1.043	1.040	1.043	1.092		1.184		0.903	1.043	0.873	1.043
1 GE	1.080	0.992	1.044	0.992	0.938	0.846	0.905	0.846	1.168		1.039		0.972	0.846	1.008	0.846
2 GE	1.083	0.992	1.025	0.997	0.906	0.846	0.888	0.846	1.336		1.105		1.051	0.925	1.094	0.925
3 GE	1.072	0.984	1.024	0.984	0.919	0.846	0.878	0.846	2.853		2.895		0.981	0.846	1.023	0.846
4 GE	1.769	1.866	1.706	1.866	0.973	0.925	0.969	0.925	2.982		3.032		1.121	1.004	1.103	1.004
5 GE	1.347	1.256	1.336	1.256	1.300	0.768	1.108	0.768	3.084		3.090		1.133	1.201	1.098	1.201
6 GE	1.603	1.547	1.568	1.547	1.029	1.004	1.015	1.004					2.206		2.187	

Comments

LPA Steam Path Datasheets

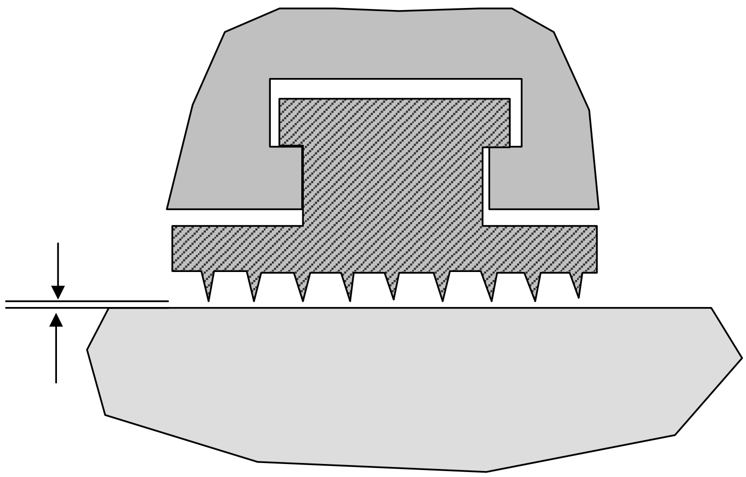
(Westinghouse Datasheet)

Straight Tooth Packing Clearance

Radial

Date (m/d/y) 5/8/20 Turbine Serial Number 4465 Prepared by C Mack

LPA Plant Comanche Unit 3 Initial Final X



		Left Side		Right Side	
		Actual	Exp.	Actual	Exp.
Position	Ring No.	Radial	Radial	Radial	Radial
Governor End Gland Case	1	0.016	0.030	0.039	0.030
	2	0.011	0.024	0.029	0.024
	3	0.011	0.024	0.027	0.024
	4	0.012	0.028	0.029	0.028
	5	0.014	0.028	0.029	0.028
Generator End Gland Case	1	0.025	0.028	0.011	0.028
	2	0.023	0.028	0.008	0.028
	3	0.025	0.024	0.011	0.024
	4	0.025	0.024	0.013	0.024
	5	0.033	0.030	0.023	0.030

Comments
LPA

LPA Steam Path Datasheets

(Westinghouse Datasheet)

LP Spindle Float

Date (m/d/y)	5/8/2020	Turbine Serial Number	4465	Prepared by	C Mack
				Initial	
Plant	Comanche	Unit	3	Final	X

In Running Position

" L" Reading @ B Coupling

"K"	
L/S	5.823
R/S	5.826
Indicator	1.000

Note***

Pushed to the Governor End

" L" Reading @ B Coupling

"K"	
L/S	5.279
R/S	5.281
Indicator	-0.545

Restrictions G/E Blade Ring #3

Pushed to the Generator End

" L" Reading @ B Coupling

"K"	
L/S	6.465
R/S	6.467
Indicator	0.643

Restrictions T/E Blade Ring #3

Total Float or Difference

" L" Reading @ B Coupling

"K"	
L/S	-1.186
R/S	-1.186

Total Travel	1.186
Total Design Travel	1.098

Total Float or Travel from "K" Forward	0.544	Design	0.441	Diff.	0.103
Total Float or Travel from "K" Aft	0.642	Design	0.657	Diff.	-0.015

LPA Steam Path Datasheets

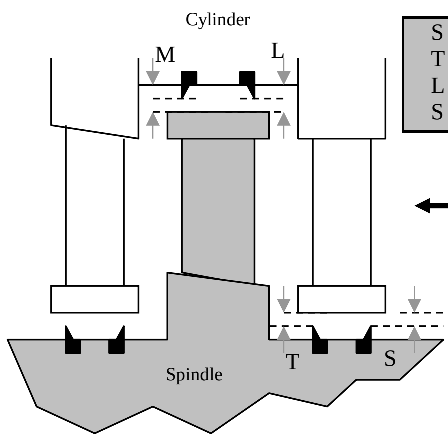
(Westinghouse Datasheet)

Reaction Blade Seal Clearances

LP Radial

Date (m/d/y) 2/3/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



S & L are Inlet Seals
T & M are Outlet Seals
L & M are Outer Seals
S & T are Inner Seals

Steam flow

INITIAL X
FINAL

SECTION
H.P.
I.P.
L.P. A

"K" READING
1.189

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"S"				"T"				"L"				"M"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE	0.098		0.187						0.296		0.312					
5 TE	0.070		0.072						0.120		0.116					
4 TE	0.063		0.063						0.081		0.100					
3 TE	0.049		0.060						0.056		0.066					
2 TE	0.064		0.057						0.045		0.063					
1 TE	0.062		0.080						0.047		0.056					
1 GE	0.064		0.077						0.047		0.061					
2 GE	0.045		0.056						0.047		0.059					
3 GE	0.049		0.060						0.060		0.064					
4 GE	0.063		0.060						0.082		0.087					
5 GE	0.070		0.071						0.102		0.120					
6 GE	0.098		0.186						0.265		0.281					

Comments

LPA Steam Path Datasheets

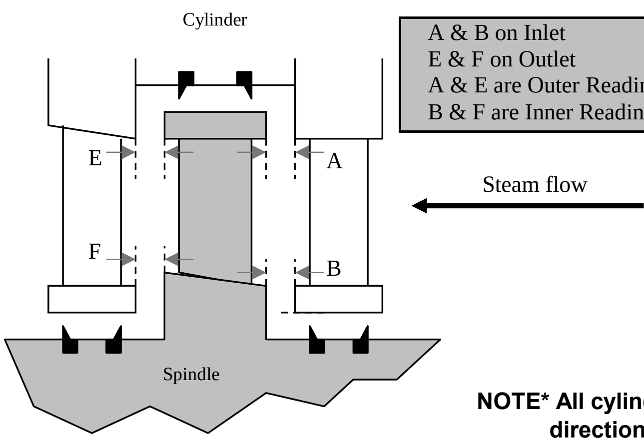
(Westinghouse Datasheet)

Reaction Blade Clearances

LP Axial

Date (m/d/y) 2/3/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



INITIAL X
FINAL ____

SECTION
H.P. ____
I.P. ____
L.P. A

"K" READING
1.186

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"A"				"B"				"E"				"F"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE			1.799				1.131									
5 TE			1.425				0.952								1.037	
4 TE			1.863				1.181								1.023	
3 TE			1.184				1.025								0.885	
2 TE			1.187				1.043								0.947	
1 TE			1.186				1.041								0.866	
1 GE			1.041				0.893								1.010	
2 GE			1.044				0.882								1.081	
3 GE			1.015				0.870								1.036	
4 GE			1.814				0.931								1.089	
5 GE			1.311				0.820								0.843	
6 GE			1.590				0.992									

Comments

LPA Steam Path Datasheets

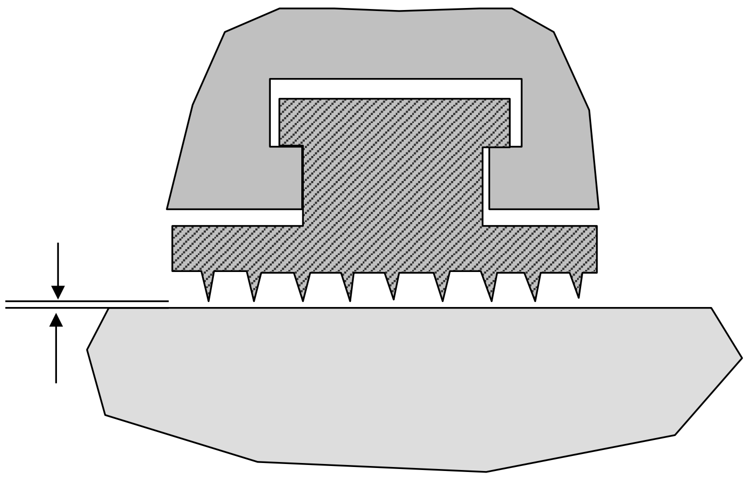
(Westinghouse Datasheet)

Straight Tooth Packing Clearance

Radial

Date (m/d/y) 2/3/20 Turbine Serial Number 4465 Prepared by C Mack

LPA Plant Comanche Unit 3 Initial X Final



		Left Side		Right Side	
		Actual	Exp.	Actual	Exp.
Position	Ring No.	Radial	Radial	Radial	Radial
Governor End Gland Case	**1**	0.020		0.045	
	2	0.015		0.030	
	3	0.015		0.035	
	4	0.020		0.035	
	5	0.020		0.040	
Generator End Gland Case	**1**	0.016		0.035	
	2	0.011		0.033	
	3	0.015		0.034	
	4	0.015		0.033	
	5	0.024		0.036	

Comments	
	LPA

IR2WH3012 ***GE Energy Services*** ***Company Proprietary Information***

LPB Steam Path Datasheets

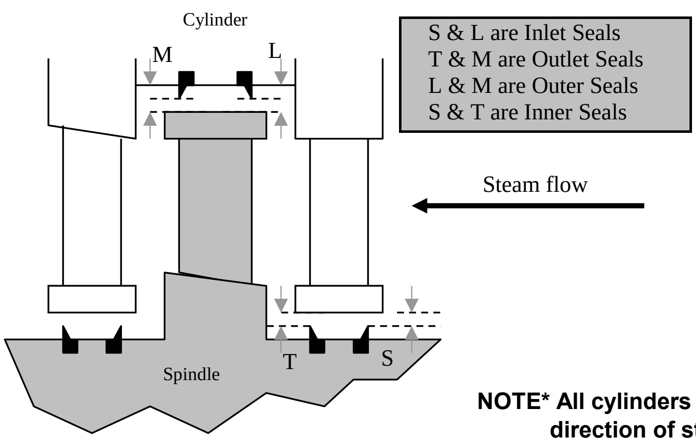
(Westinghouse Datasheet)

Reaction Blade Seal Clearances

LP Radial

Date (m/d/y) 5/7/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



INITIAL
FINAL X

SECTION
H.P.
I.P.
L.P. B

"K" READING
1.465

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"S"				"T"				"L"				"M"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE	0.115	0.087	0.375	0.087	0.105	0.087	0.100	0.087	0.305	0.307	0.100	0.307		0.307		0.307
5 TE	0.085	0.063	0.140	0.063	0.080	0.063	0.065	0.063	0.145	0.150	0.070	0.150	0.140	0.150	0.145	0.150
4 TE	0.175	0.071	0.125	0.071	0.175	0.071	0.070	0.071	0.120	0.098	0.070	0.098	0.115	0.098	0.120	0.098
3 TE	0.060	0.059	0.085	0.059	0.060	0.059	0.075	0.059	0.085	0.087	0.065	0.087	0.075	0.087	0.070	0.087
2 TE	0.065	0.055	0.075	0.055	0.060	0.055	0.065	0.055	0.070	0.055	0.055	0.055	0.068	0.055	0.067	0.055
1 TE		0.091	0.080	0.091	0.095	0.091		0.091	0.065	0.083	0.100	0.083	0.065	0.083	0.065	0.083
1 GE	0.120	0.091	0.070	0.091		0.091		0.091	0.080	0.083	0.115	0.083	0.070	0.083	0.060	0.083
2 GE	0.060	0.055	0.065	0.055	0.060	0.055	0.055	0.055	0.085	0.055	0.055	0.055	0.080	0.055	0.070	0.055
3 GE	0.075	0.059	0.070	0.059	0.080	0.059	0.060	0.059	0.085	0.087	0.055	0.087	0.110	0.087	0.085	0.087
4 GE	0.065	0.071	0.125	0.071	0.070	0.071	0.065	0.071	0.115	0.098	0.065	0.098	0.115	0.098	0.120	0.098
5 GE	0.070	0.063	0.150	0.063	0.070	0.063	0.085	0.063	0.120	0.150	0.085	0.150	0.125	0.150	0.155	0.150
6 GE	0.105	0.087	0.400	0.087	0.102	0.087	0.160	0.087		0.307	0.160	0.307	0.292	0.307		0.307

Comments

Confidential

LPB Steam Path Datasheets

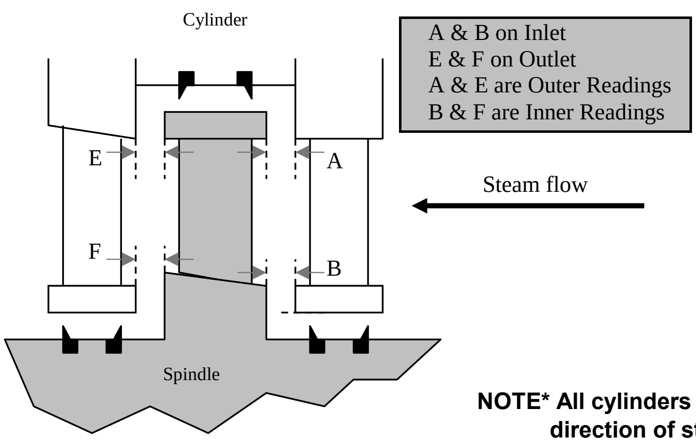
(Westinghouse Datasheet)

Reaction Blade Clearances

LP Axial

Date (m/d/y) 5/6/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



INITIAL
FINAL X

SECTION
H.P.
I.P.
L.P. B

"K" READING
1.465

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"A"				"B"				"E"				"F"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE			2.030	2.020			1.410	1.476							1.714	N/A
5 TE			1.770	1.728			1.490	1.240							0.767	0.728
4 TE			2.272	2.339			1.349	1.398							0.705	0.728
3 TE			1.440	1.457			1.494	1.319							0.734	0.571
2 TE			1.474	1.465			0.885	1.319							0.765	0.650
1 TE				1.465			1.506	1.319							0.630	0.571
1 GE			0.740	0.717			0.753	0.571							1.400	1.319
2 GE			0.770	0.717			0.770	0.571							1.477	1.398
3 GE			0.747	0.709			0.792	0.571							1.419	1.319
4 GE			1.439	1.591			0.641	0.650							1.418	1.476
5 GE			1.052	0.980			0.770	0.492							1.446	1.476
6 GE			1.447	1.272			0.730	0.728							2.534	N/A

Comments

LPB Steam Path Datasheets

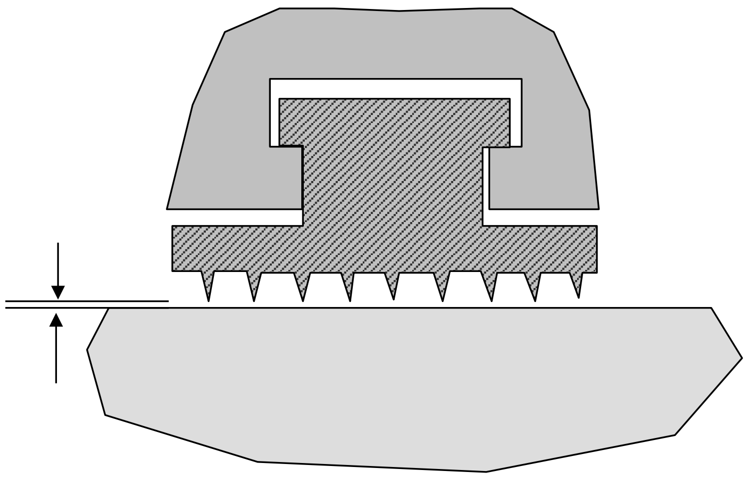
(Westinghouse Datasheet)

Straight Tooth Packing Clearance

Radial

Date (m/d/y) 5/8/20 Turbine Serial Number 4465 Prepared by C Mack

LPB Plant Comanche Unit 3 Initial Final X



		Left Side		Right Side	
		Actual	Exp.	Actual	Exp.
Position	**Ring No.**	**Radial**	**Radial**	**Radial**	**Radial**
Governor End Gland Case	**1**	0.020	0.030	0.040	0.030
	2	0.012	0.024	0.027	0.024
	3	0.010	0.024	0.026	0.024
	4	0.011	0.028	0.027	0.028
	5	0.011	0.028	0.027	0.028
Generator End Gland Case	**1**	0.015	0.028	0.070	0.028
	2	0.015	0.028	0.035	0.028
	3	0.020	0.024	0.028	0.024
	4	0.028	0.024	0.030	0.024
	5	0.025	0.030	0.035	0.030

Comments
LPB

IR2WH3012 *GE Energy Services* *Company Proprietary Information*

LPB Steam Path Datasheets

(Westinghouse Datasheet)

LP Spindle Float

Date (m/d/y)	5/8/2020	Turbine Serial Number	4465	Prepared by	C Mack
				Initial	
Plant	Comanche	Unit	3	Final	X

Note***

LPB

In Running Position

" L" Reading @ B Coupling

	"K"	
	L/S	6.241
	R/S	6.245
Indicator	0.194	

Pushed to the Governor End

" L" Reading @ B Coupling

	"K"	
	L/S	6.436
	R/S	6.437
Indicator	0.000	

Restrictions G/E Bladering #3

Pushed to the Generator End

" L" Reading @ B Coupling

	"K"	
	L/S	5.307
	R/S	5.309
Indicator	1.128	

Restrictions T/E Bladering #3

Total Float or Difference

" L" Reading @ B Coupling

"K"	
L/S	1.129
R/S	1.128

Total Travel	**1.127**
Total Design Travel	**1.098**

Total Float or Travel from "K" Forward	**0.193**	**Design**	**0.165**	**Diff.**	**0.028**
Total Float or Travel from "K" Aft	**0.934**	**Design**	**0.933**	**Diff.**	**0.001**

Confidential

LPB Steam Path Datasheets

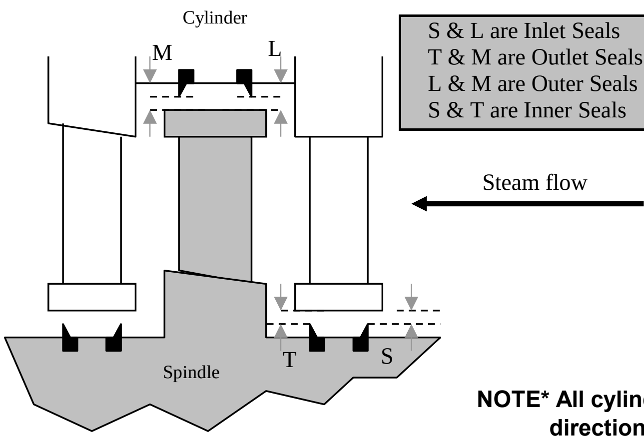
(Westinghouse Datasheet)

Reaction Blade Seal Clearances

LP Radial

Date (m/d/y) 1/24/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



INITIAL X
FINAL ____

SECTION
H.P. ____
I.P. ____
L.P. B

"K" READING ____

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"S"				"T"				"L"				"M"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE																
5 TE	0.041	0.150	0.110	0.150					0.087	0.063	0.070	0.063				
4 TE	0.043	0.098	0.110	0.098						0.071	0.072	0.071				
3 TE	0.055	0.067	0.070	0.067					0.045	0.058	0.067	0.058				
2 TE	0.055	0.055	0.065	0.055					0.045	0.055	0.065	0.055				
1 TE	0.050	0.063	0.080	0.063					0.075	0.091	0.110	0.091				
1 GE	0.045	0.063	0.060	0.063					0.070	0.091	0.105	0.091				
2 GE	0.045	0.055	0.065	0.055					0.055	0.055	0.063	0.055				
3 GE	0.060	0.067	0.070	0.067					0.055	0.058	0.065	0.058				
4 GE	0.075	0.098	0.100	0.098					0.055	0.071	0.071	0.071				
5 GE	0.105	0.150	0.170	0.150					0.060	0.063	0.080	0.063				
6 GE																

Comments

LPB Steam Path Datasheets

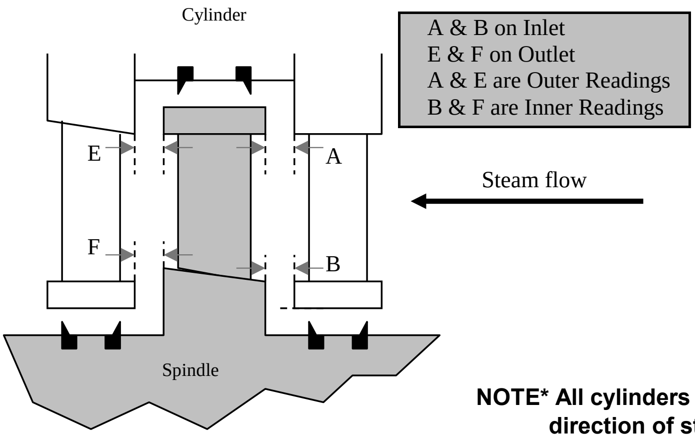
(Westinghouse Datasheet)

Reaction Blade Clearances

LP Axial

Date (m/d/y) 1/24/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3



INITIAL X
FINAL

SECTION
H.P.
I.P.
L.P. B

"K" READING
1.190"

NOTE* All cylinders & blade rings to be wedged in direction of steam flow

	"A"				"B"				"E"				"F"			
	LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT		LEFT		RIGHT	
Row	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.	ACT.	EXP.
6 TE			1.952				1.411									
5 TE			1.691				1.246									
4 TE			2.173				1.354								0.705	
3 TE			1.447				1.305								0.627	
2 TE			1.459				1.309								0.664	
1 TE			1.462				1.314								0.589	
1 GE			0.759				0.614								1.312	
2 GE			0.758				0.607								1.363	
3 GE			0.743				0.603								1.294	
4 GE			1.475				0.644								1.427	
5 GE			1.053				0.684								1.070	
6 GE			1.225				0.713									

Comments

Confidential

LPB Steam Path Datasheets

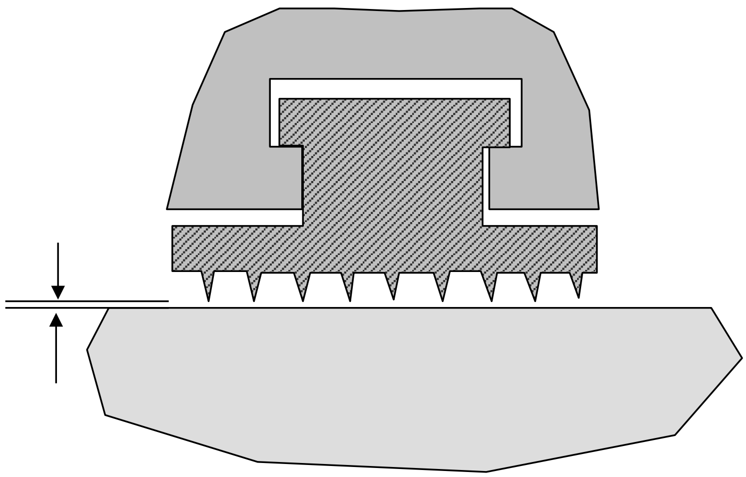
(Westinghouse Datasheet)

Straight Tooth Packing Clearance

Radial

Date (m/d/y) 1/24/20 Turbine Serial Number 4465 Prepared by C Mack

LPB Plant Comanche Unit 3 Initial X Final



		Left Side		Right Side	
		Actual	Exp.	Actual	Exp.
Position	Ring No.	Radial	Radial	Radial	Radial
Governor End Gland Case	1	0.012	0.030	0.035	0.030
	2	0.015	0.024	0.037	0.024
	3	0.012	0.024	0.035	0.024
	4	0.012	0.028	0.035	0.028
	5	0.025	0.028	0.045	0.028
Generator End Gland Case	1	0.010	0.028	0.033	0.028
	2	0.015	0.028	0.035	0.028
	3	0.017	0.024	0.035	0.024
	4	0.010	0.024	0.035	0.024
	5	0.017	0.030	0.046	0.030

Comments	
	LPB

3.7 Valves

3.7.1 Throttle Valves

Part Description:
OEM Drawing N26-G11-5355E

There are two throttle valves horizontally mounted to the steam chests. These valves throttle the admission of main steam to the steam chests on each side of the machine. They also act as main steam stop valves for the unit. The valves are held in the closed position by spring pressure and opened by an EHC operated single direction actuator that transmits force through linkages. The valves are of the double plug style with a pilot valve nested within the the main valve plug. The pilot valve seats on the inside of the main valve plug. Within the pilot valve there is a spring pilot which supplies the closing force needed to positively seat the pilot valve when the spring guide is seated on the main valve bushing. The purpose of this spring loaded pilot is to allow the spring guide to positively seat against the main valve bushing and, at the same time, allow the pilot valve to positively seat against the back side of the main valve plug. All replacement parts were supplied by the customer.

The two valves were completely disassembled, cleaned and inspected. The actuators were dismounted from the valves and the closed end overtravel was measured. The actuators were not inspected during this outage. Grit blasting and non-destructive examinations were performed per the NDE matrix provided by the customer.

A crack-like linear indication was found across the right side main valve seat. The customer decided to undertake no action at this time and the indication will be monitored for propagation during future outages. Several of the main bonnet studs showed inconclusive result through ultrasonic testing. The customer's non-destructive testing expert tested the studs in question and deemed them suitable for continued service.

At disassembly the spring pilot spring compression was measured. The left side valve was found to have zero spring compression. Further disassembly revealed that the spring seat (item 10) of the left valve was seized in the valve stem. Efforts were made to free the spring seat from the left side valve stem, but, it could not be removed, and the entire stem spring pilot assembly was replaced(items 10,15 & 6). The runout of the right side stem was found to be beyond acceptable limit and it was replaced (item 6). The right side pilot valve was found eroded at disassembly and was replaced (item 8). The right side spring guide to main bushing contact was found to be unacceptable. It appears that the holes in the stem had steam cut the spring guide surface and the spring guide was replaced (item 20). The left side pilot valve nut peening lip was found to be in unacceptable condition for continued service and it was replaced (item 9). Both of the valve stem end plugs were replaced and machined to size for acceptable spring pilot travel (item 22). The spring pilot spring of the right side valve was replaced, since the spring found in service did not have the proper free length (item 15).

3.7.1 Throttle Valves

Contact checks were performed between the main plug (item 5) and main seat (item C) , pilot valve (item 8) and pilot seat (item 5), stem backseat (item 6) to valve plug nut (item 16), plug nut (item 16) to bonnet bushing backseat (item 17) and spring guide (item 20) to main bonnet bushing (item 17). Lapping of the surfaces was performed to achieve 100% contact between all surfaces.

At reassembly travel checks were performed to verify that all design clearances were met, within the spring pilot assembly. The pilot spring was shimmed to attain design compression.

Based on recommendations from the previous outage, the register fits of the valve bonnets to the valve bodies were measured using blue light scanning. It was found that both valves had excessive clearance at this location. By design the clearance is 2-6 mils, and both valves were found to have in excess of 45 mils clearance. Several "pads" were welded on the inner diameter of the valve body fit and machined, on centerline to reduce the clearance back to within design limits.

The valve springs were visually inspected, free lengths were measured and all springs were returned to service.

The valves were reassembled and the new stems were drilled to accept new spring guide anti-rotation pins (item 21).

Prior to the valves being reinstalled to the steam chest, fine mesh strainers were installed. The strainers were screwed to the permanent strainer that is attached to the valve bonnet. Many of the screw holes had to be tapped out to a larger size because the threads were in poor condition. Screws were provided by the customer. After the screws were tightened, they were tack welded to retain them.

At reassembly the valves were installed with new gaskets (item 4), the bolt threads were coated with N-7000 anti-seize and tightened per "Bolt Tightening Procedure" provided on the OEM drawing. Bonnet bolting was heat stretched using induction heating. Bolting without pre-stress values from the drawing was tightened to 45 ksi. Actuator closed end over travel was measured as the linkages were made up.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The indication on the right side throttle valve seat should be monitored during future outages. Pre-outage planning should include provisions for seat replacement. This would include

3.7.1 Throttle Valves

procuring a new seat from the OEM and having machinists available to remove the seat and install a new seat. The new seat will also need to be seal welded. Since the material of the seat and weld prep lip is unknown, the OEM should be contacted for guidance with regards to the seal welding.

At least one new stem assembly (including the spring pilot parts) should be on-hand before the next outage
.
Since the exact cause of the steam cuts on the spring guide of the right side valve is unknown, a new spring guide should be on-hand prior to the next outage.

The fine mesh strainers should be removed after three months or if there is a decrease in inlet pressure, whichever comes first.

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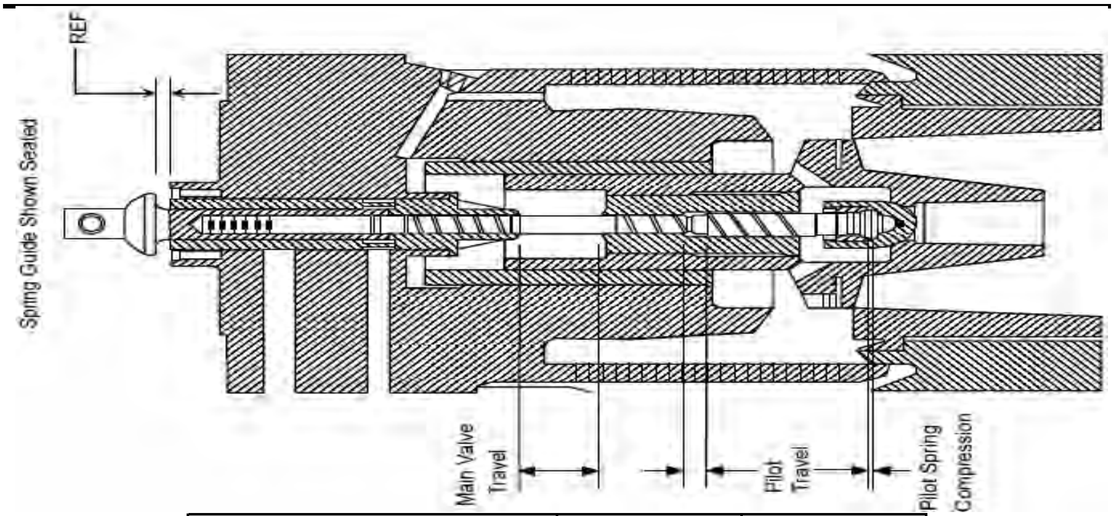
Throttle Valve Datasheets

Throttle Valve

Valve Travel (with Spring Pilot)

Date (m/d/y)	4/14/20	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	
				Final	x



Spring Pilot Travel without Spring**	0.192	0.215
Pilot Nut Spring Preload*	0.295	0.295

* This is the gap between the pilot valve disc and the pilot valve nut before spring compression
** This is the travel of the spring pilot with the spring removed from the pilot assembly

	Valve Condition	Left Side	Right Side	
1	Valve on Floor, Cross Head Seated	0.979	0.981	
2	Valve Installed, Full Closed (pilot spring compressed)	0.979	0.981	
3	Valve Installed, Full Closed (pilot spring not compressed)	1.116	1.148	
4	Valve Installed, Stem Backseated in Plug	1.795	1.795	
5	Valve Installed, Full Open	6.718	6.736	
	Travels			Design
	Spring Pilot Forward Travel (3-2)	0.137	0.167	0.126" +/- 0.008"
	Pilot Travel (4-2)	0.816	0.814	0.787" +/- 0.040"
	Main Valve Travel (5-4)	4.923	4.941	4.921" +/- 0.040"
	Total Valve Travel (5-2)	5.739	5.755	5.835" +/- 0.087"
Spring Pilot Forward Clearance (Springless Travel - Forward Travel)		0.055	0.048	0.063"
Total Spring Compression (Spring Preload+Spring Pilot Forward Travel)		0.432	0.462	0.445" +/- 0.014"

Comments	

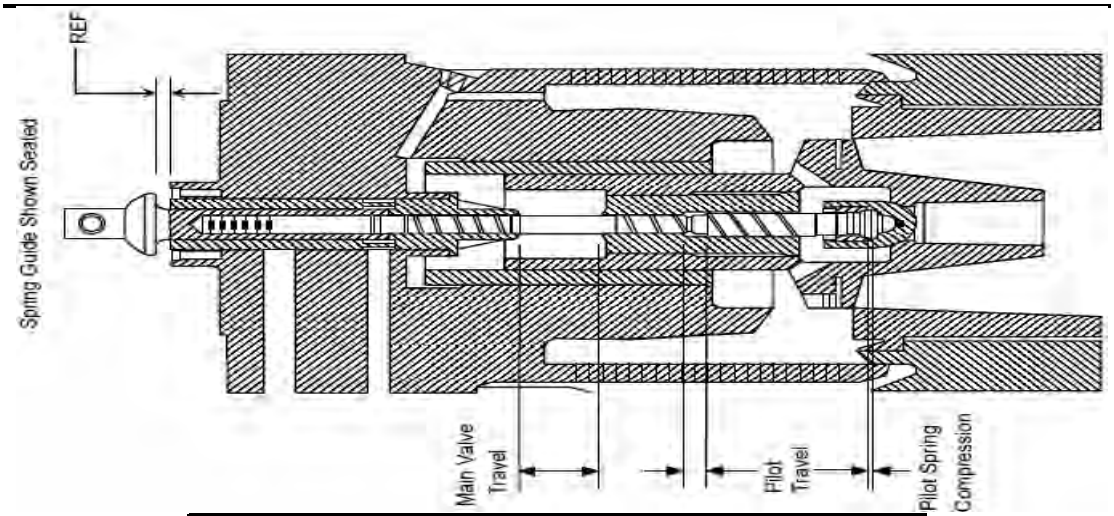
Confidential

Throttle Valve Datasheets

Throttle Valve

Valve Travel (with Spring Pilot)

Date (m/d/y)	2/8/20	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	x
				Final	



Spring Pilot Travel without Spring**		
Pilot Nut Spring Preload*		

* This is the gap between the pilot valve disc and the pilot valve nut before spring compression
** This is the travel of the spring pilot with the spring removed from the pilot assembly

	Valve Condition	Left Side	Right Side	
1	Valve on Floor, Cross Head Seated	0.984	0.980	
2	Valve Installed, Full Closed (pilot spring compressed)	0.983	0.979	
3	Valve Installed, Full Closed (pilot spring not compressed)	0.983	1.091	
4	Valve Installed, Stem Backseated in Plug	1.805	1.756	
5	Valve Installed, Full Open	6.756	6.710	
	Travels			Design
	Spring Pilot Forward Travel (3-2)	0.000	0.112	0.126" +/- 0.008"
	Pilot Travel (4-2)	0.822	0.777	0.787" +/- 0.040"
	Main Valve Travel (5-4)	4.951	4.954	4.921" +/- 0.040"
	Total Valve Travel (5-2)	5.773	5.731	5.835" +/- 0.087"
Spring Pilot Forward Clearance (Springless Travel - Forward Travel)				0.063"
Total Spring Compression (Spring Preload+Spring Pilot Forward Travel)		0.000	0.112	0.445" +/- 0.014"

Comments
Left Side had zero spring pilot travel

Throttle Valve Datasheets

(Westinghouse Datasheet)

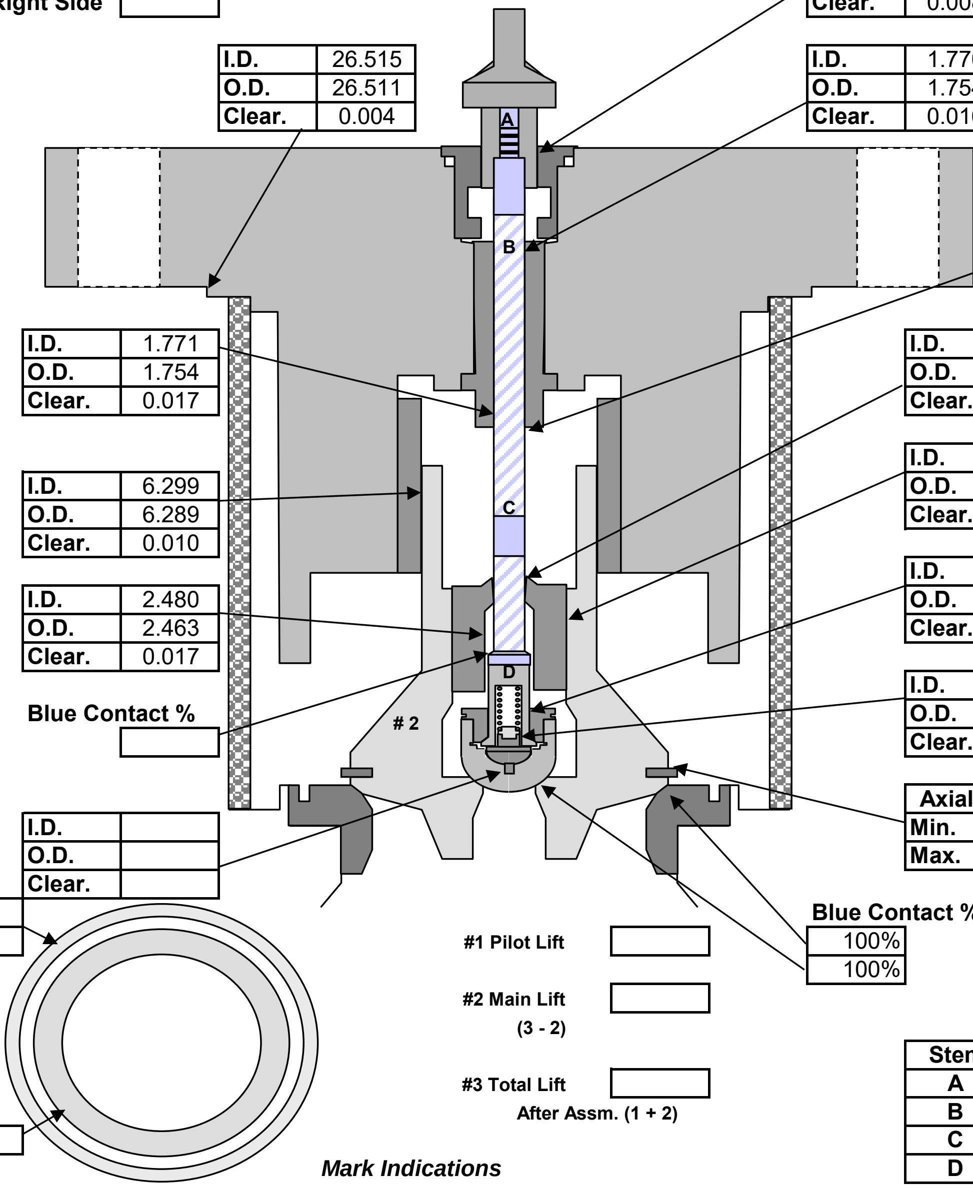
Throttle Valve (Type 5)

Clearances

Date (m/d/y) 3/3/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial Final x

Left Side	x
Right Side	



I.D.	2.752
O.D.	2.744
Clear.	0.008

I.D.	26.515
O.D.	26.511
Clear.	0.004

I.D.	1.770
O.D.	1.754
Clear.	0.016

Blue Contact 100%

I.D.	1.771
O.D.	1.754
Clear.	0.017

I.D.	1.770
O.D.	1.754
Clear.	0.016

I.D.	6.299
O.D.	6.289
Clear.	0.010

I.D.	4.170
O.D.	4.168
Clear.	0.002

I.D.	2.480
O.D.	2.463
Clear.	0.017

I.D.	
O.D.	
Clear.	

Blue Contact %

I.D.	1.692
O.D.	1.680
Clear.	0.012

Axial Clearance	
Min.	NA
Max.	NA

I.D.	
O.D.	
Clear.	

Seal Weld

Seat

Blue Contact %
100%
100%

#1 Pilot Lift

#2 Main Lift (3 - 2)

#3 Total Lift After Assm. (1 + 2)

Mark Indications

Stem Runout	
A	0.001
B	0.000
C	0.002
D	0.000

Comments
* New stem

Confidential

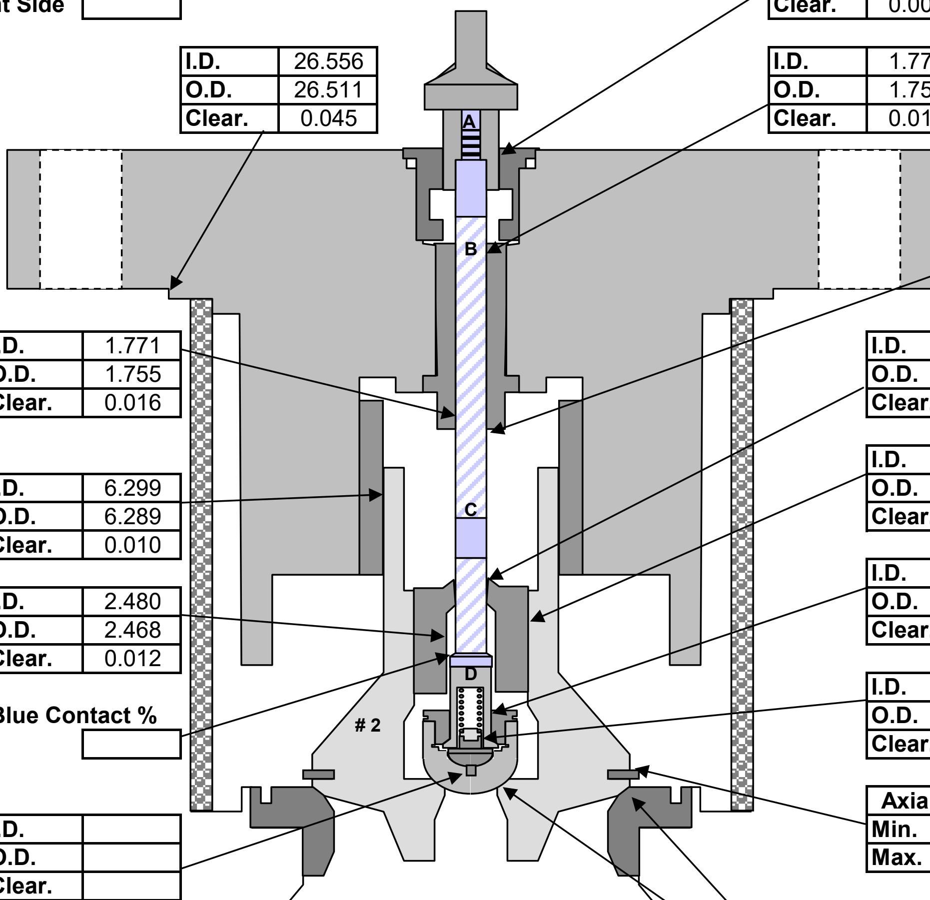
Throttle Valve Datasheets

(Westinghouse Datasheet)

Throttle Valve (Type 5)
Clearances

Date (m/d/y)	2/27/20	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	x
				Final	

Left Side	x
Right Side	



I.D.	2.752
O.D.	2.744
Clear.	0.008

I.D.	26.556
O.D.	26.511
Clear.	0.045

I.D.	1.770
O.D.	1.755
Clear.	0.015

Blue Contact

I.D.	1.771
O.D.	1.755
Clear.	0.016

I.D.	1.770
O.D.	1.757
Clear.	0.013

I.D.	6.299
O.D.	6.289
Clear.	0.010

I.D.	4.170
O.D.	4.168
Clear.	0.002

I.D.	2.480
O.D.	2.468
Clear.	0.012

I.D.	
O.D.	
Clear.	

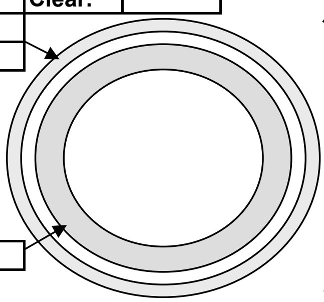
Blue Contact %

I.D.	1.692
O.D.	1.680
Clear.	0.012

Axial Clearance	
Min.	NA
Max.	NA

I.D.	
O.D.	
Clear.	

Seal
Weld



Seat

Blue Contact %

#1 Pilot Lift

#2 Main Lift (3 - 2)

#3 Total Lift After Assm. (1 + 2)

Stem Runout	
A	0.002
B	0.001
C	0.000
D	0.001

Mark Indications

Comments

Throttle Valve Datasheets

(Westinghouse Datasheet)

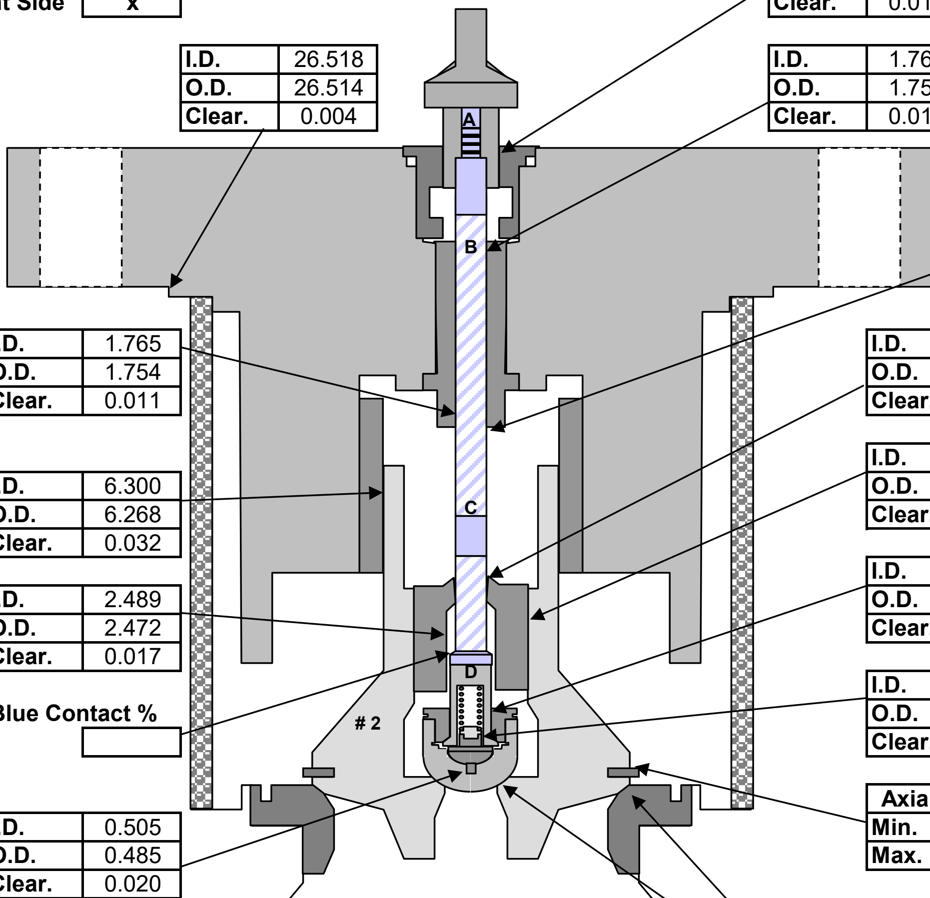
Throttle Valve (Type 5)

Clearances

Date (m/d/y) 2/26/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial Final x

Left Side
Right Side x



I.D.	2.753
O.D.	2.743
Clear.	0.010

I.D.	26.518
O.D.	26.514
Clear.	0.004

I.D.	1.767
O.D.	1.754
Clear.	0.013

Blue Contact 100%

I.D.	1.765
O.D.	1.754
Clear.	0.011

I.D.	1.773
O.D.	1.754
Clear.	0.019

I.D.	6.300
O.D.	6.268
Clear.	0.032

I.D.	4.181
O.D.	4.160
Clear.	0.021

I.D.	2.489
O.D.	2.472
Clear.	0.017

I.D.	2.530
O.D.	2.456
Clear.	0.074

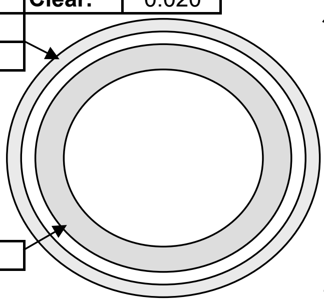
Blue Contact %

I.D.	1.691
O.D.	1.681
Clear.	0.010

Axial Clearance	
Min.	NA
Max.	NA

I.D.	0.505
O.D.	0.485
Clear.	0.020

Seal Weld



Seat

Blue Contact %
100%
100%

#1 Pilot Lift

#2 Main Lift (3 - 2)

#3 Total Lift After Assm. (1 + 2)

Mark Indications

Stem Runout	
A	0.001
B	0.000
C	0.000
D	0.000

Comments
* New stem

Throttle Valve Datasheets

(Westinghouse Datasheet)

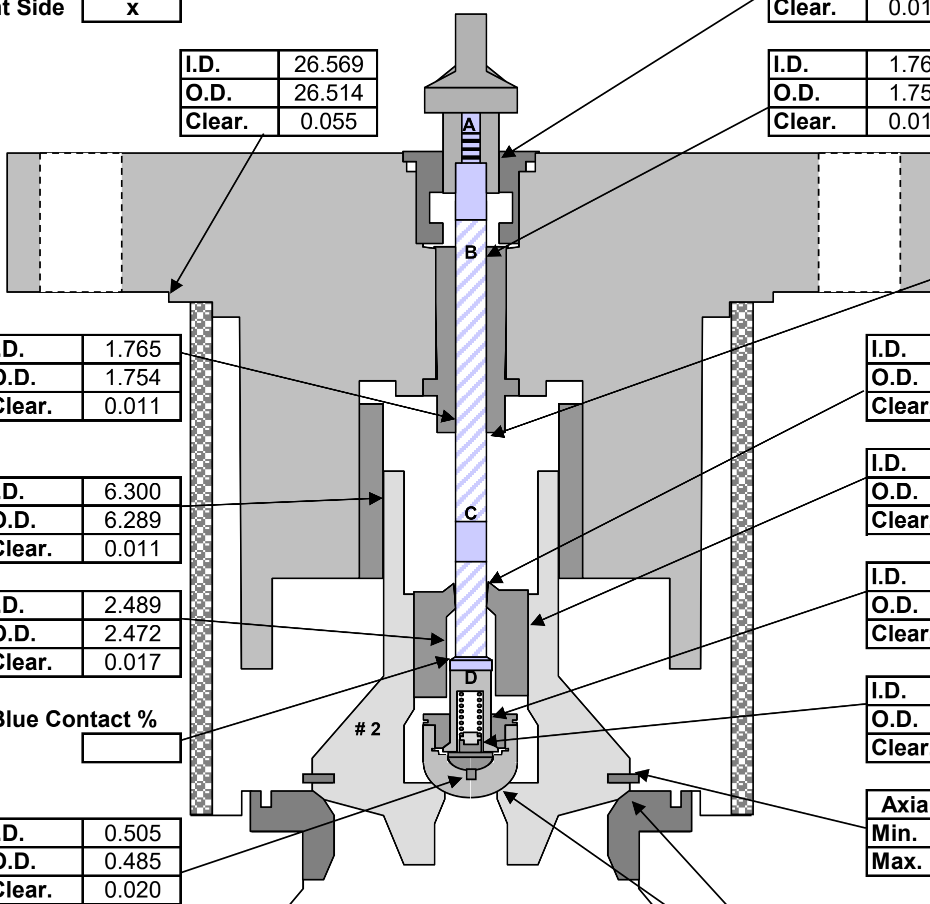
Throttle Valve (Type 5)

Clearances

Date (m/d/y) 2/26/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x Final

Left Side	
Right Side	x



I.D.	2.753
O.D.	2.743
Clear.	0.010

I.D.	26.569
O.D.	26.514
Clear.	0.055

I.D.	1.767
O.D.	1.755
Clear.	0.012

Blue Contact

I.D.	1.765
O.D.	1.754
Clear.	0.011

I.D.	1.773
O.D.	1.758
Clear.	0.015

I.D.	6.300
O.D.	6.289
Clear.	0.011

I.D.	4.170
O.D.	4.160
Clear.	0.010

I.D.	2.489
O.D.	2.472
Clear.	0.017

I.D.	2.530
O.D.	2.415
Clear.	0.115

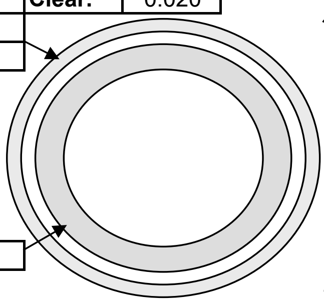
Blue Contact %

I.D.	1.684
O.D.	1.683
Clear.	0.001

Axial Clearance	
Min.	NA
Max.	NA

I.D.	0.505
O.D.	0.485
Clear.	0.020

Seal Weld



Seat

Blue Contact %

#1 Pilot Lift

#2 Main Lift (3 - 2)

#3 Total Lift After Assm. (1 + 2)

Mark Indications

Stem Runout	
A	0.004
B	0.002
C	0.004
D	0.005

Comments

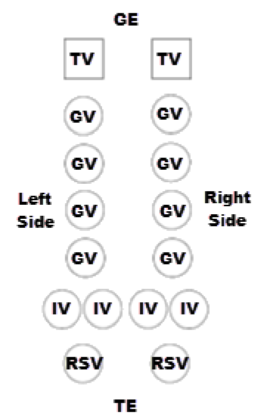
Throttle Valve Datasheets

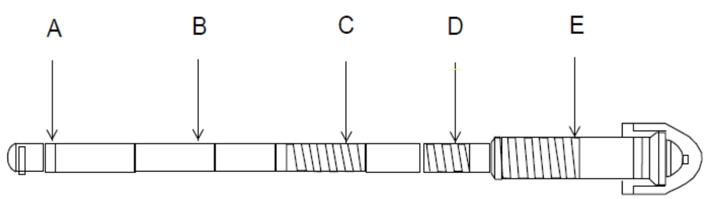
Stem Runout, TV

Date	2/26/20	Turbine Serial No.	4465	Prepared by	D. Johnson

As Found X
As Left ◯

Select Valve to the Right:





* Measurements in mils

Left Side

	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	0	0	0	0	0
180 deg	-2	1	0	-2	0
270 deg	0	0	0	-2	1
360 deg	0	0	0	0	0
Max Runout	2	1	0	2	1

Right Side

	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	4	-2	-4	-3	2
180 deg	4	0	-4	-4	5
270 deg	0	-1	-1	-2	1
360 deg	0	0	0	0	0
Max Runout	4	2	4	4	5

* Both stems replaced at reassembly

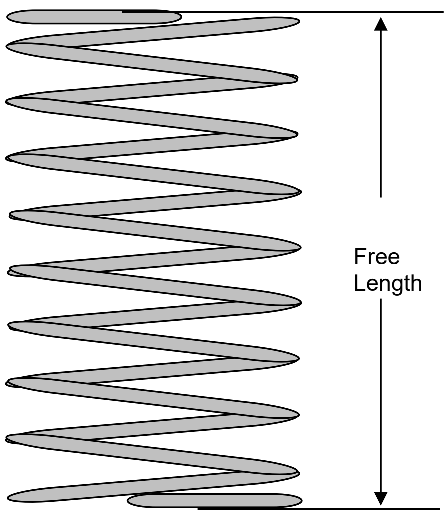
Throttle Valve Datasheets

(Westinghouse Datasheet)

Throttle Valve Spring Dimensions

Date (m/d/y) 3/9/20 Turbine Serial Number 4465 Prepared by D.Johnson

Plant Comanche Unit 3 Initial x
Final x



	Free Length	
Spring	L/S	R/S
1	31-1/4"	31-1/8"
2	31-1/4"	31-1/4"
3	27-5/16	28-3/16"
4	NA	NA

Note* Springs are numbered from inside to outside

Comments	

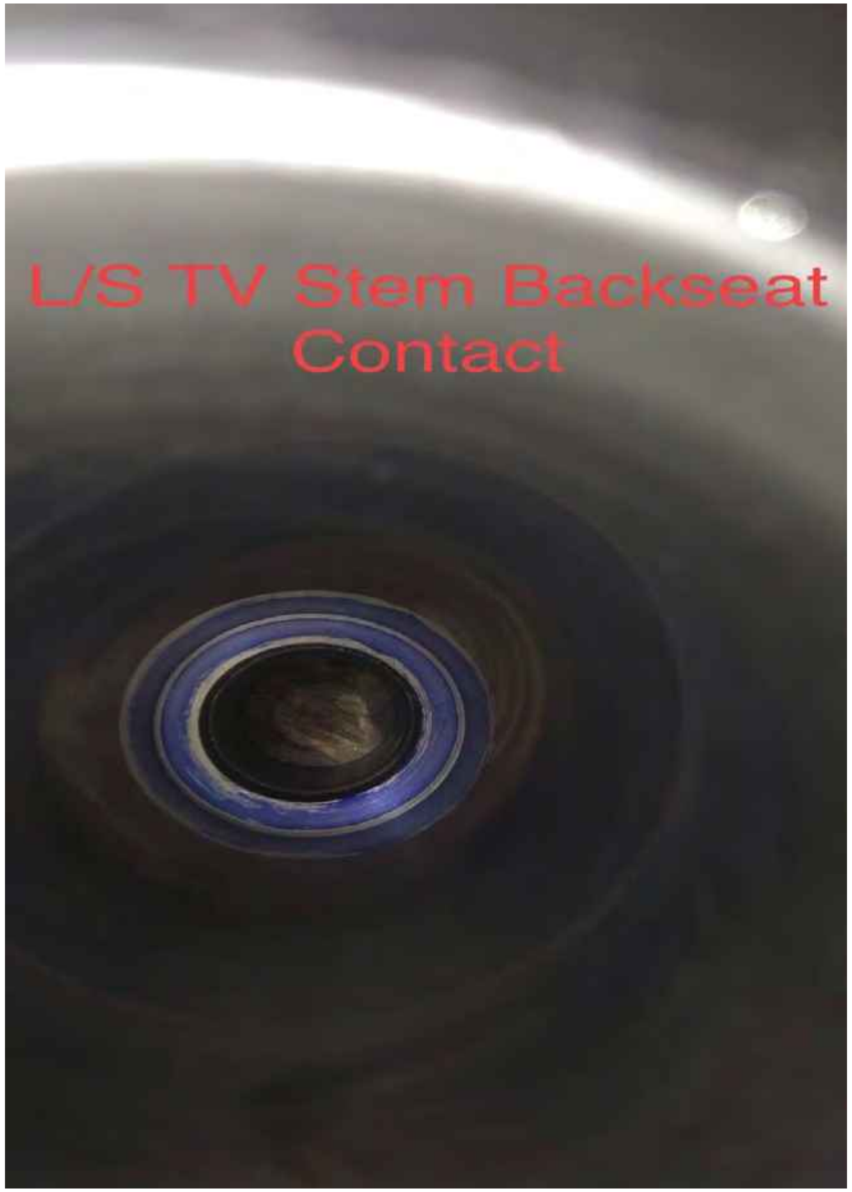
Confidential

Throttle Valve Pictures

Throttle Valve Pictures

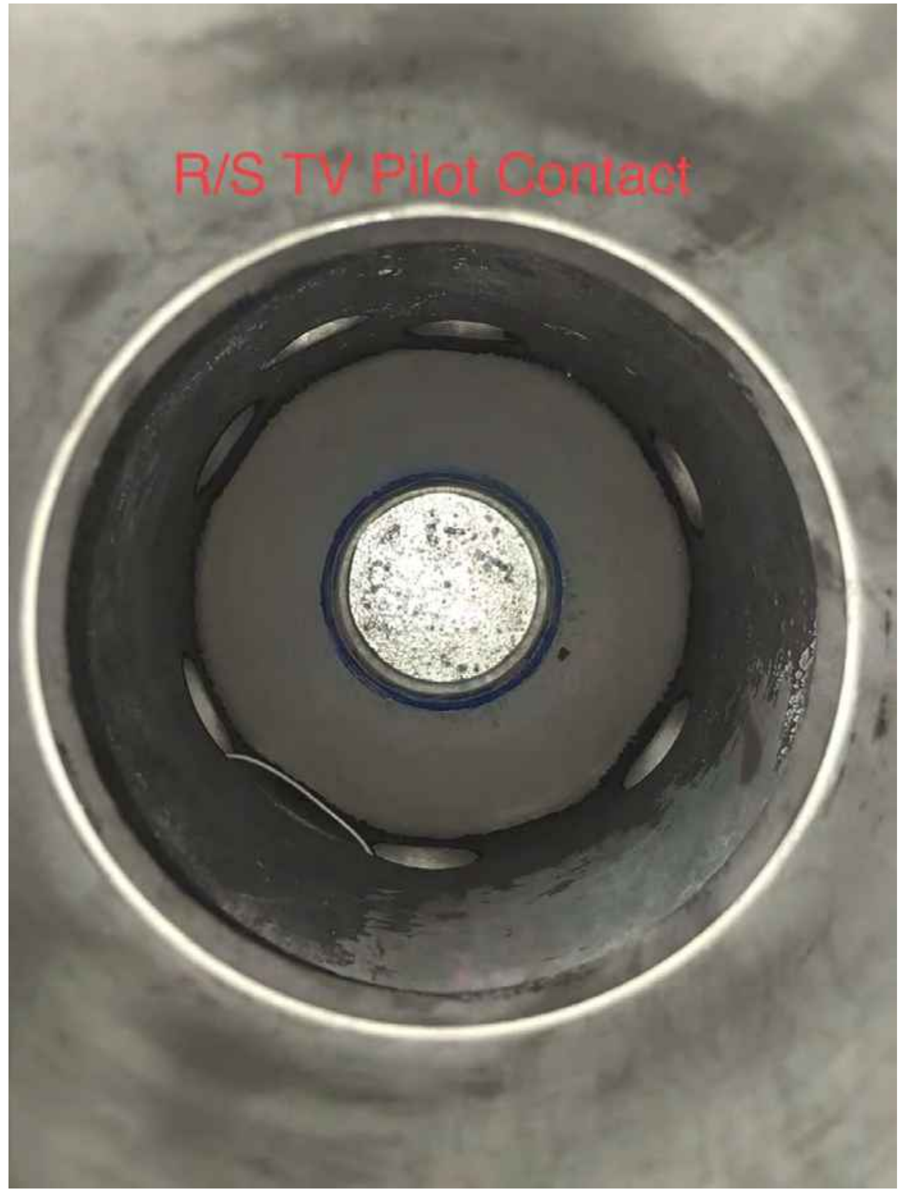
Confidential

Throttle Valve Pictures



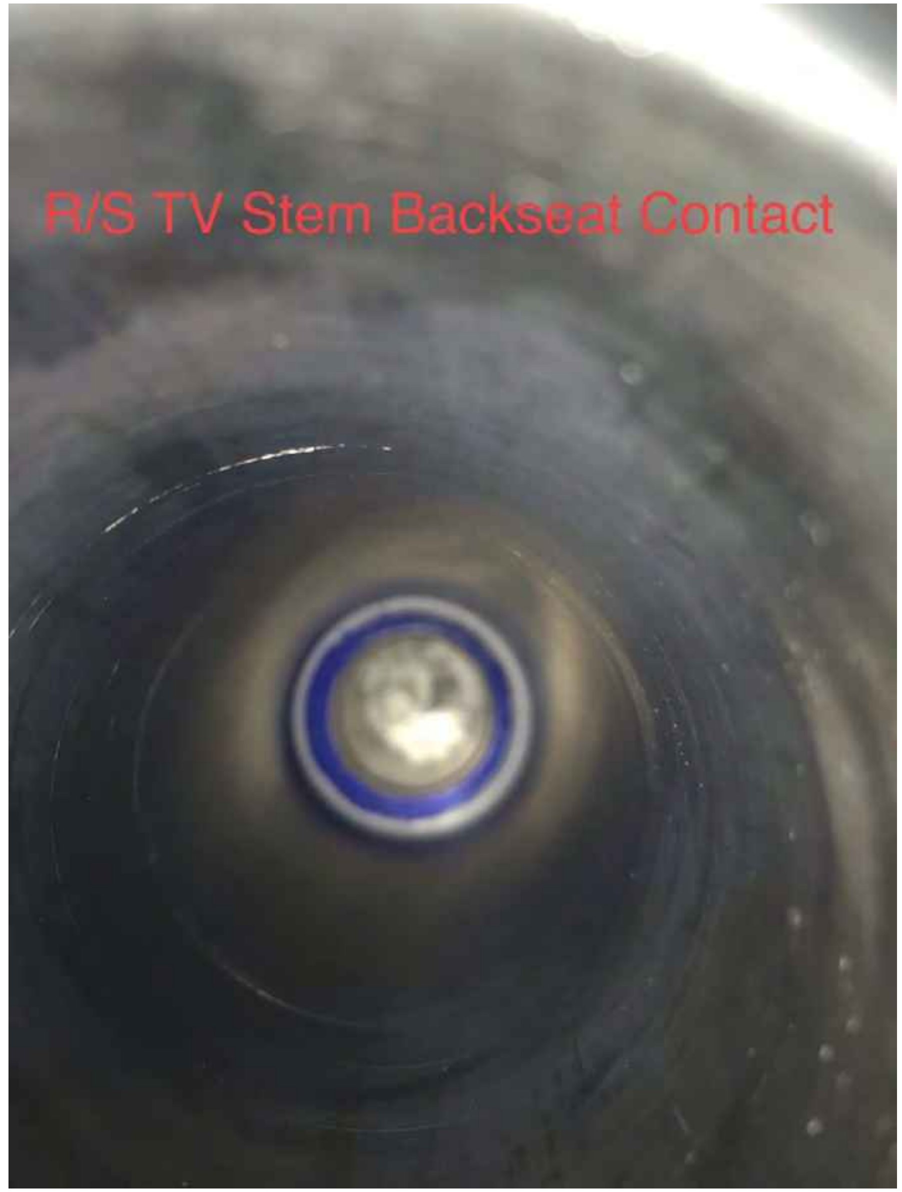
Confidential

Throttle Valve Pictures



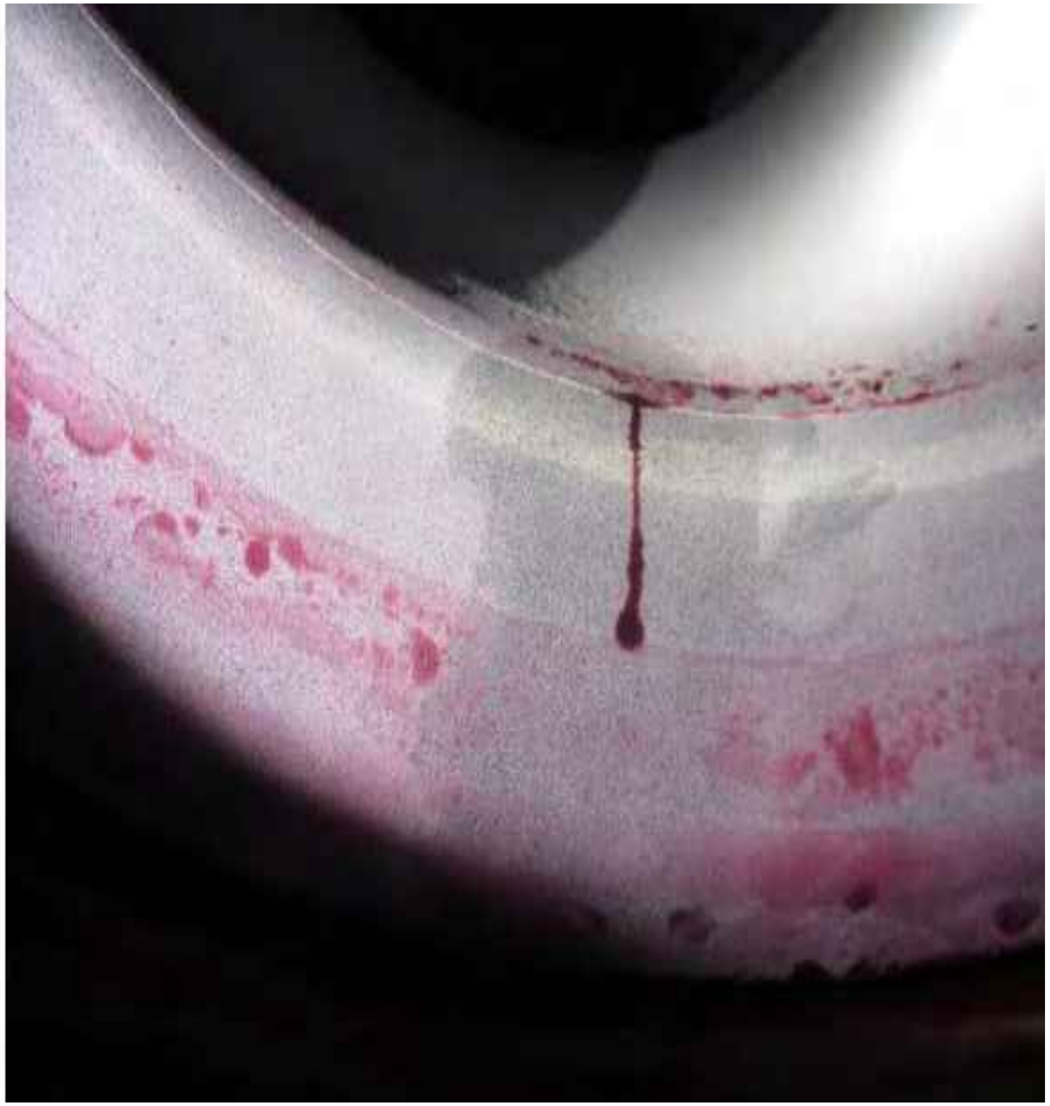
Confidential

Throttle Valve Pictures



Confidential

Throttle Valve Pictures



Right Side Throttle Valve Seat Indication

3.7.2 Governor Valves

Part Description:

OEM Drawing N26-G12-5435E

There are four vertically mounted governor valves. Two on each side steam chest. The valves govern the admission of main steam into a common inlet chamber in a full arc admission arrangement. The valves are opened by single action side mounted actuators connected by linkage arms and closed by spring force supplied by vertically mounted spring cans. The valve stems are coupled to a flexible shaft that passes vertically through the spring can and is pinned to the actuator linkage. The seats of these valves are integral to the steam chest and can not be removed or replaced.

The four valves were dismounted from the steam chests, cleaned, disassembled and inspected. Non-destructive examinations were performed per the customer supplied NDE matrix. The actuators and spring cans were not disassembled during this outage. Also, the stem/plug assemblies were not taken apart due to risk of damage requiring replacement parts.

At disassembly actuator closed end over travel was measured as the the linkages were were unpinned. All over travels were found to be acceptable. Bushing clearances, stem runouts and pilot lifts were measured. Bushings were honed, as needed, to acheive design clearances. Contact checks were performed and the seats were lapped as needed for acceptable contact.

The #3 valve pilot lift was 23 mils beyond design, but, was not adjusted during this outage. Minor indications were found in the corners of the seat bores in the steam chests on #1 and #2 valve seats.

At reassembly, new gaskets were installed and the bolting was tightened per the OEM drawing "Bolt Tighteneing Procedure". Where specific prestress values were not provided bolting was tightened to 45 ksi. The threads of all bolting were coated with N-7000 anti-seize. The coupling bolts were lock wired per the OEM drawing. Closed end over travel of the actuators was measured as the linkages were made-up.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

Spring cans should be disassembled and the springs should be inspected during the next planned outage.

The indications found at the corners of seats #1 and #2 should be monitored for propagation.

#3 governor valve should be completely disassembled during the next outage to investigate

3.7.2 Governor Valves

the excessive pilot travel. Since it is unlikely that the stem/plug can be disassembled without resorting to destructive means, a new stem/plug should be on-hand.

The lower steam chest fit areas were beyond design clearance and should be investigated during the next outage. These bores locate the centerline of the stem to the centerline of the seat and misalignment could result in the valve not seating correctly.

Governor Valve Datasheets

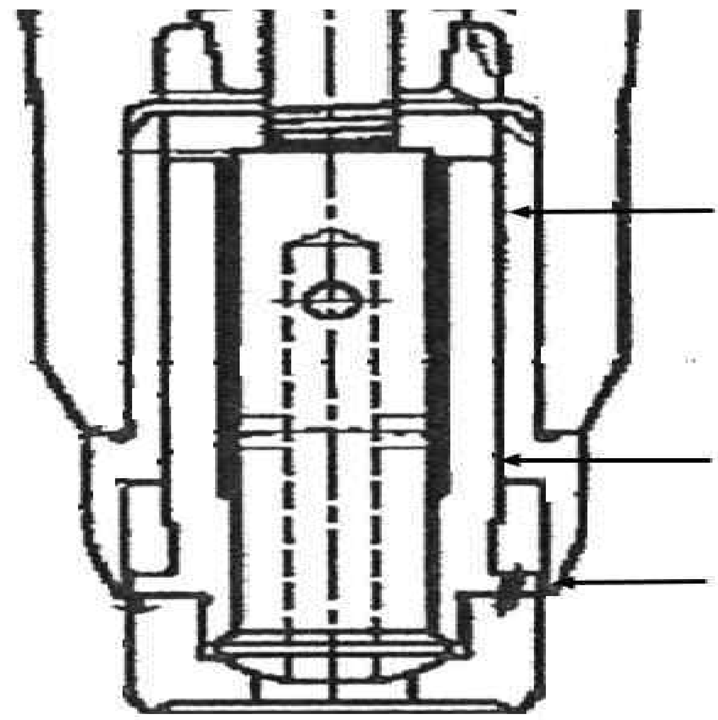
(Westinghouse Datasheet)

Governor Valve

Valve Plug Radial Clearances

Date (m/d/y) 3/2/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial ____ Final x



		#1		#2		#3		#4	
		0°	90°	0°	90°	0°	90°	0°	90°
A	ID	9.580	9.582	9.584	9.585	9.584	9.583	9.584	9.582
	OD	9.447	9.447	9.453	9.452	9.458	9.458	9.448	9.448
	Min Clr	0.133		0.133		0.125		0.134	
B	ID	7.670	7.670	7.674	7.673	7.668	7.667	7.676	7.676
	OD	7.656	7.656	7.661	7.661	7.655	7.655	7.656	7.657
	Min Clr	0.014		0.013		0.012		0.020	
C	ID	7.666	7.666	7.671	7.666	7.667	7.667	7.667	7.667
	OD	7.649	7.648	7.650	7.650	7.655	7.655	7.648	7.645
	Min Clr	0.017		0.016		0.012		0.019	

Comments	

Governor Valve Datasheets

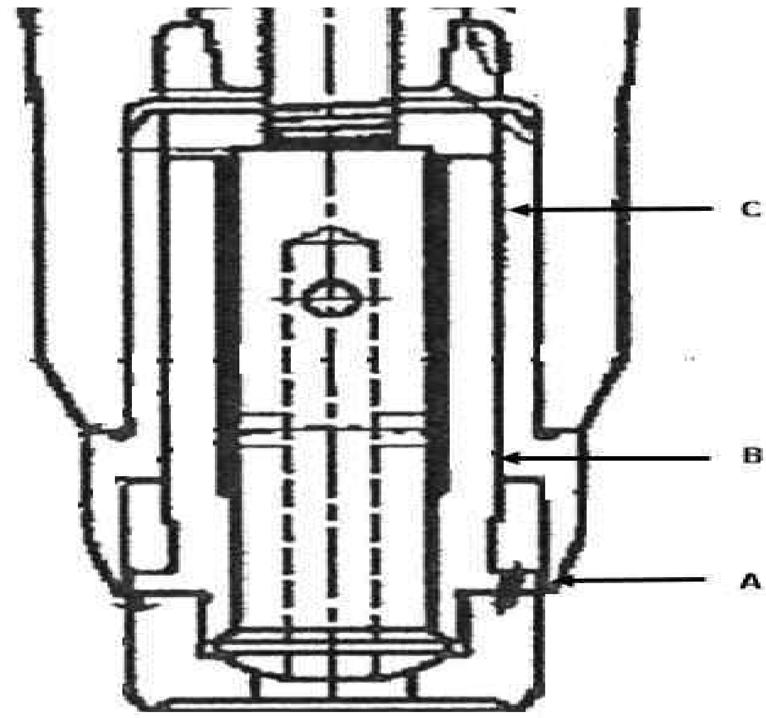
(Westinghouse Datasheet)

Governor Valve

Valve Plug Radial Clearances

Date (m/d/y) 2/28/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial x
Final



		#1		#2		#3		#4	
		0°	90°	0°	90°	0°	90°	0°	90°
A	ID	9.580	9.582	9.584	9.585	9.584	9.583	9.584	9.582
	OD	9.447	9.447	9.453	9.452	9.458	9.458	9.448	9.448
	Min Clr	0.133		0.133		0.125		0.134	
B	ID	7.670	7.670	7.674	7.673	7.668	7.667	7.676	7.676
	OD	7.656	7.656	7.661	7.661	7.665	7.665	7.656	7.657
	Min Clr	0.014		0.013		0.003		0.020	
C	ID	7.666	7.666	7.671	7.666	7.667	7.667	7.666	7.666
	OD	7.658	7.658	7.662	7.662	7.662	7.663	7.658	7.658
	Min Clr	0.008		0.009		0.005		0.008	

Comments	

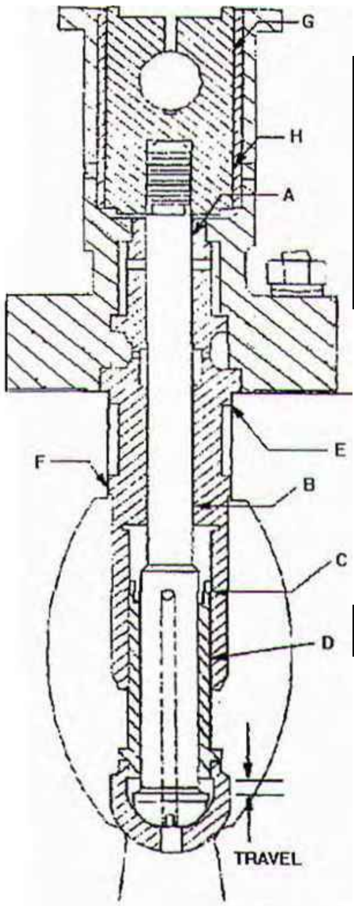
Governor Valve Datasheets

Governor Valve

Clearances

Date(m/d/y) 2/18/2020 Turbine S/N 4465 Prepared by D. Johnson

Units:



Valve # 1

	OD		ID	
	0°	90°	0°	90°
A	2.902	2.902	2.919	2.919
B	2.902	2.902	2.916	2.916
C	Separate Datasheet			
D				
E	13.857	13.858	13.859	13.868
F	13.775	13.778	13.793	13.800
G	NA			
H				

	Clearance	Design Clearance
A	0.018	.016 to .018
B	0.014	.016 to .018
C	Separate Datasheet	
D		
E	0.001	.001 to .004
F	0.015	.001 to .004
G	NA	
H		
Shaft Runout	0.003	0.003
Pilot Travel	0.027	.027 to .032

Inspection Form Template Sheet: (a) Rev 1.0 - 04/04/2017

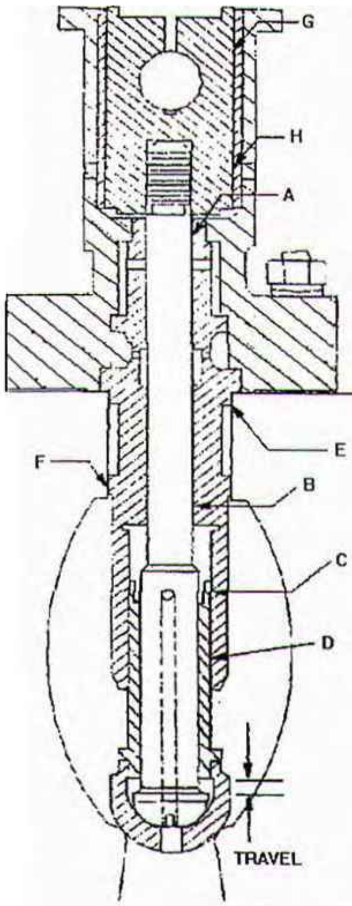
Confidential

Governor Valve Datasheets

Governor Valve

Clearances

Date(m/d/y)	2/18/2020	Turbine S/N	4465	Prepared by	D. Johnson
		Units:			



Valve # 2

	OD		ID	
	0°	90°	0°	90°
A	2.902	2.902	2.919	2.919
B	2.905	2.905	2.916	2.916
C	Separate Datasheet			
D				
E	13.856	13.856	13.860	13.859
F	13.768	13.772	13.790	13.782
G	NA			
H				

	Clearance	Design Clearance
A	0.017	.016 to .018
B	0.011	.016 to .018
C	Separate Datasheet	
D		
E	0.003	.001 to .004
F	0.01	.001 to .004
G	NA	
H		
Shaft Runout	0.003	0.003
Pilot Travel	0.022	.027 to .032

Inspection Form Template Sheet: (a) Rev 1.0 - 04/04/2017

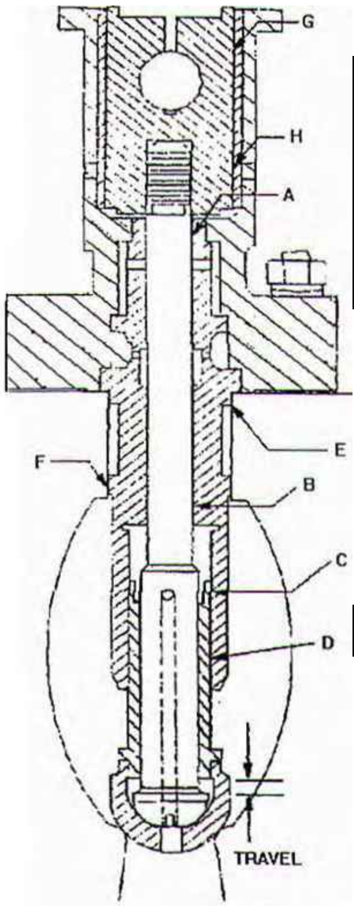
Governor Valve Datasheets

Governor Valve

Clearances

Date(m/d/y) 2/18/2020 Turbine S/N 4465 Prepared by D. Johnson

Units:



Valve # 3

	OD		ID	
	0°	90°	0°	90°
A	2.902	2.902	2.919	2.919
B	2.902	2.902	2.916	2.916
C	Separate Datasheet			
D				
E	13.857	13.856	13.859	13.865
F	13.776	13.778	13.791	13.792
G	NA			
H				

	Clearance	Design Clearance
A	0.017	.016 to .018
B	0.014	.016 to .018
C	Separate Datasheet	
D		
E	0.002	.001 to .004
F	0.013	.001 to .004
G	NA	
H		
Shaft Runout	0.004	0.003
Pilot Travel	0.055	.027 to .032

Confidential

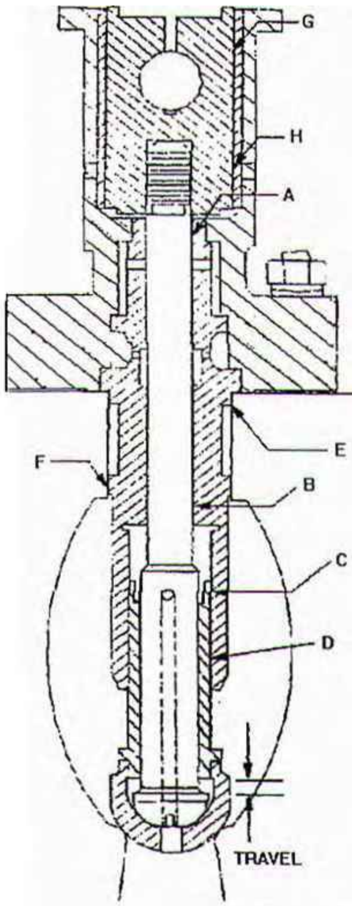
Governor Valve Datasheets

Governor Valve

Clearances

Date(m/d/y)	2/18/2020	Turbine S/N	4465	Prepared by	D. Johnson
		Units:			

Valve # 4



	OD		ID	
	0°	90°	0°	90°
A	2.902	2.902	2.919	2.919
B	2.902	2.902	2.916	2.916
C	Separate Datasheet			
D				
E	13.858	13.860	13.862	13.865
F	13.775	13.778	13.785	13.787
G	NA			
H				

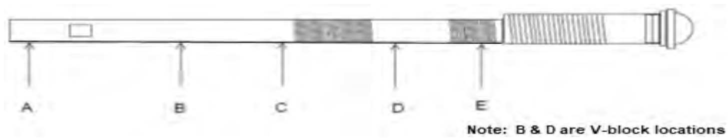
	Clearance	Design Clearance
A	0.017	.016 to .018
B	0.014	.016 to .018
C	Separate Datasheet	
D		
E	0.002	.001 to .004
F	0.007	.001 to .004
G	NA	
H		
Shaft Runout	0.003	0.003
Pilot Travel	0.025	.027 to .032

Inspection Form Template Sheet: (a) Rev 1.0 - 04/04/2017

Governor Valve Datasheets

Stem Runout, GV

Date 3/7/20 Turbine Serial No. 4465 Prepared by D. Johnson



Note: Measurements taken in mils

#1 Governor Valve

	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	0	0	0	0	0
180 deg	-2	1	0	0	0
270 deg	-3	1	0	1	1
360 deg	0	0	0	0	0
Max Runout	3	1	0	1	1

#2 Governor Valve

	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	0	0	0	0	1
180 deg	2	1	0	-1	1
270 deg	2	1	0	-1	0
360 deg	0	0	0	0	0
Max Runout	2	1	0	1	1

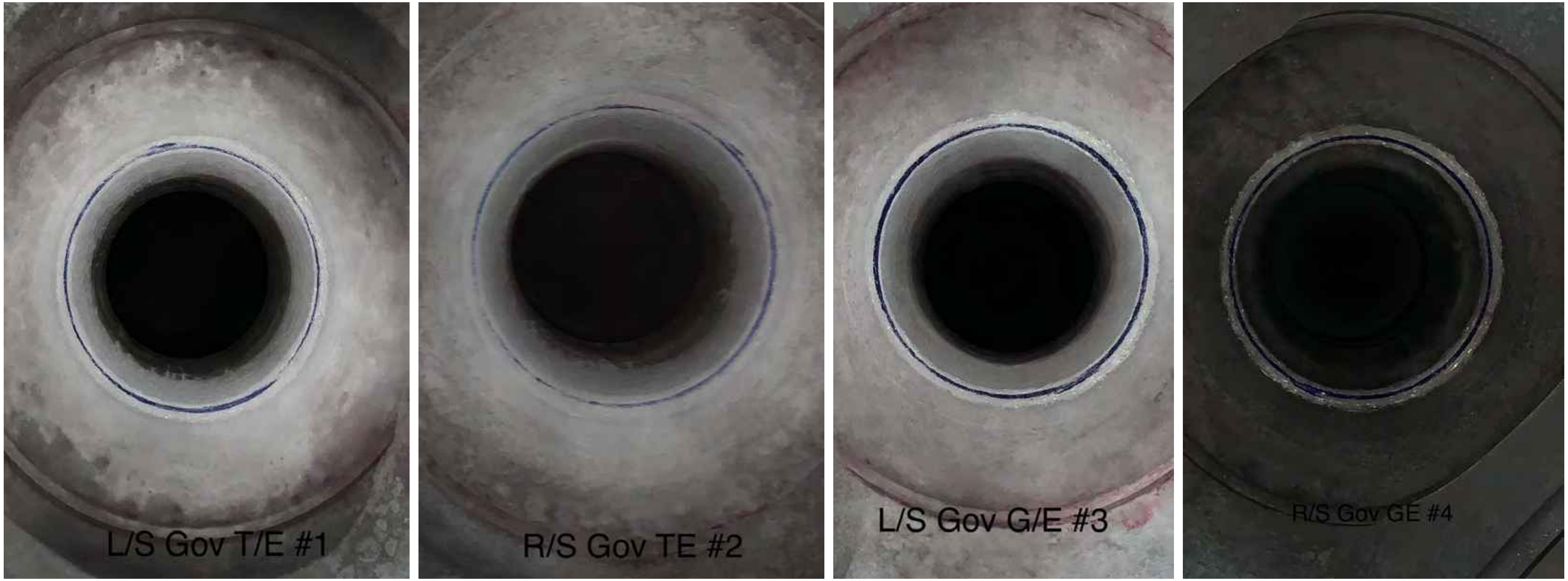
#3 Governor Valve

	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	0	0	0	0	0
180 deg	0	0	0	0	0
270 deg	0	0	0	0	0
360 deg	0	0	0	0	0
Max Runout	0	0	0	0	0

#4 Governor Valve

	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	-1	0	0	1	0
180 deg	-2	0	0	2	1
270 deg	-1	0	0	1	0
360 deg	0	0	1	0	0
Max Runout	2	0	1	2	1

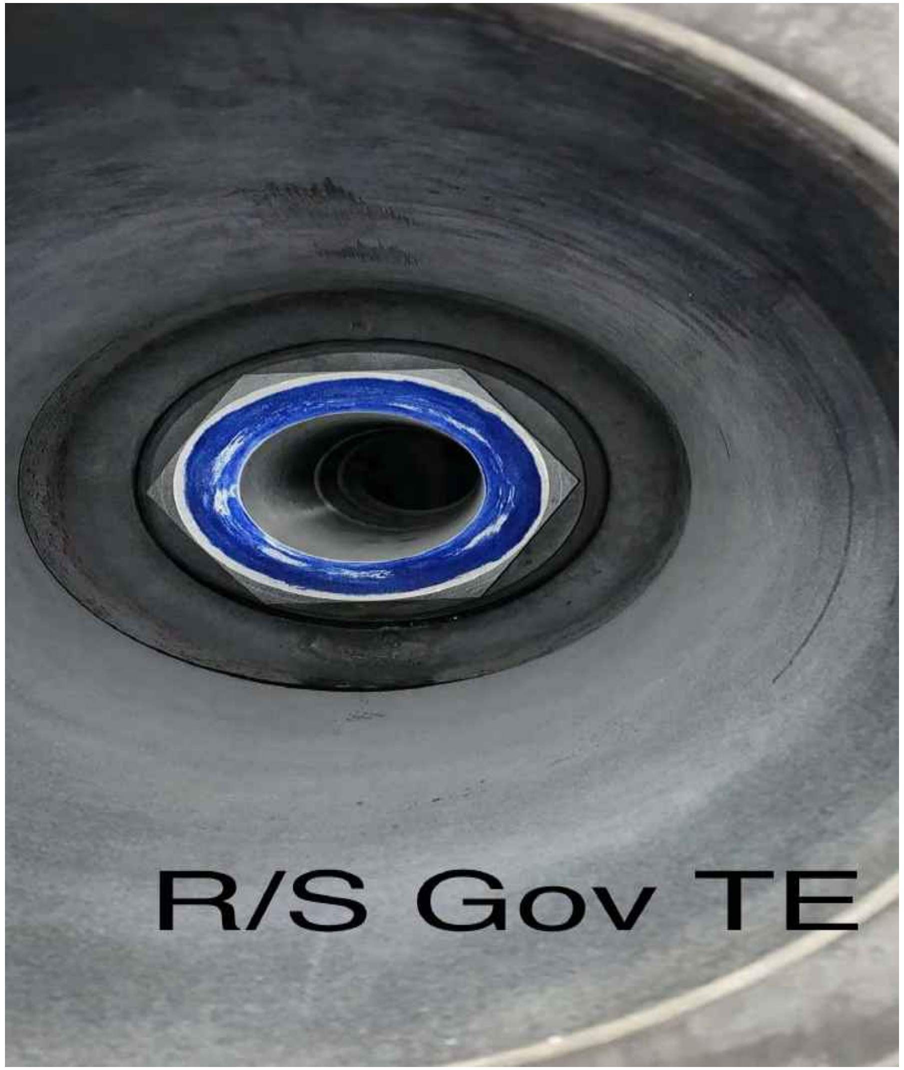
Confidential



Governor Valve Main Seat Contact

Confidential

Governor Valve Backseat Contact



Governor Valve Backseat Contact

Governor Valve Pictures

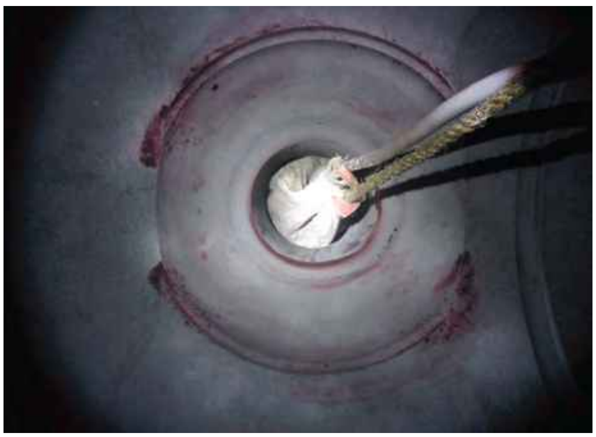
3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

Project: CF-5862
Site: Comanche Generating Station
Date: 2/28-29 2020 Page 219 of 264

CUSTOMER:	FCSS
PO #: 4900073380	SURFACE CONDITION: In Service / Cleaned
MATERIAL DESCRIPTION:	Governor Valves Seats and Corners

Description

- R/S #2 indication on the seat
- L/S #1 indication corner of the seat



NDT Technician: Joop Kraijesteijn MT/PT/VT III, UT II — Lawrence Craig MT/PT/VT II

n/a — n/a

Member of ASNT * SNT - TC - 1A Certified Technicians

3A-NDE-0000P_R9_040419 _Components Report_Continuation Sheet

3.7.3 Reheat Stop Valves

Part Description:

OEM Drawing N26-G13-5207E

There are two reheat stop valves mounted in the reheat inlet lines, one on each side of the machine. Each valve outlets to two intercept valves. The reheat stop valves are flapper style valves that prevent steam from entering the intercept valve admission pipes in the event of a unit trip. The valve is an added safety precaution to prevent unit overspeed if the intercept valves do not positively seal during a trip event. The valve consists of a yoke which is keyed to a shaft that passes through the valve body. A disc is attached to the yoke. The disc has a post in its center that passes through a hole in the yoke. The attachment between the disc and yoke is made by a nut which threads onto the end of the post. Clearance between the yoke and the disc allows the disc to articulate relative to the yoke. The shaft is turned by a "knuckle" arm that is keyed to the shaft and pinned to an actuator on the outboard side of the valve. The shaft is supported on each end by a bushing. On the inboard side of the valve there is a removable bearing end cover which allows steam pressure to be exhausted from the valve body through a pipe and hydraulically actuated trip pilot valve. The trip pilot valve is plumbed into the end of the bearing end cover by a solid welded pipe. On the outboard side of the valve there is an internal shoulder ring which seals steam from exiting around the shaft by sealing axially when the valve is in the open position due to steam pressure exerting force on the inboard end of the shaft. During a trip event the trip pilot valve opens and steam pressure is exhausted to the condenser, almost simultaneously, the actuator releases pressure and the valve is closed by spring tension. The actuator is single acting to open the valve. These valves have a axially acting spring that pulls the shaft toward the outboard side and helps the shoulder ring to seal.

The valves were disassembled, cleaned and inspected. The trip pilot pipe was cut and re-welded by customer personnel. Non-destructive examinations were performed, per the customer supplied NDE matrix. The actuators and spring cans were not disassembled during this outage.

Before the valves were disassembled, the axial shaft clearances were measured and found to be acceptable. Reference measurements were taken on the axial spring assemblies (Detail E) and they were removed. Closed end over travel of the actuators was measured when they were unpinned from the knuckles. Bushing clearances and shaft runouts were measured. Contact checks were performed and seats were lapped as needed for acceptable contact.

The center posts of both valve discs were found to have circumferential indications 360-degrees around the interface point to the discs. The discs (item 2) and yokes (item 6) were shipped out for repair. New disc nuts (item 36) and pins (item 37) were shipped with the assemblies. The disc posts were repaired and contact checks were performed between the underside of the yoke to the discs and between the nut and the upper side of the yoke while offsite. The disc clearance was set and the new nuts were drilled for anti-rotstion pin

3.7.3 Reheat Stop Valves

installation. The anti-rotation pins were installed and staked to retain. The yoke/disc assemblies were returned to site fully assembled.

The right side shaft (item 5) was found to have excessive runout and it was replaced. The outboard shaft bushing (item 10) on the right side valve was found to have a helical indication and it was replaced. The bushing bore in the valve body was honed, the outer diameter of the bushing was machined for 0.004" interference and installed after being submerged in a liquid nitrogen bath. Both of the shoulder rings (item 20) were replaced and lapped to the shafts and bushings for 100% contact.

At reassembly, contact checks were performed between the disc and the seat and accepted by the customer. The valve was reassembled and the axial clearance between the shaft shoulder and was measured and found to be acceptable. Actuators were pinned to the knuckle arms and closed end over travel was measured. The axial spring assemblies were installed and set for proper spring compression per the OEM drawing. The top covers and bearing end covers were installed with new gaskets. Bolting was tightened, per the "Bolt Tightening Procedure" found on the OEM drawing. Any bolting that was not detailed was tightened to 45 ksi. All bolting threads were coated with N-7000 anti-seize.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

Consideration should be given to adding a post to the valve covers that the disc post can seat against when the valve is fully opened. This would hold the disc rigidly against the seat of the yoke and not allow the disc to fret in operation. Similar valves incorporate this arrangement and it's abscence is the likely cause for the circumferential indications found on both discs.

Consideration should be given to adding flanges or unions to the trip pilot pipe so that it does not need to be cut and rewelded each time the valve is disassembled. Discussions were undertaken during this outage, but, this recommendation was not implemented.

At least one new shaft and two new shoulder rings should be on-hand before the next scheduled outage.

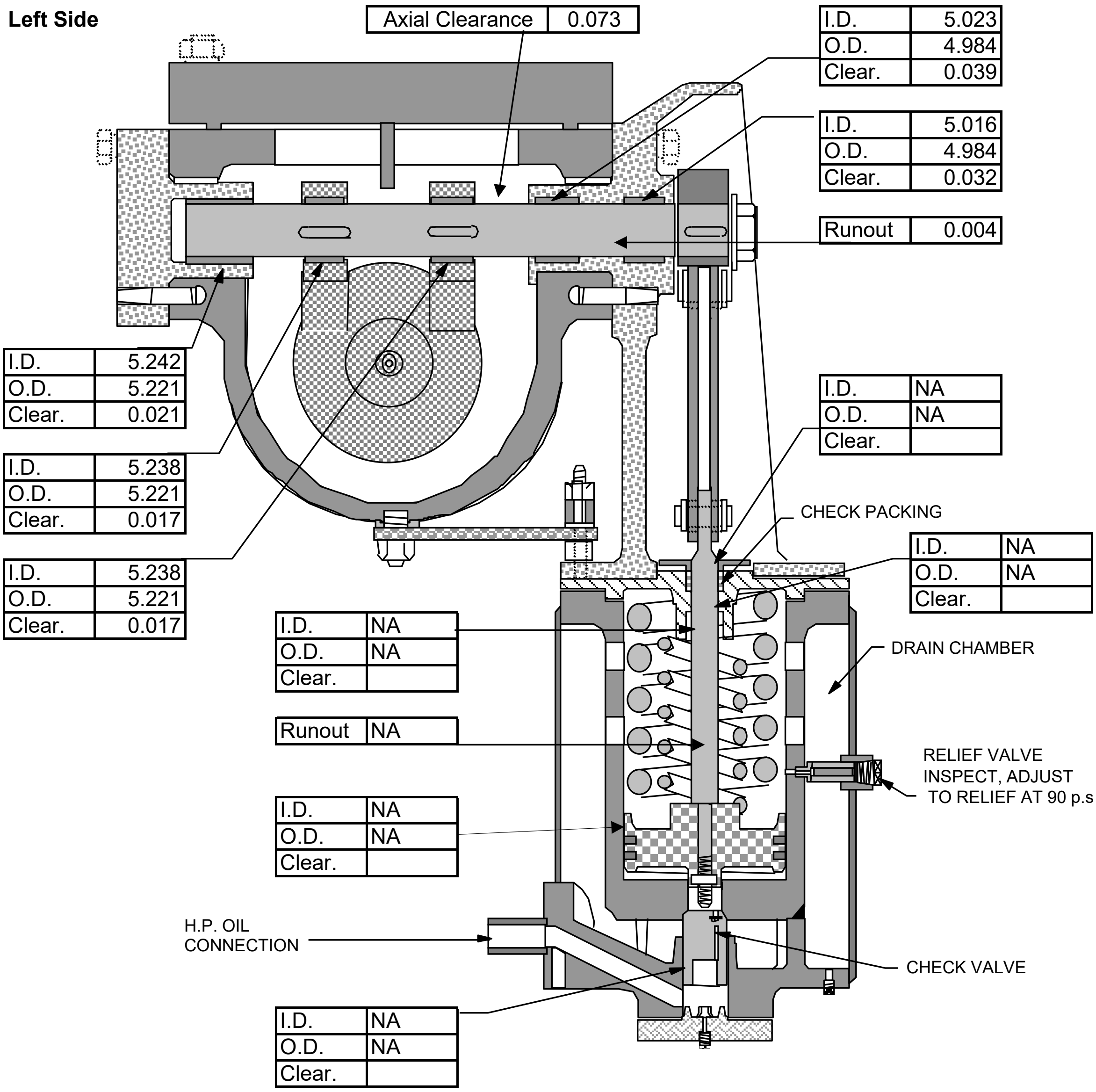
Reheat Stop Valve Datasheets

(Westinghouse Datasheet)

Reheat Stop Valve and Servovomotor (Type 1)

Date	2/15/2020	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	X
				Final	X

Left Side



Comments	

Reheat Stop Valve Datasheets

(Westinghouse Datasheet)

Reheat Stop Valve and Servovomotor (Type 1)

Date	4/4/2020	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	
				Final	X

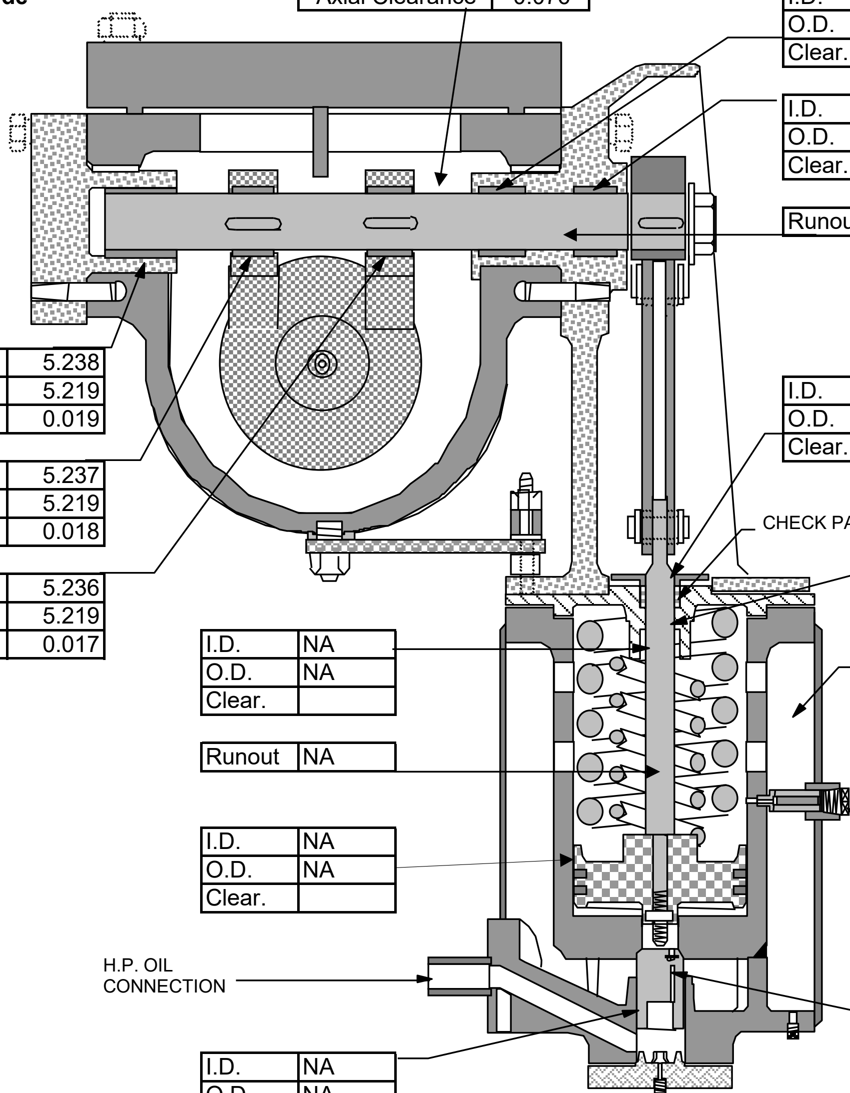
Right Side

Axial Clearance	0.076

I.D.	5.011	New
O.D.	4.982	New
Clear.	0.029	

I.D.	5.011	New
O.D.	4.982	New
Clear.	0.029	

Runout	0.001	New



I.D.	5.238
O.D.	5.219
Clear.	0.019

I.D.	5.237
O.D.	5.219
Clear.	0.018

I.D.	5.236
O.D.	5.219
Clear.	0.017

I.D.	NA
O.D.	NA
Clear.	

I.D.	NA
O.D.	NA
Clear.	

I.D.	NA
O.D.	NA
Clear.	

Runout	NA

I.D.	NA
O.D.	NA
Clear.	

I.D.	NA
O.D.	NA
Clear.	

Comments
* New shaft & outboard bushing

Reheat Stop Valve Datasheets

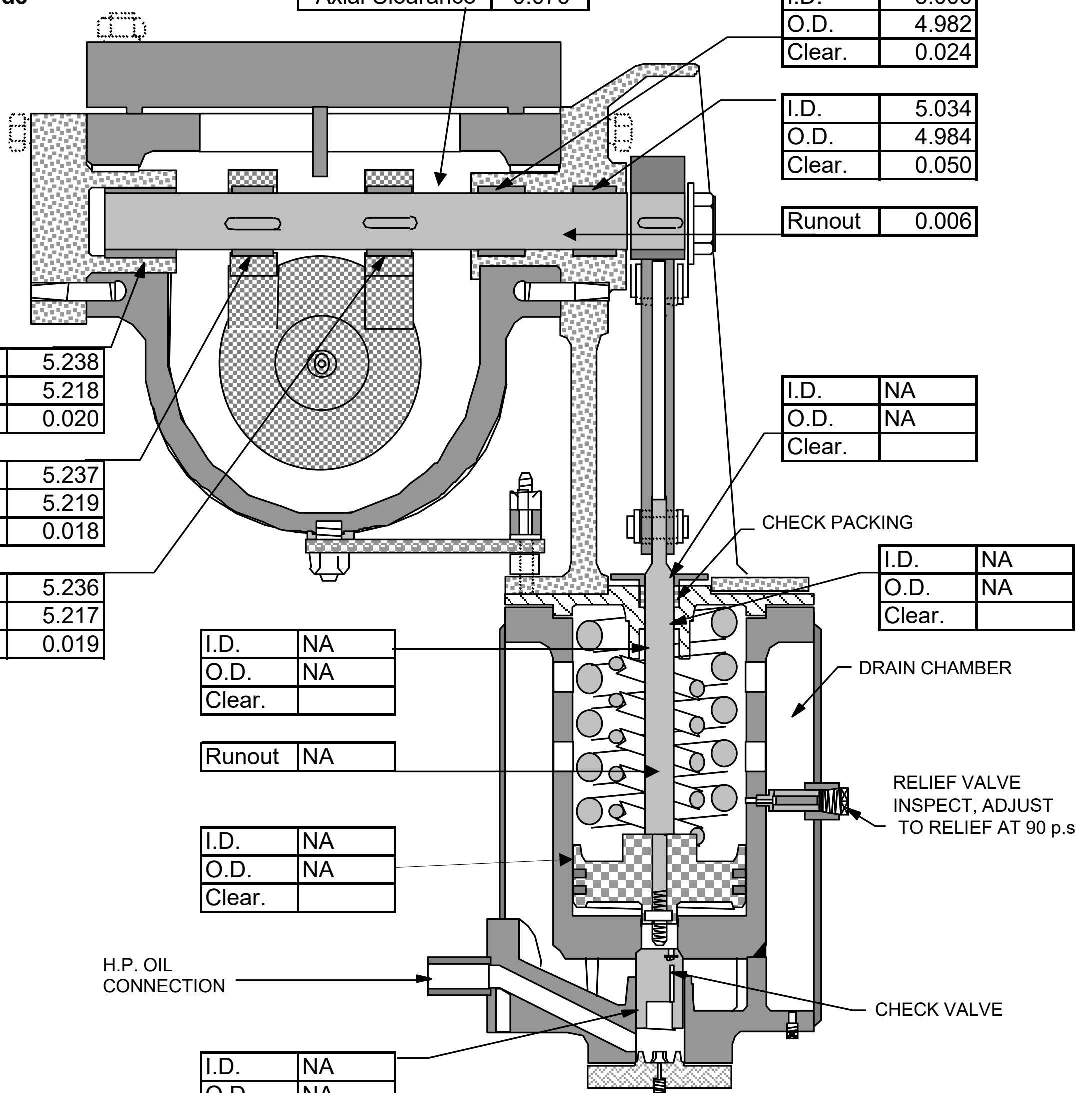
(Westinghouse Datasheet)

Reheat Stop Valve and Servovomotor (Type 1)

Date	2/15/2020	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	X
				Final	

Right Side

Axial Clearance	0.076



I.D.	5.006
O.D.	4.982
Clear.	0.024

I.D.	5.034
O.D.	4.984
Clear.	0.050

Runout	0.006

I.D.	5.238
O.D.	5.218
Clear.	0.020

I.D.	5.237
O.D.	5.219
Clear.	0.018

I.D.	5.236
O.D.	5.217
Clear.	0.019

I.D.	NA
O.D.	NA
Clear.	

I.D.	NA
O.D.	NA
Clear.	

I.D.	NA
O.D.	NA
Clear.	

Runout	NA

I.D.	NA
O.D.	NA
Clear.	

I.D.	NA
O.D.	NA
Clear.	

Comments
* Shaft & outboard bushing replaced

Confidential

Reheat Stop Valve Datasheets

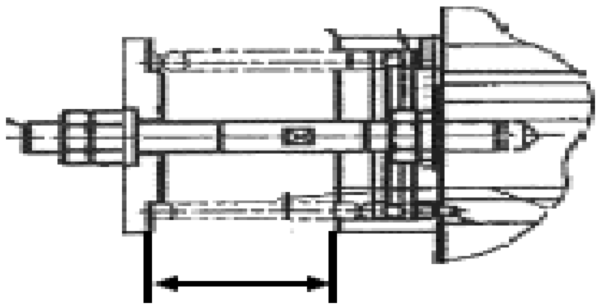
(Westinghouse Datasheet)

Reheat Stop Valve

Spring Plate Reference Measurement

Date (m/d/y) 4/20/20 Turbine Serial Number 4465 Prepared by D. Johnson

Plant Comanche Unit 3 Initial ___ Final x



	Left Side	Right Side
Turbine End	9-1/2"	9-5/8"
Top	9-1/2"	9-5/8"
Bottom	9-1/2"	9-5/8"

Reference Before Compression	6-13/16"	7"	
Reference After Compression	5-11/16"	5-7/8"	Design
Spring Compression	1-1/8"	1-1/8"	1.182"

Comments

Confidential

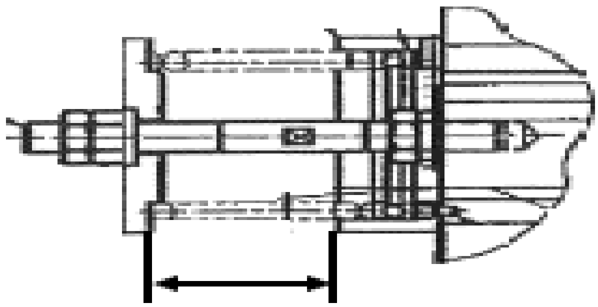
Reheat Stop Valve Datasheets

(Westinghouse Datasheet)

Reheat Stop Valve

Spring Plate Reference Measurement

Date (m/d/y)	2/10/20	Turbine Serial Number	4465	Prepared by	D. Johnson
Plant	Comanche	Unit	3	Initial	x
				Final	

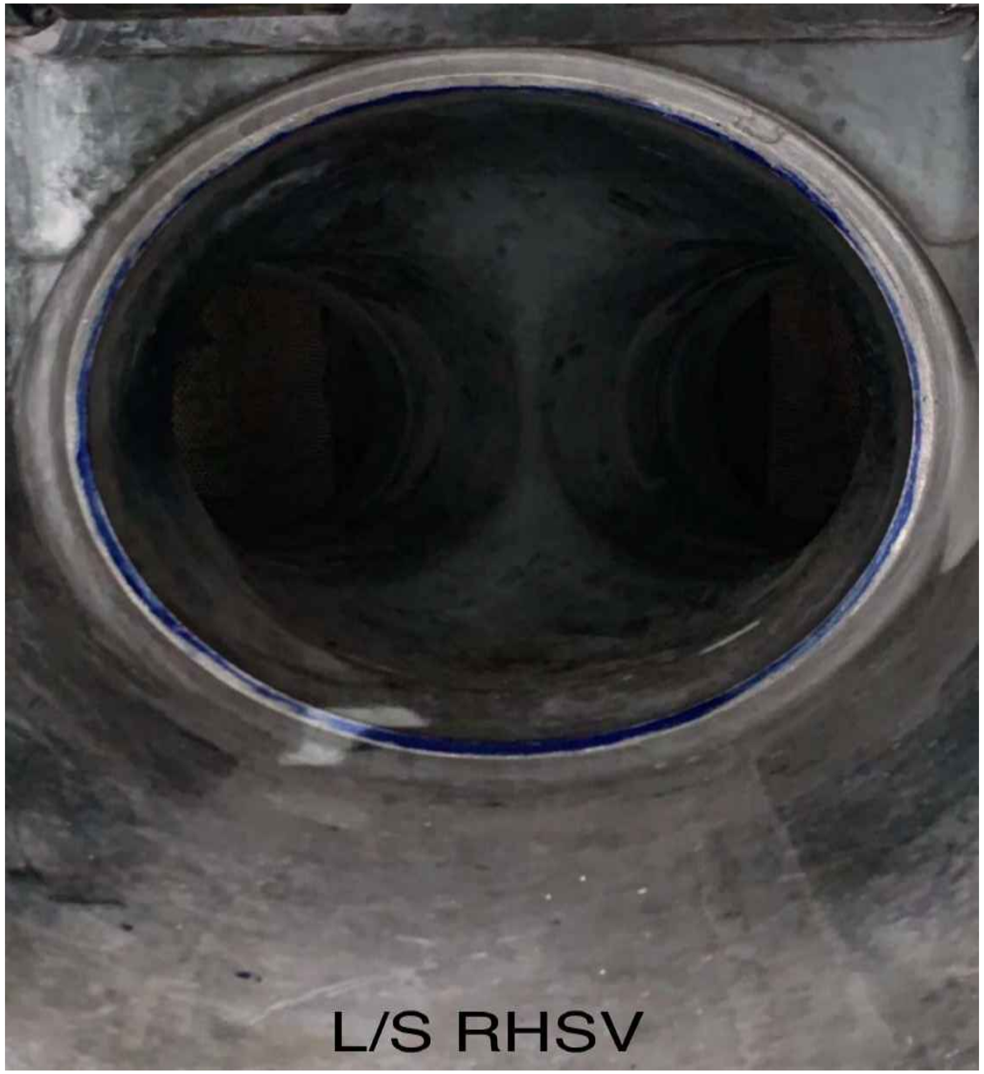


	Left Side	Right Side
Turbine End	9-7/16"	9-5/16"
Top	9-7/16"	9-5/16"
Generator End		
Bottom	9-7/16"	9-5/16"

Comments	

Confidential

Reheat Stop Valve Pictures



Reheat Stop Valve Main Seat Contact

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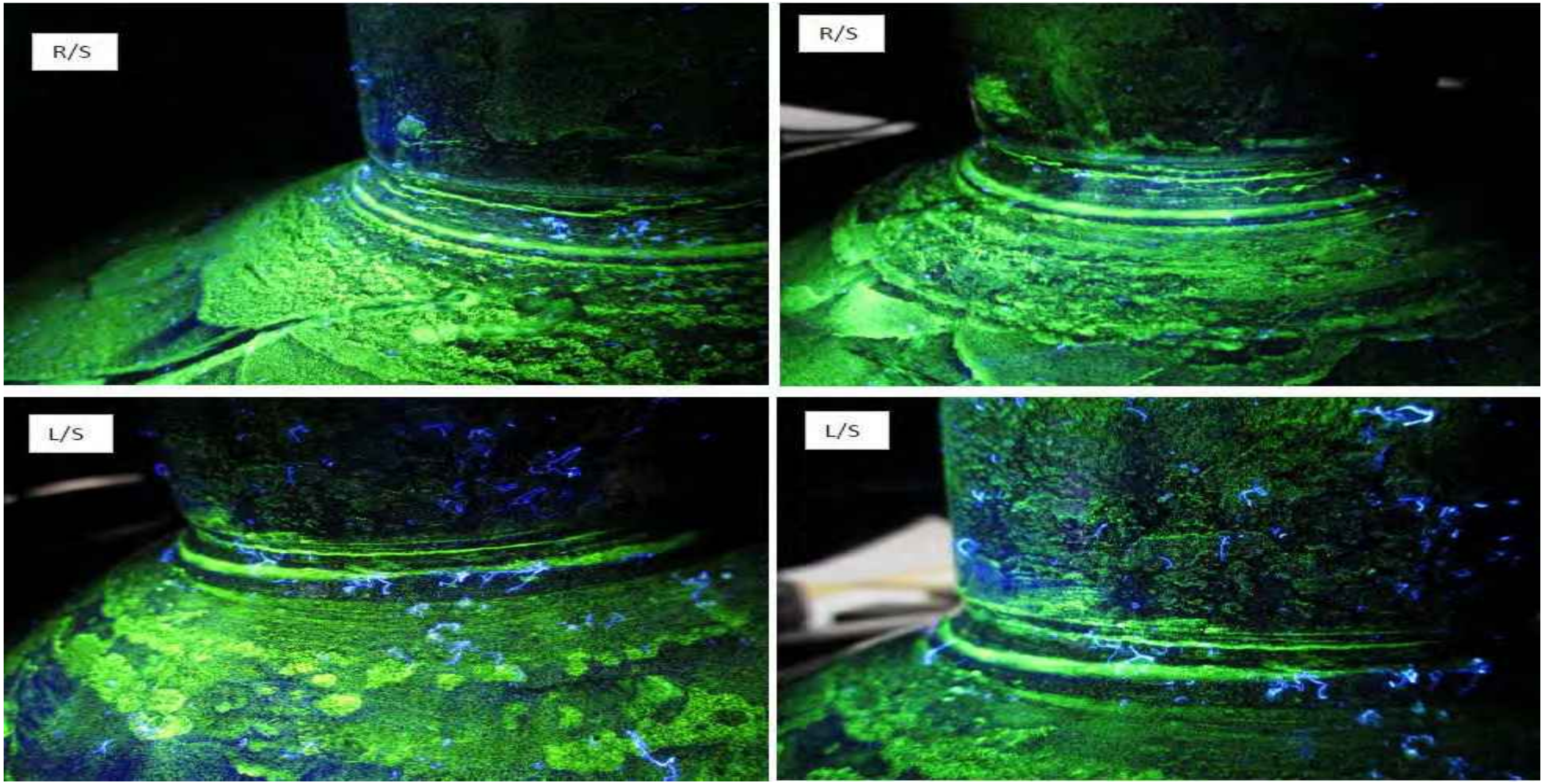
Reheat Stop Valve Pictures

Reheat Stop Valve Shoulder Ring to Bushing Contact

Reheat Stop Valve Pictures



Reheat Stop Valve Disc Post Indications

Confidential

Reheat Stop Valve Pictures

Left Side Reheat Stop Valve Yoke-
Disc Assembly – After Repair

Right Side Reheat Stop Valve Yoke -
Disc Assembly – After Repair

3.7.4 Intercept Valves

Part Description:

OEM Drawing N26-G14-5253E

There are four reheat intercept valves vertically mounted on the reheat inlet lines. Two valves on each side of the machine are inline with each of the reheat stop valves through a "Y" connection. These valves control the admission of steam to the IP section of the turbine. All four of the valves outlet to a common annular chamber in the turbine through the reheat inlet pipes. Two of the pipes are connected by flanged connections to the HP-IP outer cylinder cover and to welded pipes to the outer cylinder base. The valves are directly actuated by single acting EHC powered actuators mounted to the tops of the valve spring cans. The valves are held in the closed position by spring force and opened by the actuators. Each of the valves has a strainer pinned to the valve bonnets at the strainer tops and are seated into groove, machined into the valve bodies, at their bottoms. Piston rings on the valve plugs prevent steam leakage when the valve is in the closed position. Eight pads on each of the valves' plugs outer diameters work to stabilize the plug within the valve body during operation. All replacement parts were supplied by the customer.

The four valves were completely disassembled, cleaned and inspected during this outage. The actuator/spring can assemblies were dismounted from the valve bodies. The spring cans and actuators were not separated or inspected. Grit blasting and non-destructive examinations were performed, per the NDE matrix provided by the customer.

Linear indications were found in the strainer grooves of both the right side outboard and inboard valves. These indications were ground out and should be monitored during future outages. Some bleed out from the dye penetrant examination was found at the bottoms of the anti-swirl dams on both right side valves. These area should be monitored for crack initiation during future outages.

Pilot travels were measured prior to removing the stems from the plugs. Stem runouts and bushing clearances were measured. All pilot travels were found to be acceptable. The left side outboard stem (item 1) was found to be bent and was replaced. Bushings were honed as needed to attain acceptable clearances.

The customer had one spare stem nut (item # not available) that was used to replace the one removed from the left side outboard valve plug. This was the nut that was in worst condition, however, all of these nuts should be replaced during the next outage. When reassembled the new nut was machined as needed for acceptable pilot travel. The nuts were hot peened to retain at assembly.

Consideration should be given altering the configuration of these nuts. The OEM design has four holes into which pins on a hollow shaft are inserted. The hollow shaft slides over the valve stem and the pins engage into the four holes on the top of the nut. The shaft is then turned by use of an impact wrench to loosen the nut. This arrangement is is deficient in

3.7.4 Intercept Valves

several regards. First the pins break/bend regularly, and second, the holes in the top of the nut become deformed. If the nut was configured with an integral hexagonal protrusion at the top, rather than the pin holes, then more force could be efficiently transferred to the nut. This is the arrangement found on the main plug bushing nut on the throttle valves (Dwg N26-G11-5355E item 16).

Contact checks were performed on the stem backseats and main plug seats. The main valve seats were found to be poor condition and were power lapped by Accurate Machine Tool. It was not possible to get 100% on the right side inboard valve due to a deep gouge in the seating area of the integral seat. This gouge should be repaired during the next outage.

The left side inboard valve was found to have no contact between the seat and the plug. Further investigation revealed that the left side outboard valve had a coupling reference measurement (the dimension from the valve body body to the bottom side of the coupling) that was approximately 0.600" less than the inboard valve. Comparisons of these measurements to the right side valves showed that the left side inboard measurement was approximately 0.300" smaller and the left side inboard measurement was approximately 0.300" larger. The couplings of the left side valves were disassembled and the inboard valve was found with no liner (item 26) and the outboard valve was found with two liners. One of the liners was installed in the each of the left side valves at reassembly.

The strainers, that are pinned to the valve balance chambers, were found with uneven gaps to the undersides of the bonnets. Most notably the left side outboard strainer had approximately 1/4" gap on one side and no gap at 180-degrees around the outer circumference of the strainer. The pins were all still in place, meaning that either the pins had broken or there was excessive clearance between the pins and the holes allowing the strainer to move axially . The strainer pins (item 16) of the left side outboard valve were drilled out and the strainer was trued up to bonnet with zero gap about the circumference. New pin holes were drilled, clocked from the existing holes, the holes were reamed and new pins were installed. The new pins were hot peened to retain.

At assembly the new left side outboard valve stem was drilled and reamed to accept a new tapered anti-rotation pin (item 10). The valves were installed into the bodies with new gaskets (item 31), threads of the bolting were coated with N-7000 anti-seize and the bolting was tightened, per the "Bolt Tightening Procedure" table provided on the OEM drawing. All bolting not specified in the table was tightened to a prestress of 45 ksi.

Recommendation Status: Should be planned for next Outage

Recommendation Description:

The right side inboard seat should be weld repaired and lapped during the next outage. The intercept valve body was PMI'ed by the customer and found to be either 434 SS or grade 91 Steel.

3.7.4 Intercept Valves

The indications found in the right side strainer grooves should be monitored for propagation during future outages.

At least two new stems should be on-hand prior to the next outage. These stems are rather small in diameter and bend easily.

Intercept Valve Datasheets

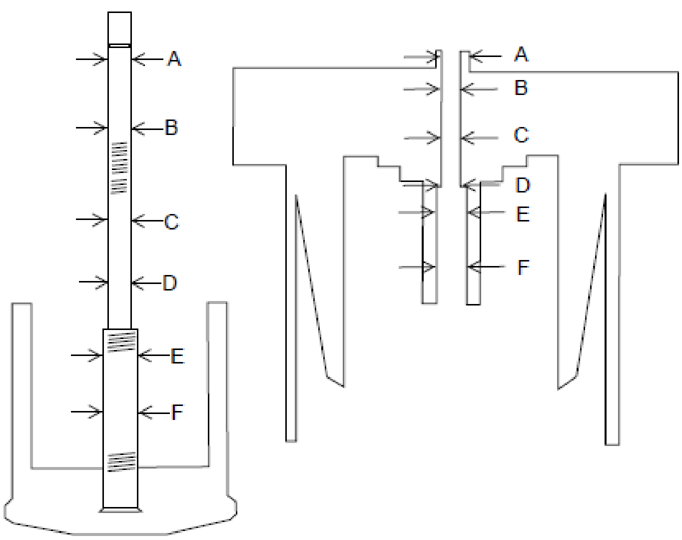
Bushing Clearances, ICV (N54)

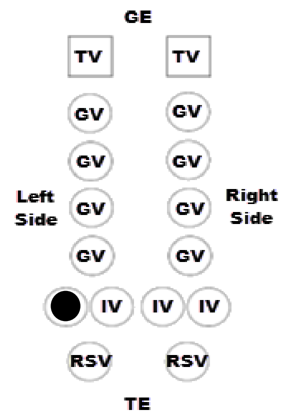
Date(m/d/y) 2/22/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found ◯
As Left X

Select Valve to the Right:

Left Side Outboard





	A	B	C	D	E	F
Shaft 0 deg	1.761	1.761	1.761	1.761	2.507	2.507
Shaft 90 deg	1.761	1.761	1.761	1.761	2.507	2.507
Bushing 0 deg	1.781	1.781	1.781	1.781	2.530	2.530
Bushing 90 deg	1.781	1.781	1.781	1.781	2.529	2.530
min. clearance.	0.020	0.020	0.020	0.020	0.022	0.023
Design	**0.020" - 0.024"**					

TC4F-36-019

Intercept Valve Datasheets

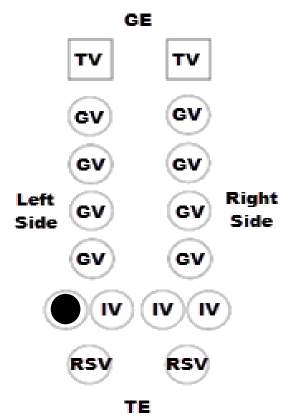
Bushing Clearances, ICV (N54)

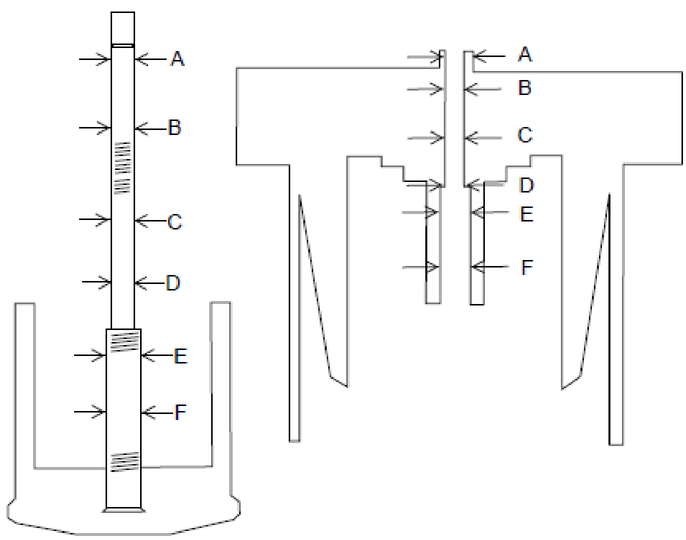
Date(m/d/y) 2/22/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left ◯

Select Valve to the Right:

Left Side Outboard





	A	B	C	D	E	F
Shaft 0 deg	1.760	1.760	1.760	1.760	2.508	2.508
Shaft 90 deg	1.760	1.760	1.760	1.760	2.508	2.508
Bushing 0 deg	1.781	1.781	1.781	1.781	2.530	2.530
Bushing 90 deg	1.781	1.781	1.781	1.781	2.529	2.530
min. clearance.	0.021	0.021	0.021	0.021	0.021	0.022
Design	**0.020" - 0.024"**					

Bent Stem Replaced

TC4F-36-019

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Intercept Valve Datasheets

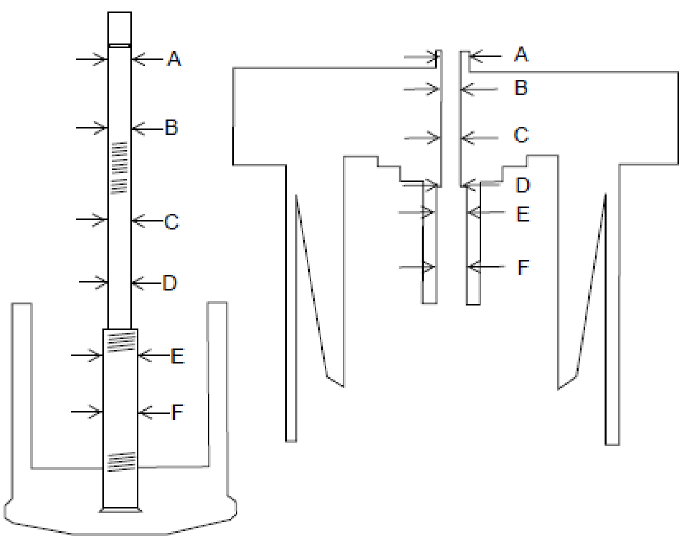
Bushing Clearances, ICV (N54)

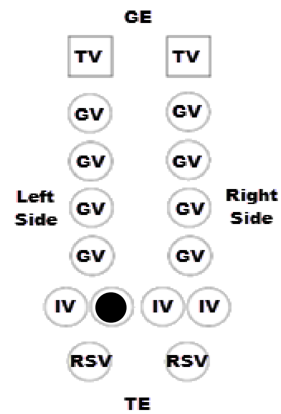
Date(m/d/y) 2/22/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Left Side Inboard





	A	B	C	D	E	F
Shaft 0 deg	1.760	1.760	1.759	1.762	2.508	2.508
Shaft 90 deg	1.760	1.760	1.759	1.762	2.508	2.508
Bushing 0 deg	1.781	1.781	1.781	1.781	2.531	2.529
Bushing 90 deg	1.781	1.781	1.781	1.781	2.529	2.529
min. clearance.	0.021	0.021	0.022	0.019	0.021	0.022
Design	**0.020" - 0.024"**					

TC4F-36-019

Intercept Valve Datasheets

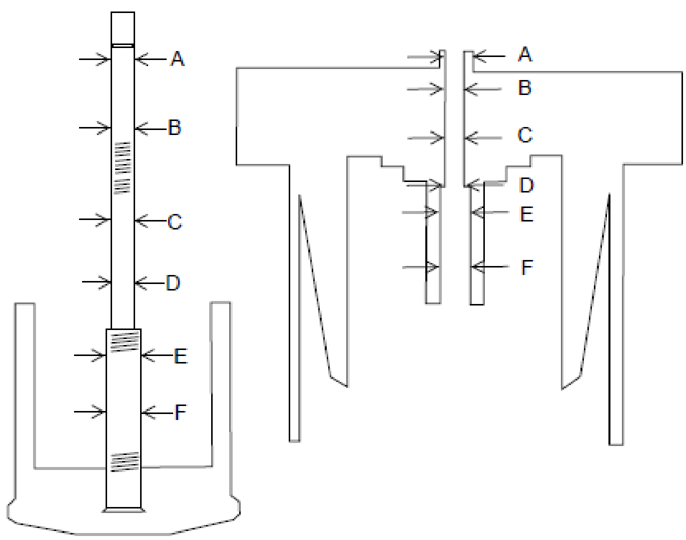
Bushing Clearances, ICV (N54)

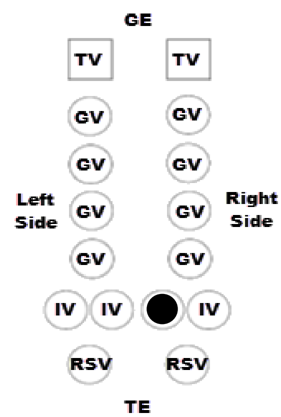
Date(m/d/y) 2/22/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Right Side Inboard





	A	B	C	D	E	F
Shaft 0 deg	1.760	1.760	1.760	1.759	2.507	2.506
Shaft 90 deg	1.760	1.760	1.760	1.759	2.507	2.506
Bushing 0 deg	1.781	1.780	1.781	1.781	2.530	2.529
Bushing 90 deg	1.781	1.780	1.781	1.781	2.529	2.530
min. clearance.	0.021	0.020	0.021	0.022	0.022	0.023
Design	**0.020" - 0.024"**					

TC4F-36-019

Intercept Valve Datasheets

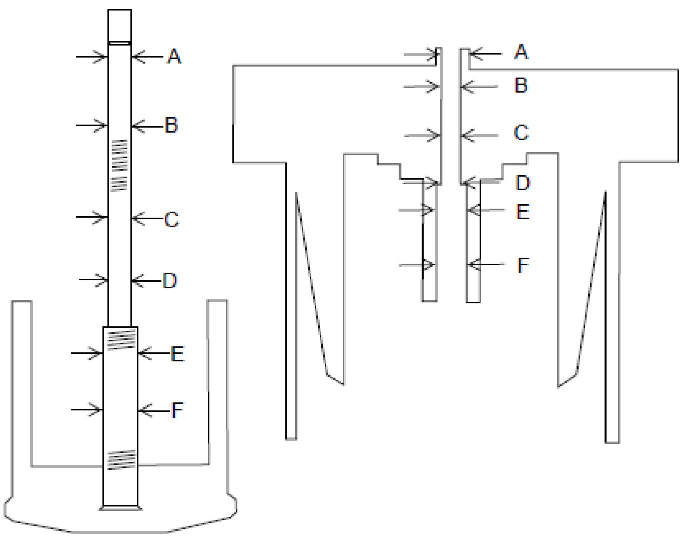
Bushing Clearances, ICV (N54)

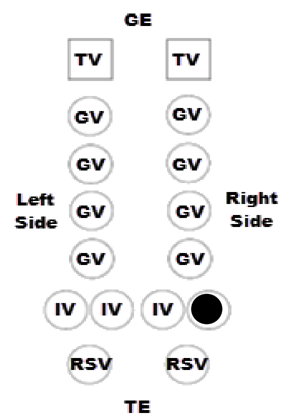
Date(m/d/y) 2/22/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Right Side Outboard





	A	B	C	D	E	F
Shaft 0 deg	1.760	1.760	1.760	1.758	2.506	2.506
Shaft 90 deg	1.760	1.760	1.760	1.758	2.506	2.506
Bushing 0 deg	1.780	1.780	1.778	1.778	2.530	2.529
Bushing 90 deg	1.781	1.780	1.778	1.778	2.529	2.530
min. clearance.	0.020	0.020	0.018	0.020	0.019	0.024
Design	**0.020" - 0.024"**					

TC4F-36-019

Intercept Valve Datasheets

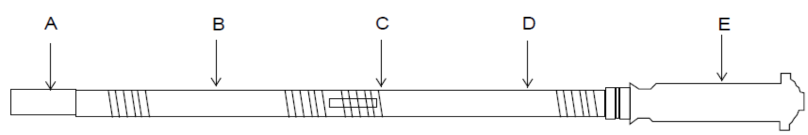
Stem Runout, ICV

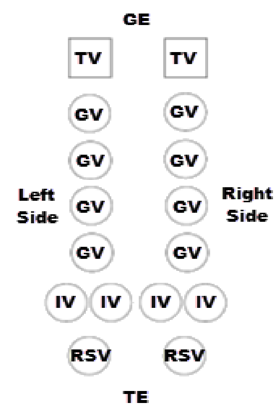
Date(m/d/y) 4/4/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found
As Left X

Select Valve to the Right:

Left Side Outboard





	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	1	0	0	1	1
180 deg	1	0	0	1	0
270 deg	1	0	0	0	0
360 deg	0	0	0	0	0
Max Runout	1	0	0	1	1

Note: Measurements in mils

Note: Maximum Allowable Runout = 0.003"

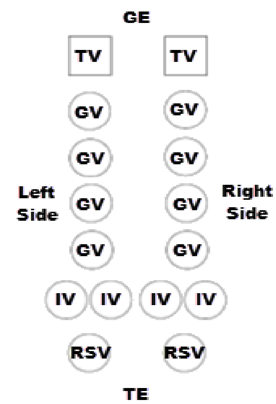
Intercept Valve Datasheets

Stem Runout, ICV

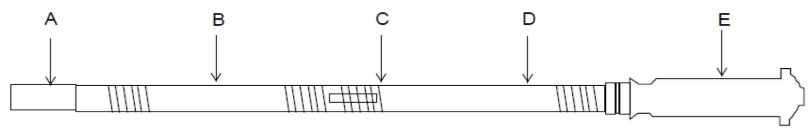
Date(m/d/y) 2/26/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left

Select Valve to the Right:



Left Side Outboard



	A	B	C	D	E
0 deg	o	0	0	0	0
90 deg	-3	4	3	1	-1
180 deg	-3	6	5	2	-1
270 deg	0	0	1	3	0
360 deg	0	0	0	0	0
Max Runout	3	6	5	3	1

Note: Measurements in mils

Note: Maximum Allowable Runout = 0.003"

Intercept Valve Datasheets

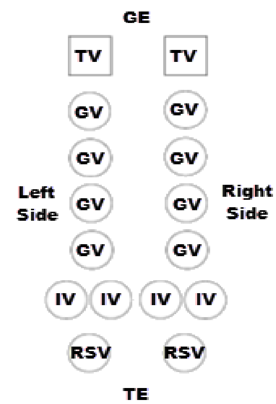
Stem Runout, ICV

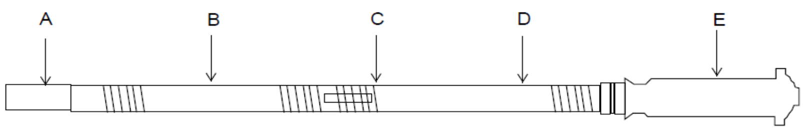
Date(m/d/y) 2/26/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Left Side Inboard





	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	0	0	0	0	1
180 deg	0	0	0	0	1
270 deg	0	1	1	0	0
360 deg	0	0	0	0	0
Max Runout	0	1	1	0	1

Note: Measurements in mils

Note: Maximum Allowable Runout = 0.003"

Confidential

Intercept Valve Datasheets

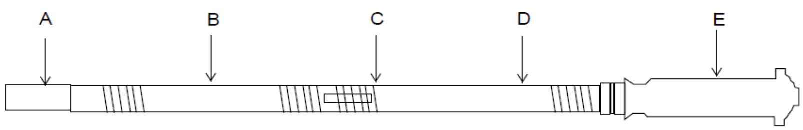
Stem Runout, ICV

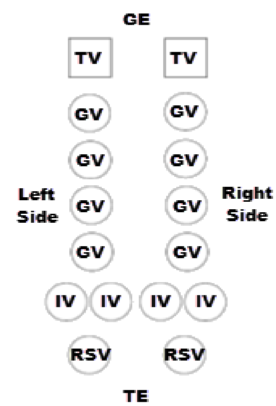
Date(m/d/y) 2/26/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Right Side Inboard





	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	0	1	1	-2	1
180 deg	1	0	0	0	-2
270 deg	2	-1	-1	1	1
360 deg	0	0	0	0	0
Max Runout	2	2	2	3	3

Note: Measurements in mils

Note: Maximum Allowable Runout = 0.003"

Intercept Valve Datasheets

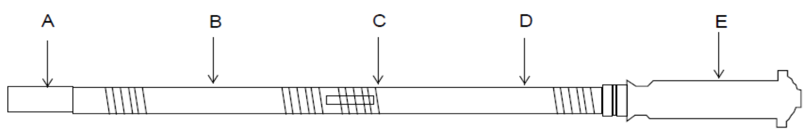
Stem Runout, ICV

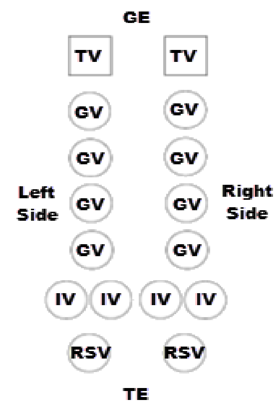
Date(m/d/y) 2/26/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Right Side Outboard





	A	B	C	D	E
0 deg	0	0	0	0	0
90 deg	1	0	0	1	2
180 deg	2	0	-1	1	2
270 deg	2	0	-1	0	1
360 deg	0	0	0	0	0
Max Runout	2	0	1	1	2

Note: Measurements in mils

Note: Maximum Allowable Runout = 0.003"

Intercept Valve Datasheets

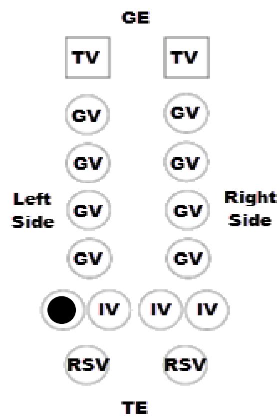
Clearances, ICV

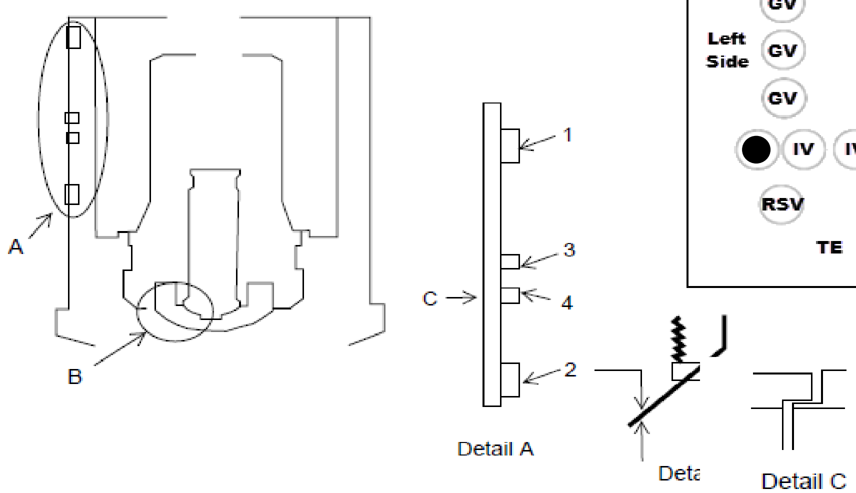
Date(m/d/y) 2/26/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Left Side Outboard





Guide Post to	Meas. Number			
Bushing Clearance	1	2		
Bushing ID 0 -180	19.000	18.995		
Guide Post 0-180	18.929	18.931		
Clearance	0.071	0.064		
Bushing ID 90-270	19.000	18.996		
Guide Post 90-270	18.930	18.924		
Clearance	0.070	0.045		
Design	**0.047"-0.053"**			
Meas.	Ring Side Gap (Axial Clearance			
Number	0 deg	90 deg	180 deg	270 deg
3	0.015	0.016	0.015	0.016
4	0.014	0.014	0.014	0.015
Design	**0.020" - 0.024"**			
Seal Ring Gap				
	Ring Gap		Ring Orientation	
3	1.910			
4	2.008			
Design	Uncompressed reference			
Pilot Valve Clearance				
Meas. 5	0.116		0.135 after machining new stem nut	
Design	**0.133"-0.149"**			

TC4F-36-018 Balance Chamber Clearances, ICV - LS OB

Intercept Valve Datasheets

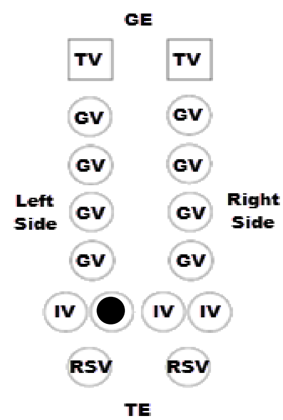
Clearances, ICV

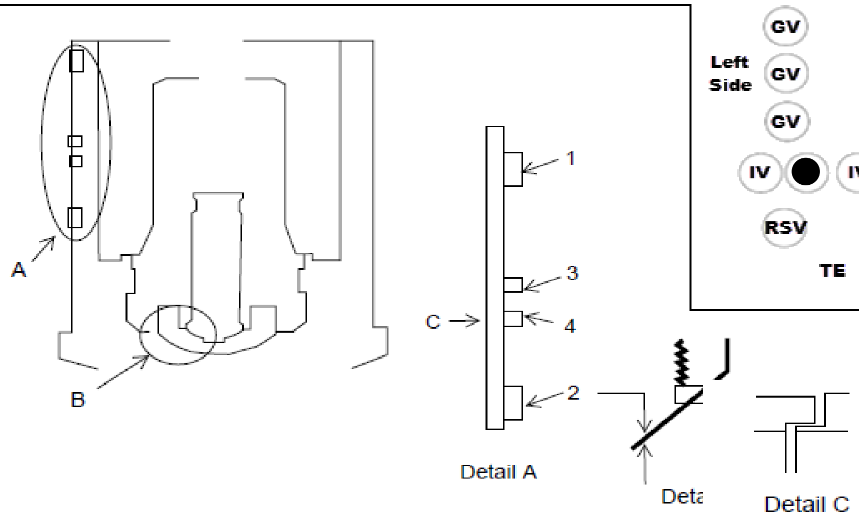
Date(m/d/y) 2/26/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Left Side Inboard





Guide Post to	Meas. Number	
Bushing Clearance	1	2
Bushing ID 0 -180	18.997	18.995
Guide Post 0-180	18.903	18.970
Clearance	0.094	0.025
Bushing ID 90-270	18.997	18.995
Guide Post 90-270	18.900	18.968
Clearance	0.097	0.027
Design	**0.047"-0.053"**	

Meas.	Ring Side Gap (Axial Clearance			
Number	0 deg	90 deg	180 deg	270 deg
3	0.02	0.02	0.017	0.019
4	0.018	0.019	0.018	0.017
Design	**0.020" - 0.024"**			

Seal Ring Gap		
	Ring Gap	Ring Orientation
3	1.922	
4	1.859	
Design	Uncompressed reference	

Pilot Valve Clearance	
Meas. 5	0.133
Design	**0.133"-0.149"**

Intercept Valve Datasheets

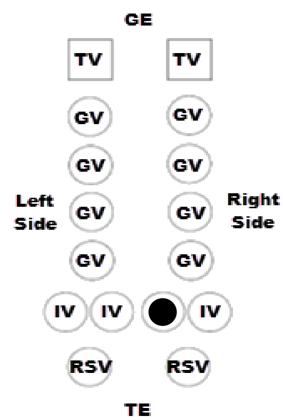
Clearances, ICV

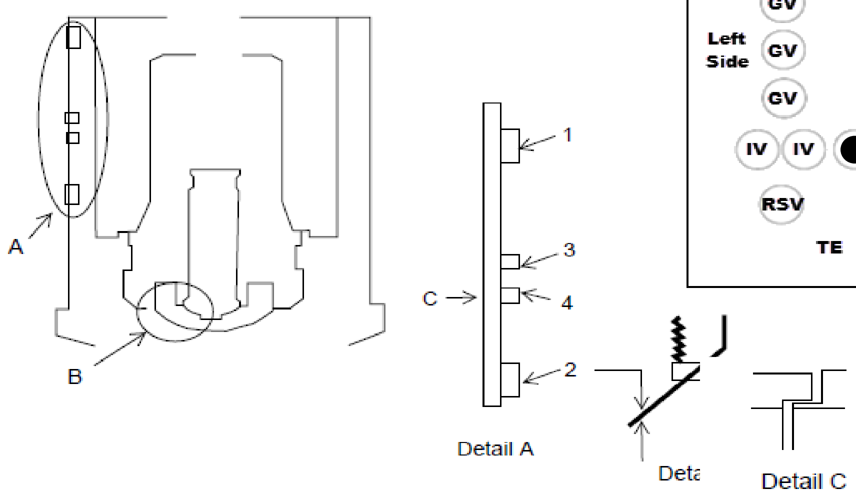
Date(m/d/y) 2/27/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Right Side Inboard





Guide Post to	Meas. Number			
Bushing Clearance	1	2		
Bushing ID 0 -180	18.983	18.988		
Guide Post 0-180	18.927	18.960		
Clearance	0.056	0.028		
Bushing ID 90-270	18.983	18.988		
Guide Post 90-270	18.918	18.950		
Clearance	0.065	0.038		
Design	**0.047"-0.053"**			
Meas.	Ring Side Gap (Axial Clearance)			
Number	0 deg	90 deg	180 deg	270 deg
3	0.016	0.017	0.016	0.016
4	0.015	0.014	0.014	0.016
Design	**0.020" - 0.024"**			
Seal Ring Gap				
	Ring Gap		Ring Orientation	
3	1.907			
4	1.888			
Design	Uncompressed reference			
Pilot Valve Clearance				
Meas. 5	0.127			
Design	**0.133"-0.149"**			

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Intercept Valve Datasheets

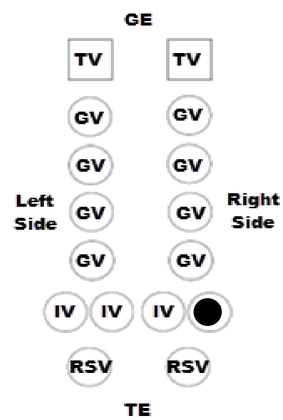
Clearances, ICV

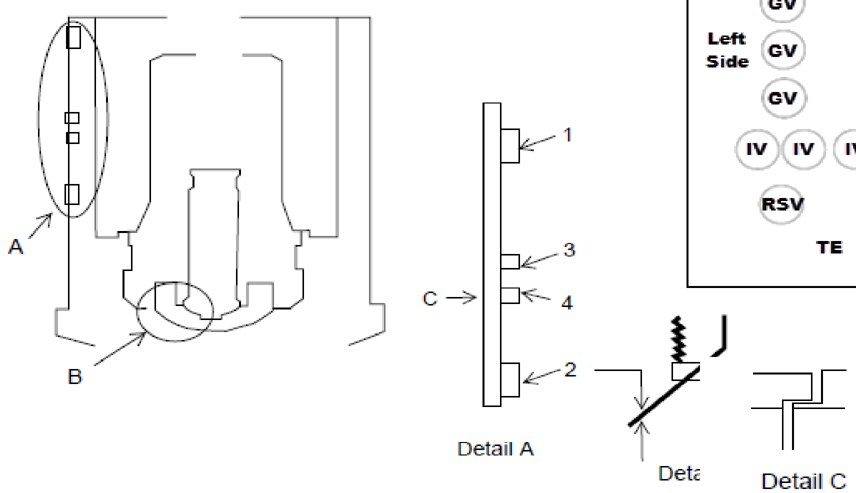
Date(m/d/y) 2/26/20 Turbine Serial No. 4465 Prepared by D. Johnson

As Found X
As Left X

Select Valve to the Right:

Right Side Outboard



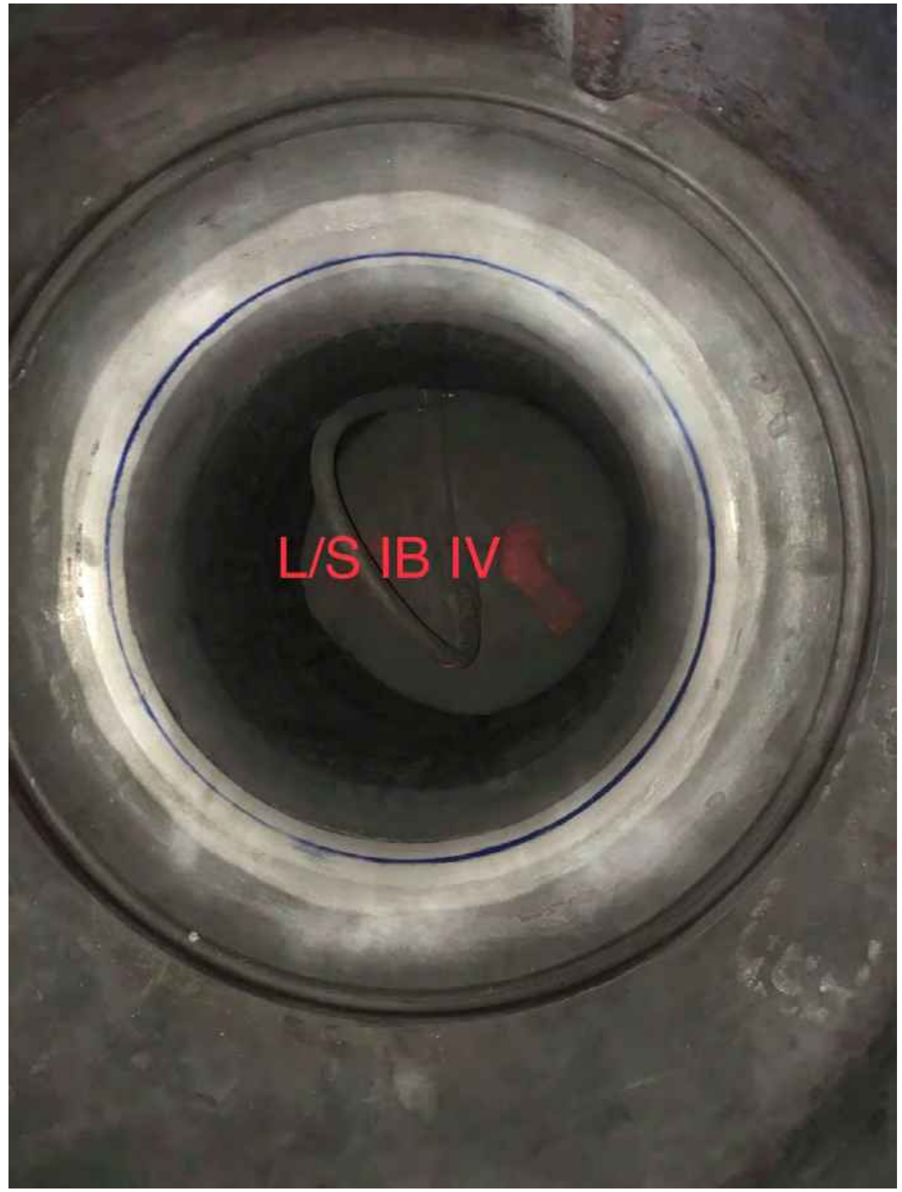


Guide Post to	Meas. Number			
Bushing Clearance	1	2		
Bushing ID 0 -180	18.973	18.989		
Guide Post 0-180	18.934	18.943		
Clearance	0.039	0.046		
Bushing ID 90-270	18.973	18.989		
Guide Post 90-270	18.928	18.959		
Clearance	0.045	0.030		
Design	**0.047"-0.053"**			
Meas.	Ring Side Gap (Axial Clearance)			
Number	0 deg	90 deg	180 deg	270 deg
3	0.013	0.015	0.014	0.014
4	0.016	0.014	0.015	0.014
Design	**0.020" - 0.024"**			
Seal Ring Gap				
	Ring Gap		Ring Orientation	
3	1.870			
4	1.936			
Design	Uncompressed reference			
Pilot Valve Clearance				
Meas. 5	0.119			
Design	**0.133"-0.149"**			

TC4F-36-018 Balance Chamber Clearances, ICV - RS OB

Confidential

Intercept Valve Pictures



Confidential

Intercept Valve Pictures

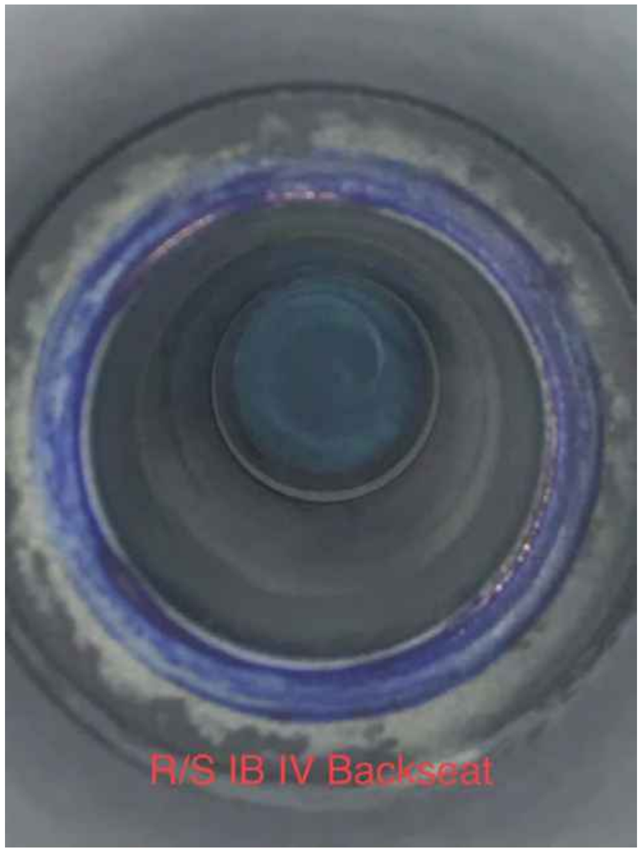
Confidential

Intercept Valve Pictures

Right Side Inboard Intercept Valve Seat Damage

Confidential

Intercept Valve Pictures



Confidential

Intercept Valve Pictures

Right Side Outboard
Intercept Valve Body
PT Indications

Confidential

Intercept Valve Pictures

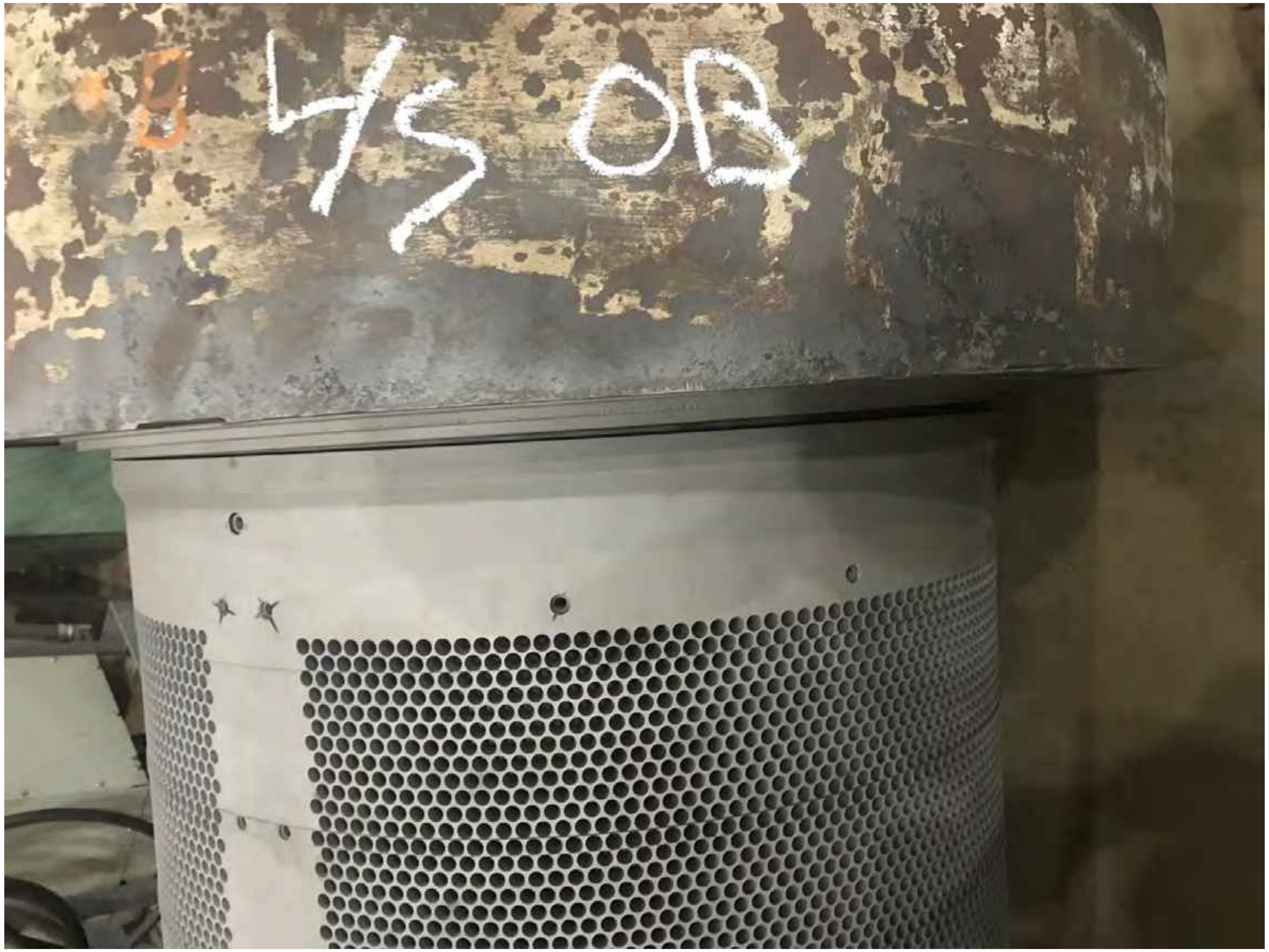
Right Side Inboard
Intercept Valve Body
PT Indications

Intercept Valve Pictures

Right Side Inboard
Intercept Valve Strainer Groove
PT Indications

Confidential

Intercept Valve Pictures



Left Side Outboard Intercept Valve – Strainer Gap

3.7.5 Non-return Valves

Part Description:

12 extraction Non return valves were inspected this outage. Repairs were made as needed. Replacement bonnet gaskets were provided by the customer. Free operation of valve while not connected to the actuator, contact checks and close out inspections were conducted with a customer representative. All inspections were signed off in the QCP by a FieldCore and customer representative.

NRV 3119-01 to feedwater heater 7B is located on the third floor. All inspections of this valve were satisfactory as found. A new Flexitallic bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3102-02 to deaerator is located on the sixth floor. Upon inspection of this valve the anti-rotation pin in the disk retaining nut was found to be missing. The disk nut was tightened and a new anti-rotation pin hole was drilled and new anti-rotation pin installed. All other inspections were satisfactory. A new Grafoil bonnet gasket was installed and the 1 1/8" bonnet studs were torqued to 533 foot-pounds .

NRV 3110-01 to 6A and 6B HP heaters is located on the second floor. All inspections of this valve were satisfactory as found. A new Grafoil bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3116-01 to 7A HP heater is located on the third floor. All inspections of this valve were satisfactory as found. A new Flexitallic bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3122-01 to 8A and 8B HP heaters is located on the second floor. Upon inspection of this valve both the disk retaining nut and anti-rotation pin were found to be missing. The disk nut was replaced and a new anti-rotation pin hole was drilled and new anti-rotation pin installed. All other inspections were satisfactory. A new Grafoil bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3011-01 to deaerator is located on the second floor under the grating. Upon inspection of this valve the weighted arm on the actuator was found with a broken fastener and was out of its operating position. The customer provided a replacement fastener and the weighted arm was returned to its operating position. The packing follower was also found to have minimal adjustment left. The customer provided new packing and the old packing was removed and replaced with new. Upper limit switch on actuator arm was found to be missing. This finding was reported to customer for follow up by station personnel. All other inspections were satisfactory. A new Grafoil bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3023-01 to cold reheat is located on the second floor. Upon inspection of this valve the packing follower was found to have minimal adjustment left. The customer provided new

3.7.5 Non-return Valves

packing and the old packing was removed and replaced with new. All other inspections were satisfactory. A new Flexitallic bonnet gasket was installed and the 2" bonnet studs were torqued to 3300 foot-pounds.

NRV 3024-01 to cold reheat is located on the second floor. Upon inspection of this valve one bonnet stud was found to have minor thread damage. Damage was repaired by chasing threads with a die nut. Upper limit switch on actuator arm was found to be missing. This finding was reported to customer for follow up by station personnel. All other inspections were satisfactory. A new Flexitallic bonnet gasket was installed and the 2" bonnet studs were torqued to 3300 foot-pounds.

NRV 3094-02 to LP heater number 4 is located on the second floor. Upon inspection of this valve the packing follower was found to have minimal adjustment left. The customer provided new packing and the old packing was removed and replaced with new. All other inspections were satisfactory. A new Grafoil bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3129-01 to boiler feed pump turbine is located on the second floor. All inspections of this valve were satisfactory as found. A new Flexitallic bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3107-01 to boiler feed pump turbine is located on the second floor. Upon inspection of this valve the disk would not close all the way to valve seat. It was determined that the disk arm and disk were assemble wrong with a spacer out of place. The spacer was in between the disk and disk arm and should be between the disk arm and disk retaining nut. The disk was removed from the arm and reassembled with the spacer in its proper orientation. A new anti-rotation pin was provided by the customer and installed in the disk retaining nut. The contact check was performed after reassembly and was satisfactory. All other inspections were satisfactory. A new Grafoil bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

NRV 3098-02 to LP heater number 3 is located on the second floor. Upon inspection of this valve the packing follower was found to have minimal adjustment left. The customer provided new packing and the old packing was removed and replaced with new. All other inspections were satisfactory. A new Grafoil bonnet gasket was installed and the 1 3/8" bonnet studs were torqued to 1020 foot-pounds.

Check Valve Inspection

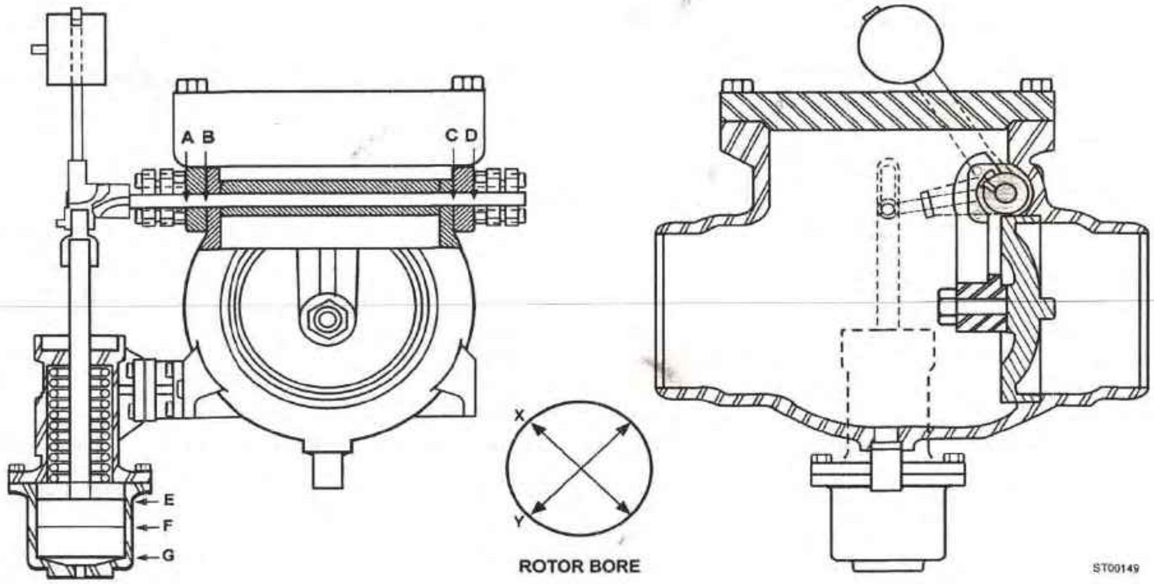
Extraction Non-Return

Date (m/d/y) 4/6/20 Turbine Serial No. ____________ Prepared by GARY + SAM

Location ____________

INSPECTIONS & CHECKS				
Seat	(Inspect)	X		OK
Seat Contact	(Paper Check)	X		OK
Disk	(Inspect)	X		OK
Packing	(Inspect)	X		C
Disk nut pin	(Inspect)	X	Repack	OK
Gasket surface	(Inspect)	X		OK
Weighted Lever	(Inspect)	X		OK
Linkage	(Inspect)	X		OK

CODE	
X	Work Carried Out
N	Not Done
NA	Not Applicable
C	See Comments
V	Visual Inspection



Comments
#3023-01 C ← PACKING FOLLOWER HAS 1/4" TRAVEL SHOWS SMALL SIGNS OF LEAKAGE (PROBABLY OLD)

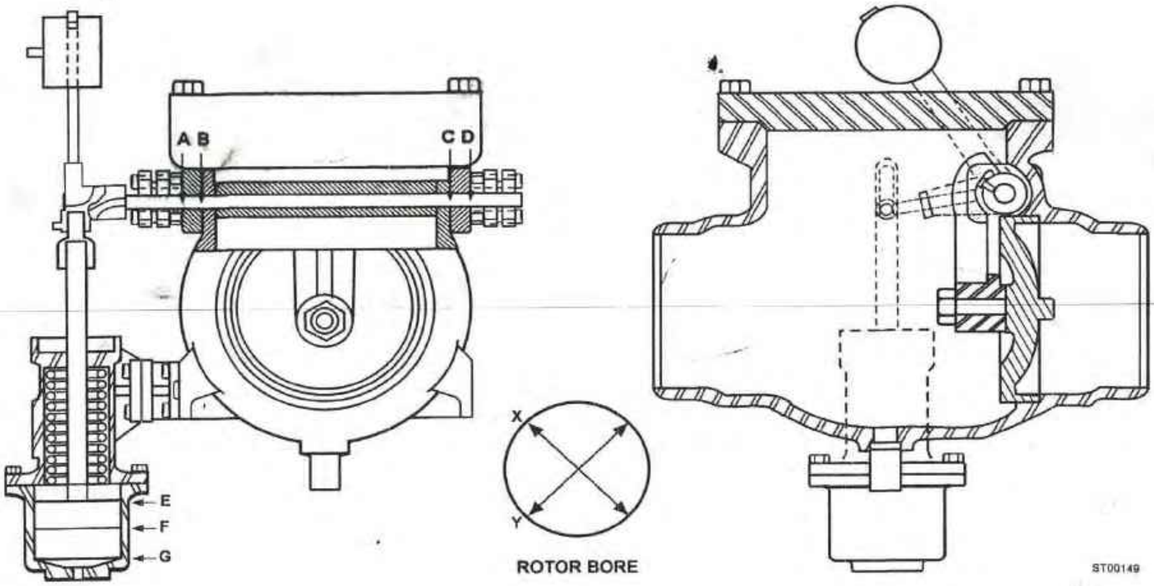
Check Valve Inspection

Extraction Non-Return

Date (m/d/y) 4/1/20 Turbine Serial No. ____________ Prepared by GARY + SAM

Location ____________

INSPECTIONS & CHECKS					CODE	
Seat	(Inspect)	X		OK	X	Work Carried Out
Seat Contact	(Paper Check)	X		OK	N	Not Done
Disk	(Inspect)	X		OK	NA	Not Applicable
Packing	(Inspect)	X		C	C	See Comments
Disk nut pin	(Inspect)	X	Repack	OK	V	Visual Inspection
Gasket surface	(Inspect)	X		OK		
Weighted Lever	(Inspect)	X		C		
Linkage	(Inspect)	X		C		



Comments
#3011-01 C= WEIGTED LEVER FOUND OUT OF POSITION 180°, BROKEN BOLTS, LIMIT SWITCHES NO FUNCTIONAL,

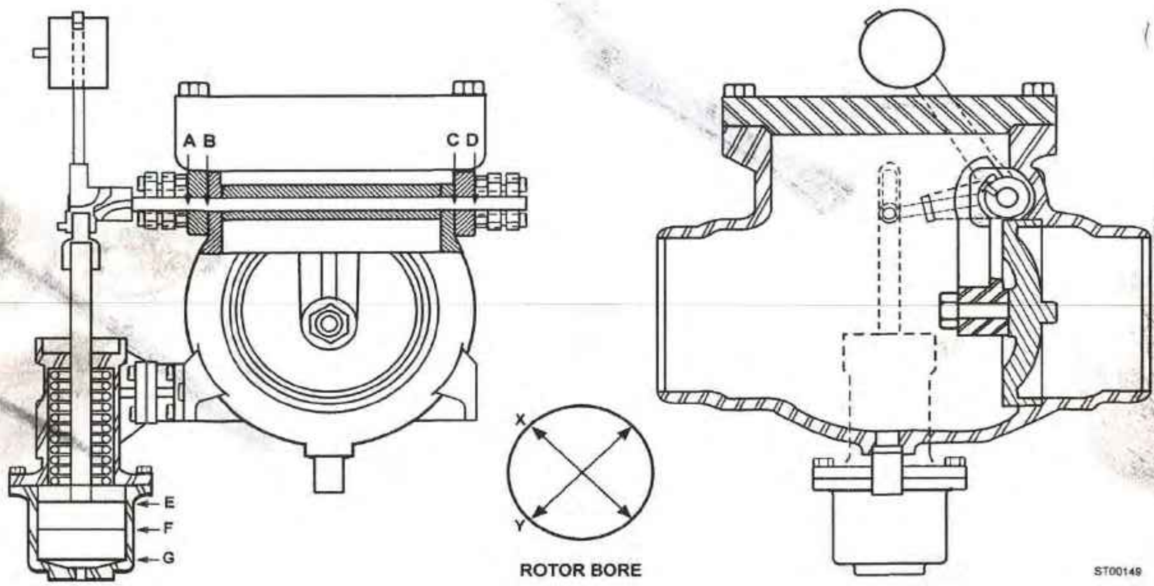
C= PACKING FOLLOWER HAS 3/8" TRAVEL

Check Valve Inspection

Extraction Non-Return

Date (m/d/y) 4/4/20 Turbine Serial No. ______ Prepared by GARY + DEREK
Location ______

INSPECTIONS & CHECKS					CODE	
Seat	(Inspect)	X		OK	X	Work Carried Out
Seat Contact	(Paper Check)	X		OK	N	Not Done
Disk	(Inspect)	X		OK	NA	Not Applicable
Packing	(Inspect)	X		C	C	See Comments
Disk nut pin	(Inspect)	X	Repack	OK	V	Visual Inspection
Gasket surface	(Inspect)	X		OK		
Weighted Lever	(Inspect)	X		OK		
Linkage	(Inspect)	X		OK		



Comments

#3024-01 UPPER LIMIT SWITCH ARM MISSING
C = PACKING FOLLOWER HAS 5/8" TRAVEL
* ONE STUD HAS THREAD DAMAGE
CAUSED BY REMOVING NUT (NO ANTI-SEEZE

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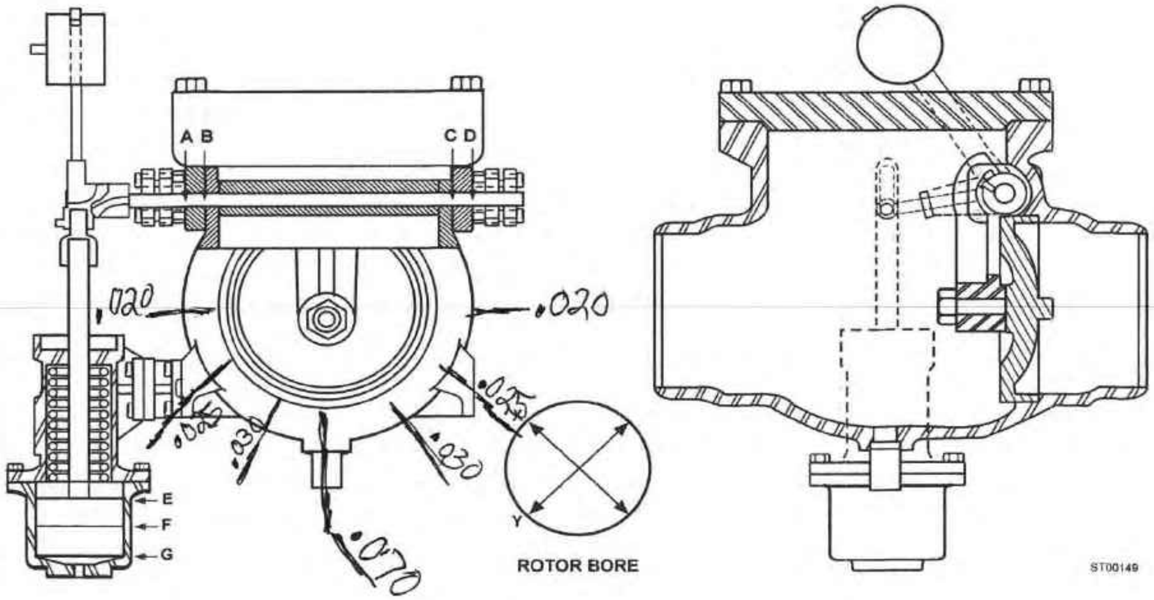
Check Valve Inspection

Extraction Non-Return

Date (m/d/y) 4/3/20 Turbine Serial No. ______________ Prepared by GARY + DEREK
Location ______________

INSPECTIONS & CHECKS				
Seat	(Inspect)	X		OK
Seat Contact	(Paper Check)	X		C
Disk	(Inspect)	X		OK
Packing	(Inspect)	X		C
Disk nut pin	(Inspect)	X	Repack	OK
Gasket surface	(Inspect)	X		OK
Weighted Lever	(Inspect)	X		OK
Linkage	(Inspect)	X		OK

CODE	
X	Work Carried Out
N	Not Done
NA	Not Applicable
C	See Comments
V	Visual Inspection



Comments
#3107-01 PACKING FOLLOWER HAS 1/2" TRAVEL C = CONTACT CHECK RESULTS

NRV Data Sheets

Check Valve Inspection

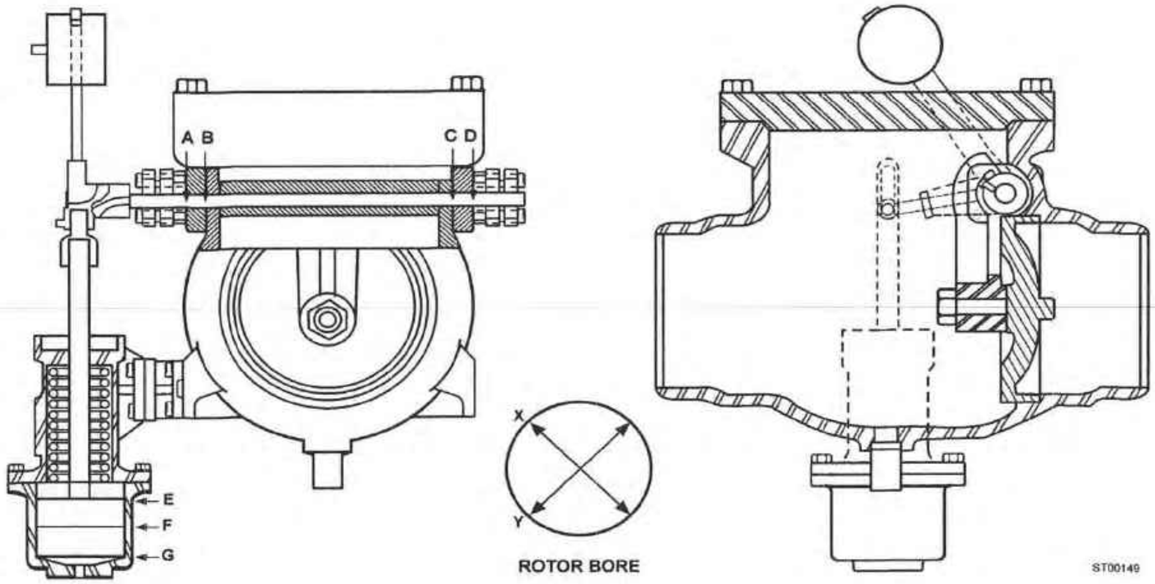
Extraction Non-Return

Date (m/d/y) 4/3/20 Turbine Serial No. ____________ Prepared by GARY + DEREK

Location ____________

INSPECTIONS & CHECKS				
Seat	(Inspect)	X		OK
Seat Contact	(Paper Check)	X		OK
Disk	(Inspect)	X		OK
Packing	(Inspect)	X		C
Disk nut pin	(Inspect)	X	Repack	OK
Gasket surface	(Inspect)	X		OK
Weighted Lever	(Inspect)	X		OK
Linkage	(Inspect)	X		OK

CODE	
X	Work Carried Out
N	Not Done
NA	Not Applicable
C	See Comments
V	Visual Inspection



Comments

#3098-02

PACKING FOLLOWER HAS 1/2" TRAVEL

Check Valve Inspection

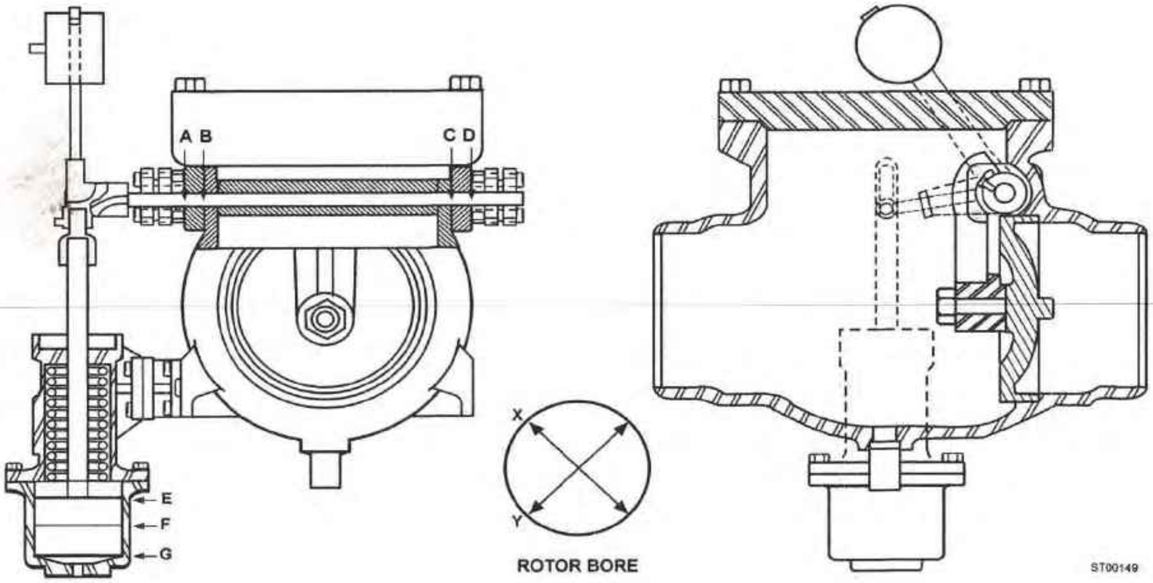
Extraction Non-Return

Date (m/d/y) 4/3/20 Turbine Serial No. ____________ Prepared by GARY + DEREK

Location ____________

INSPECTIONS & CHECKS				
Seat	(Inspect)	X		OK
Seat Contact	(Paper Check)	X		OK
Disk	(Inspect)	X		OK
Packing	(Inspect)	X		C
Disk nut pin	(Inspect)	X	Repack	OK
Gasket surface	(Inspect)	X		OK
Weighted Lever	(Inspect)	X		OK
Linkage	(Inspect)	X		OK

CODE	
X	Work Carried Out
N	Not Done
NA	Not Applicable
C	See Comments
V	Visual Inspection



Comments

3129-01

C = PACKING FOLLOWER HAS 1/2" TRAVEL

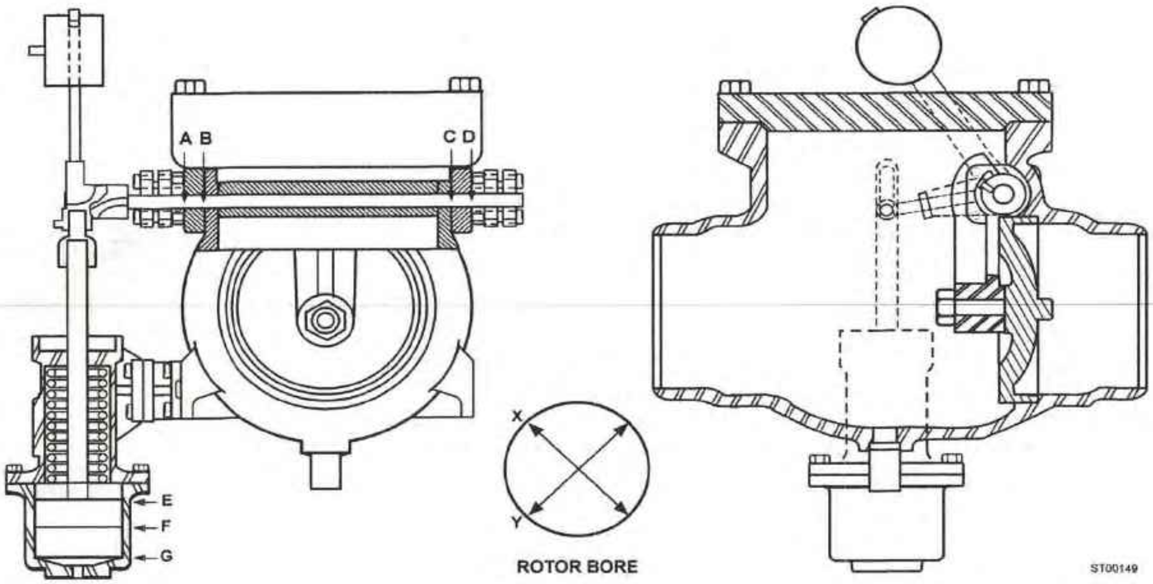
Check Valve Inspection

Extraction Non-Return

Date (m/d/y) 4/3/20 Turbine Serial No. ______ Prepared by GARY + DEREK
Location ______

INSPECTIONS & CHECKS				
Seat	(Inspect)	X		OK
Seat Contact	(Paper Check)	X		OK
Disk	(Inspect)	X		OK
Packing	(Inspect)	X		C
Disk nut pin	(Inspect)	X	Repack	OK
Gasket surface	(Inspect)	X		OK
Weighted Lever	(Inspect)	X		OK
Linkage	(Inspect)	X		OK

CODE	
X	Work Carried Out
N	Not Done
NA	Not Applicable
C	See Comments
V	Visual Inspection



Comments

3094-02

PACKING FOLLOWER HAS 3/8" TRAVEL

D310450 Sheet: (a) Rev 0.0 - 06/05/98

GE Energy Proprietary Information

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Check Valve Inspection

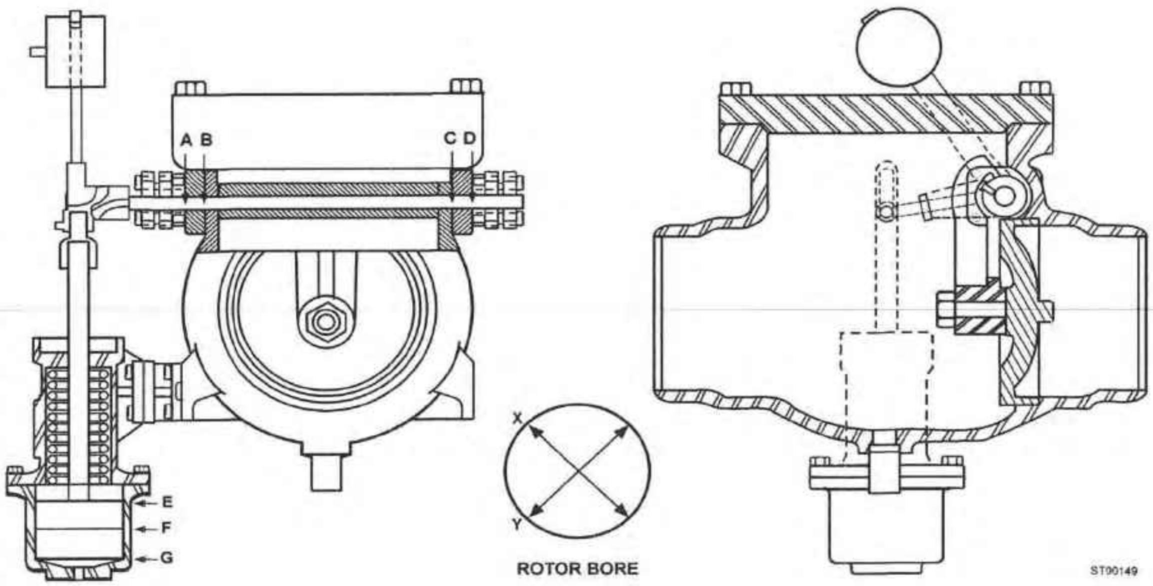
Extraction Non-Return

Date (m/d/y) 4/2/20 Turbine Serial No. ____________ Prepared by GARY + DEREK

Location ____________

INSPECTIONS & CHECKS					
Seat	(Inspect)	X		OK
Seat Contact	(Paper Check)	X		OK
Disk	(Inspect)	X		OK
Packing	(Inspect)	X		OK
Disk nut pin	(Inspect)	X	Repack	OK
Gasket surface	(Inspect)	X		OK
Weighted Lever	(Inspect)	X		OK
Linkage	(Inspect)	X		OK

CODE	
X	Work Carried Out
N	Not Done
NA	Not Applicable
C	See Comments
V	Visual Inspection



Comments

#3119-01 - packing follower has ½" clearance left

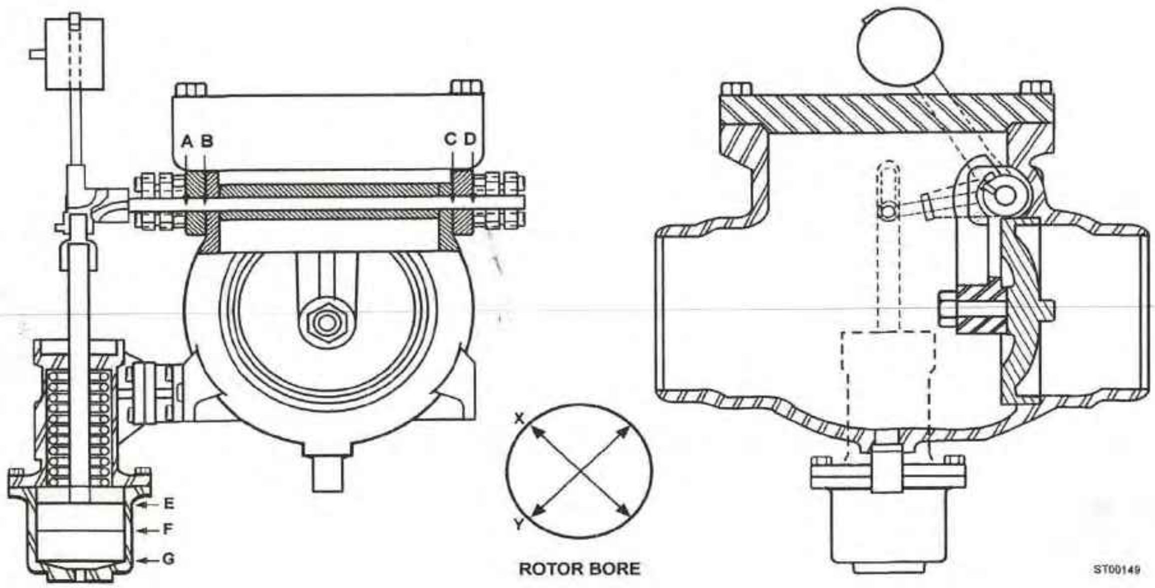
NRV Data Sheets

Check Valve Inspection

Extraction Non-Return

Date (m/d/y) 4/2/20 Turbine Serial No. ________ Prepared by GARY + DEREK
Location ________

INSPECTIONS & CHECKS					CODE	
Seat	(Inspect)	X		OK	X	Work Carried Out
Seat Contact	(Paper Check)	X		OK	N	Not Done
Disk	(Inspect)	X		OK	NA	Not Applicable
Packing	(Inspect)	X		C	C	See Comments
Disk nut pin	(Inspect)	X-MISSING	Repack	C	V	Visual Inspection
Gasket surface	(Inspect)	X		OK		
Weighted Lever	(Inspect)	X		OK		
Linkage	(Inspect)	X		OK		



Comments

3102-02

C = DISK NUT PIN MISSING UPON OPENING

C = PACKING FOLLOWER HAS 1/2" TRAVEL REMAINING

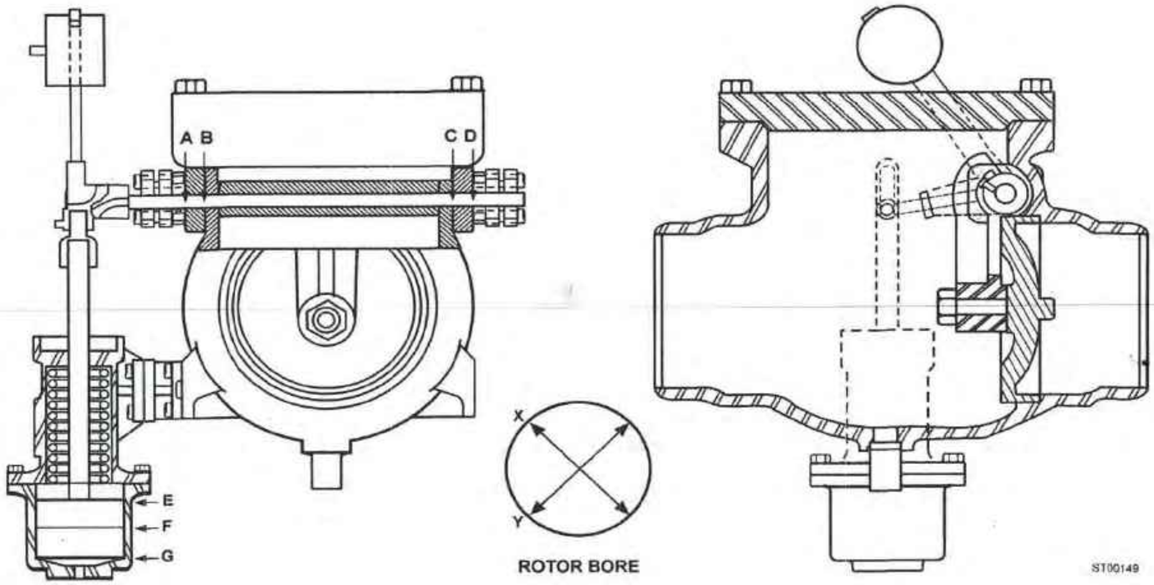
NRV Data Sheets

Check Valve Inspection

Extraction Non-Return

Date (m/d/y) 4/2/20 Turbine Serial No. ______ Prepared by GARY + DEREK
Location ______

INSPECTIONS & CHECKS					CODE	
Seat	(Inspect)	X		OK	X	Work Carried Out
Seat Contact	(Paper Check)	X		C	N	Not Done
Disk	(Inspect)	X		OK	NA	Not Applicable
Packing	(Inspect)	X		C	C	See Comments
Disk nut pin	(Inspect)	X	Repack	OK	V	Visual Inspection
Gasket surface	(Inspect)	X		OK		
Weighted Lever	(Inspect)	X		C		
Linkage	(Inspect)	X		OK		



Comments

#3110-01

PAPER CHECK = 4 SHEETS THICKNESS
PACKING FOLLOWER HAS 1/2 TRAVEL REMAINING
LEVER MISSING WEIGHT

Confidential

NRV Data Sheets

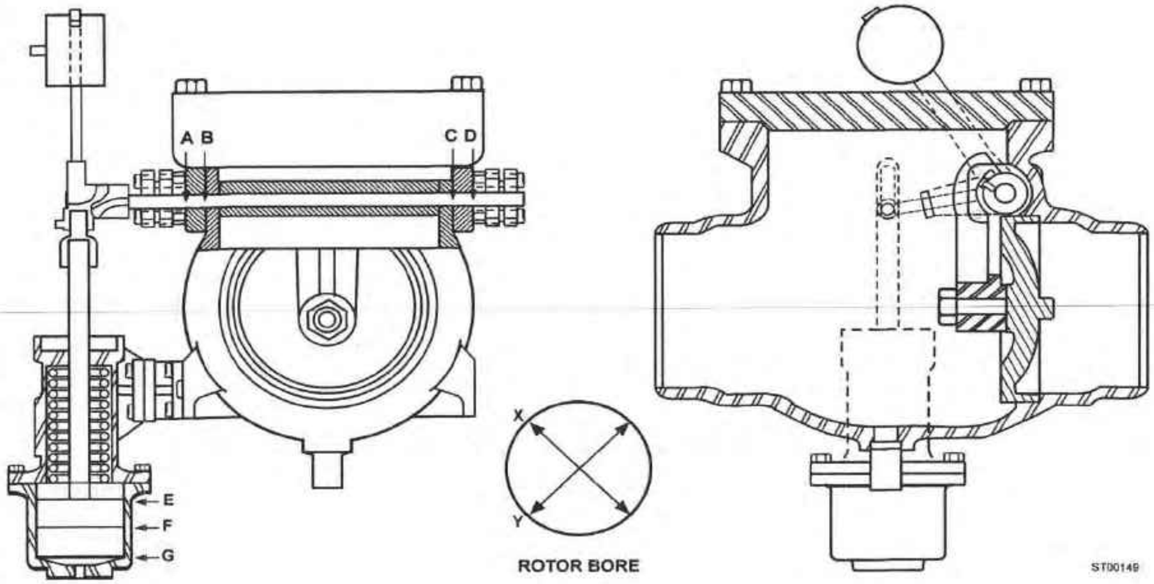
Check Valve Inspection

Extraction Non-Return

Date (m/d/y) 4/2/20 Turbine Serial No. ______ Prepared by GARY + DEREK

Location ______

INSPECTIONS & CHECKS					CODE	
Seat	(Inspect)	X		OK	X	Work Carried Out
Seat Contact	(Paper Check)	X		OK	N	Not Done
Disk	(Inspect)	X		OK	NA	Not Applicable
Packing	(Inspect)	X		OK	C	See Comments
Disk nut pin	(Inspect)	X	Repack	OK	V	Visual Inspection
Gasket surface	(Inspect)	X		OK		
Weighted Lever	(Inspect)	X		OK		
Linkage	(Inspect)	X		OK		



Comments

#3116-01

C = PACKING FOLLOWER HAS 1/2" TRAVEL REMAINING
C = WEIGHTED LEVER HAS NO WEIGHT +

Check Valve Inspection

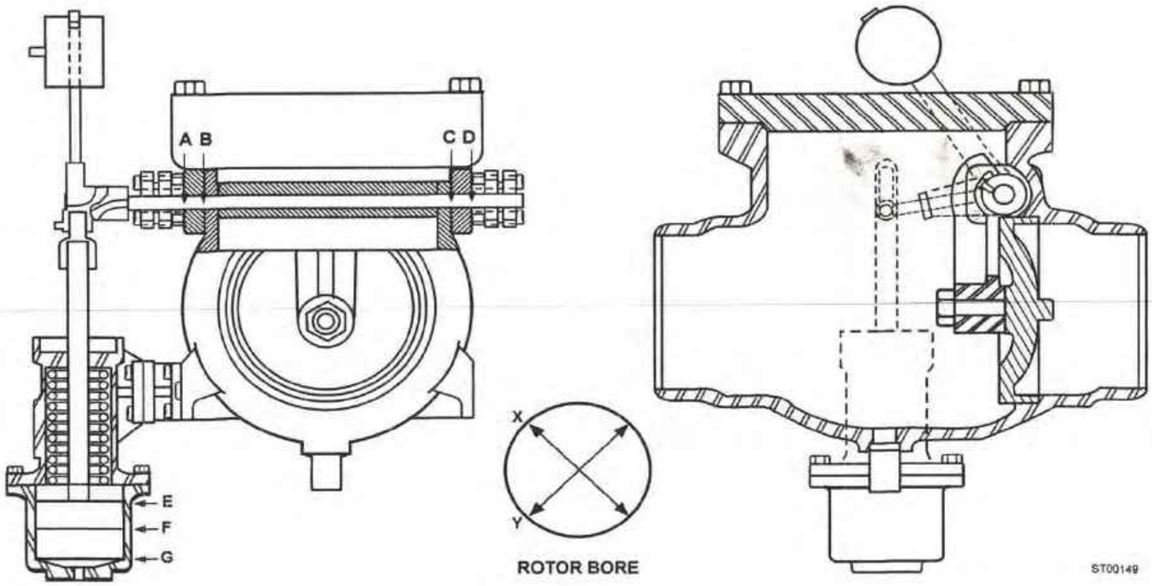
Extraction Non-Return

Date (m/d/y) 4/2/20 Turbine Serial No. ______ Prepared by GARY + DEREK

Location ______

INSPECTIONS & CHECKS				
Seat	(Inspect)	X		OK
Seat Contact	(Paper Check)	X		OK
Disk	(Inspect)	X		OK
Packing	(Inspect)	X		C
Disk nut pin	(Inspect)	X	Repack	C
Gasket surface	(Inspect)	X		OK
Weighted Lever	(Inspect)	X		C
Linkage	(Inspect)	X		OK

CODE	
X	Work Carried Out
N	Not Done
NA	Not Applicable
C	See Comments
V	Visual Inspection



Comments

#3122-01

C = DISK NUT AND PIN MISSING AS FOUND
C = WEIGHTED LEVER MISSING WEIGHT
C = PACKING FOLLOWER HAS 1/2" ADJ. REMAINING

3.8 Lubrication System

3.8.1 Lube Oil Flush

Part Description:

Prior to this outage a lube oil jumper system was not available. During the outage, jumpers were fabricated for both the lube oil and seal oil systems. Oil was circulated with 100 mesh filter bags attached to the ends of the jumpers.

Small metal wires were discovered in the filter bags after the oil had been circulated for a short period of time. Further investigation revealed that one of the lube oil filters at the tank filter housings had failed and was shedding wire mesh into the oil system. It was discovered, anecdotally, that the oil filters had not been changed for three years and the differential pressure across the filters was exceptionally low. The OEM recommendation is that the filter elements be changed when the differential pressure reaches 15 psi or every six months of operation, whichever comes first. Since the differential pressure was only 3 psi, the filter elements were not changed. It was also discovered anecdotally that an incident had occurred in 2017, where the three-way transfer valve had not completely isolated one side of the duplex filters and an attempt was made to remove the filter housing cover. The result was that the individual removing the cover was doused with lube oil. After that occurrence routine changing of filter elements was abandoned.

After the lube oil tank was drained, it was found that the filter elements that had been installed were not the of the OEM design. The OEM design filters have a hard piece of pipe in the axial location of the oil inlet to the filter housings. The filters that were installed did not have the hard pipe section. The filter failure occurred in the area where the hard pipe section was not present.

The lube oil tank cleaned and the oil pumps were inspected, in-situ, and found to be undamaged. Small metal wires were also found in the seal oil strainers.

After the filter elements were removed, the lube oil tank was refilled and oil was circulated through the empty filter housings until no solid particles were found in the bearing jumper filter bags.

New filter elements were installed at assembly with a shim wrapped around the housing in the area of the oil inlet to the filter housings..

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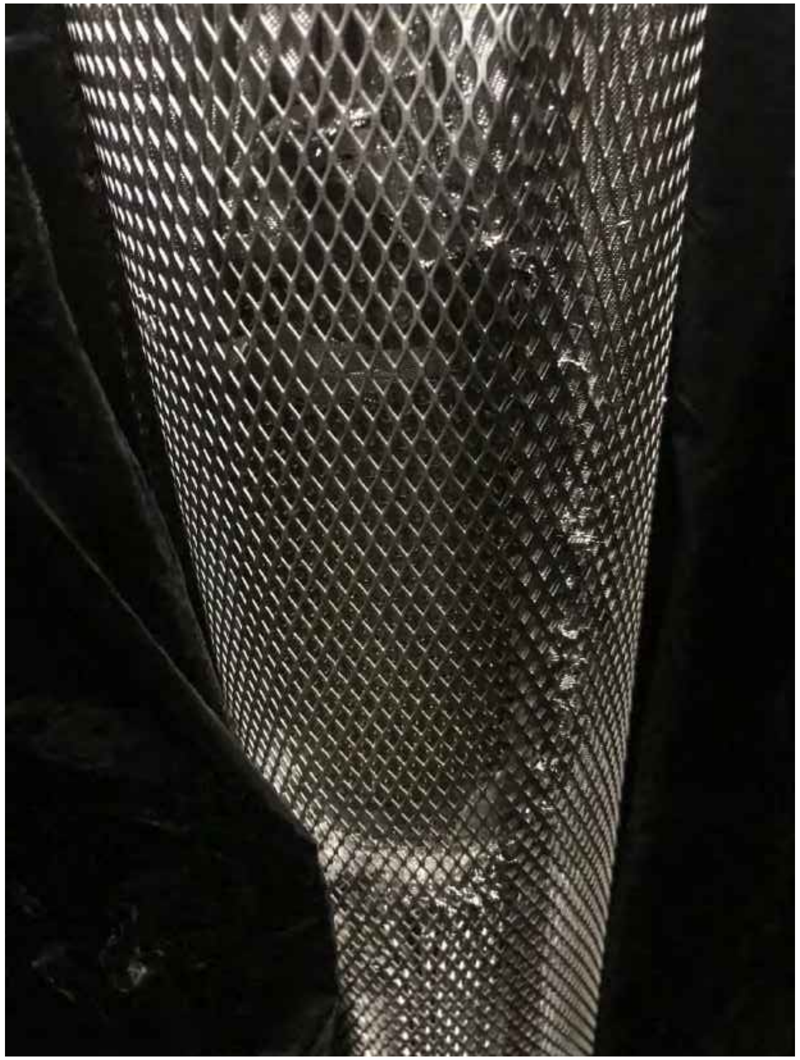
Lube Oil Filter Element Failure

Installed oil filter element without hard section

OEM oil filter element with hard section

Confidential

Lube Oil Filter Element Failure



“Blown Out” Filter Element

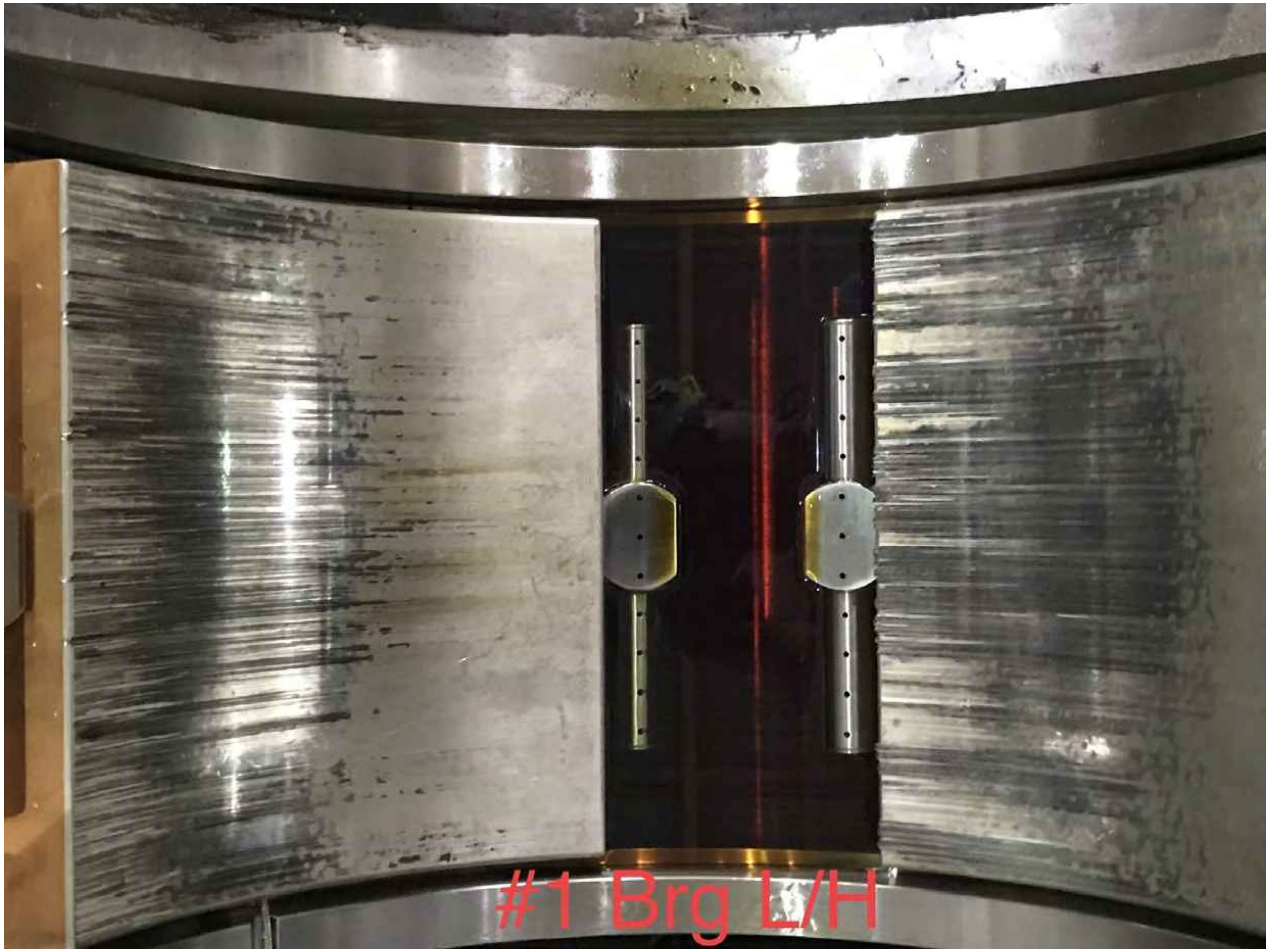
Confidential

Lube Oil Filter Element Failure

Metal Wires Found in Flush Strainer Bags

Lube Oil Filter Element Failure

Confidential



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Lube Oil Filter Element Failure

4 Generator

4.1 Generator Mechanical

4.1.1 Rotor - Mechanical

Part Description:

The generator rotor is a two pole MELCO design with an integral exciter shaft. A blower hub is mounted to the turbine end of the rotor forward of the retaining ring that has T slot grooves for five rows of rotating blower blades. A fan impeller is mounted to the collector end of the rotor for exciter cooling.

The rotor was removed from the stator, per OEM drawing A11B528. Several of the multi-piece rotor body shoes, items T6 and T7, were found to be in poor condition and were replaced with segments fabricated and supplied by the customer.

After the rotor was removed, it was electrically tested. The rotating blower blades were removed and non-destructively examined using wet fluorescent magnetic particles. Shear wave non-destructive testing was performed on the retaining rings. The rotor bore was pressure tested to verify that the radial lead seals were not leaking.

At reassembly, the rotor was installed into the stator and the rotating blower blades were installed. Once the bearing brackets were reassembled, radial position measurements were taken to verify that the rotor centerline was returned to it's "As Found" position.

Generator Rotor

Generator Rotor

4.1.2 Stator - Mechanical

Part Description:

The generator stator is a Mitsubishi Electric Company (MELCO) design. There are bearing brackets on the turbine end and collector end. A gas blower and two hydrogen coolers are housed in the turbine end. Hydrogen gland seal brackets are mounted to the internal side of each bearing bracket.

The hydrogen seal brackets were removed from both ends of stator. The upper and lower bearing brackets were removed from the collector end. It was not necessary to remove the lower half turbine end bearing bracket for rotor removal. The stationary portion of the blower assembly and its support structure was removed from the turbine end, per OEM drawing AK99955. The gas gap baffle was removed from the collector end.

At reassembly all clearances were set, per OEM drawing AK99425. The stator shims were adjusted for coupling alignment, per customer request. After the stator position was adjusted, the centerline transverse keys were machined for appropriate clearance. Rather than shimming the hold down bolt sleeves, retainers were tack welded to the studs after the nut clearances were set.

Resistance checks between the rotor and stator frame were performed. A 500 V test, just before coupling the generator rotor to the LP, was witnessed by the customer and found to be satisfactory.

After the bearing brackets were assembled to the stator frame and tightened, Dow Corning fluorosilicone was pumped into the sealant grooves. The fluorosilicone and pump was supplied by the customer. An air test was performed after everything was assembled and the seal oil was started. As with the air test performed in 2011, acceptable results were not acheived, however, the customer found the results to be satisfactory. As was noted in the 2011 field service report, the installed instrumentation should be upgraded to accurately measure gas leakage.

Recommendation Status: Should be planned for next available shut down

Recommendation Description:

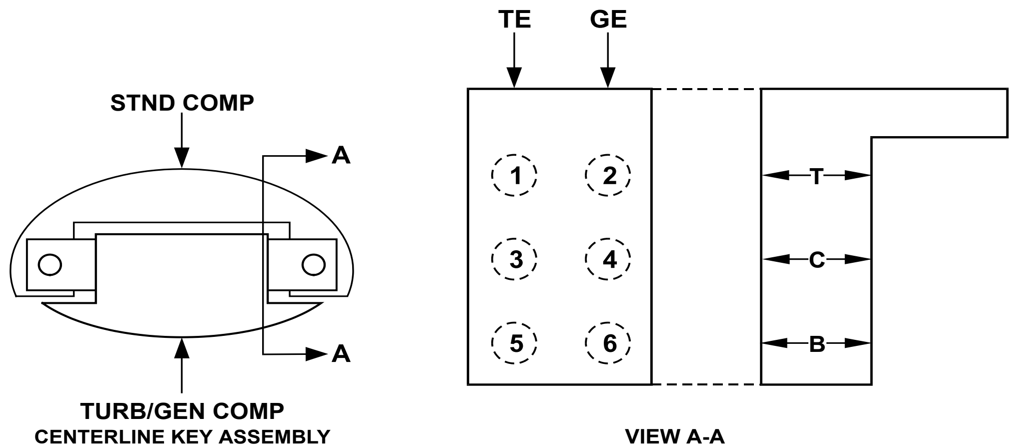
Upgraded instrumentation should be installed to more accurately measure the gas leakage from the generator.

Generator Datasheets

Centerline Key Data

Date (m/d/y) 5/20/2020 Turbine Serial No. 4465 Prepared by D. Johnson

INSPECTIONS & CHECKS				CODE	
Measure Keys	x	Measure Keyways	x	X	Work Carried Out
				N	Not Done
				NA	Not Applicable



Notes: Enter key location as #1 Standard - HP, etc.
Data in inches.

KEY LOCATION: Turbine End							
Location	Key-Way Data		Key Data		Clearance		Comments
	L/S	R/S	L/S	R/S	L/S	R/S	
1 (T)	0.733	0.728	0.729	0.705	0.004	0.023	0.015" was machined from the right side key & 0.003" shim was added to the left side. A feeler check was performed after installation and 0.002" clearance was measured on each side.
2 (T)	0.733	0.708	0.724	0.705	0.009	0.003	
3 (C)							
4 (C)							
5 (B)	0.734	0.707	0.728	0.705	0.006	0.002	
6 (B)	0.732	0.707	0.723	0.705	0.009	0.002	

KEY LOCATION: Collector End							
Location	Key-Way Data		Key Data		Clearance		Comments
	L/S	R/S	L/S	R/S	L/S	R/S	
1 (T)	0.685	0.883	0.668	0.891	0.017	-0.008	0.011" was machined from the right side key & 0.007" shim was added to the left side. A feeler check was performed after installation and 0.003" clearance was measured on each side.
2 (T)	0.683	0.883	0.671	0.891	0.012	-0.008	
3 (C)							
4 (C)							
5 (B)	0.678	0.883	0.671	0.891	0.007	-0.008	
6 (B)	0.677	0.884	0.670	0.891	0.007	-0.007	

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Generator Datasheets

Generator Shim Packs

Date 5-14-20 Generator Serial No. 05HBSE01 Prepared by D. Johnson

Turbine Serial No. 4465 FSR #

Units recorded in English - inches

As Built

Shim Pack	Shim Pack - record thickness in inches											Total
L1 T/E	0.122	0.060	0.013	0.004	0.008	0.013	0.004					0.224
L2	0.122	0.061	0.013	0.003	0.013	0.008						0.220
L3	0.122	0.060	0.013	0.006	0.013							0.214
L4	0.122		0.013	0.006	0.014	0.015	0.014	0.013	0.004	0.003	0.003	0.207
L5	0.122	0.060	0.014									0.196
L6	Could not remove shim packs due to interference with stator cooling water pipes. Measurement is gap between stator foot and sole plate.											0.194
L7												0.186
L8	0.122	0.061										0.183
L9	0.122	0.060		0.008								0.190
L10	0.122	0.061		0.008								0.191
L11	0.122	0.061		0.008								0.191
L12	0.123	0.061		0.008								0.192
L13	0.122	0.061										0.183
L14	0.122	0.061										0.183
L15	0.122	0.061		0.008								0.191
L16	0.122	0.061	0.016	0.008								0.207
L17	0.122	0.061	0.014	0.008	0.008							0.213
L18	0.122	0.014	0.014	0.014	0.014	0.013	0.011	0.008	0.004	0.004		0.218
L19	0.122	0.060	0.014	0.013	0.013							0.222
L20 C/E	0.122	0.060	0.014	0.014	0.013	0.004	0.002					0.229

Comments:

Generator Datasheets

Generator Shim Packs

Date 5-14-20 Generator Serial No. 05HBSE01 Prepared by D. Johnson

Turbine Serial No. 4465 FSR #

Units recorded in English - inches

As Built

Shim Pack	**Shim Pack - record thickness in inches**											**Total**
R1 T/E	0.122	0.060	0.014	0.013	0.008	0.006	0.002					0.225
R2	0.122	0.060	0.014	0.005	0.013	0.004						0.218
R3	0.123	0.060	0.014	0.013	0.006							0.216
R4	0.122	0.060	0.013	0.006	0.008							0.209
R5	0.122	0.061	0.013	0.008								0.204
R6	0.122	0.061		0.008								0.191
R7	0.121	0.061										0.182
R8	0.122	0.061										0.183
R9	0.120	0.060		0.008								0.188
R10	0.122	0.060		0.007	0.002							0.191
R11	0.119	0.060		0.008	0.002							0.189
R12	0.122	0.060										0.182
R13	0.123	0.060										0.183
R14	0.122	0.060		0.008								0.190
R15	0.122	0.060		0.008								0.190
R16	0.122	0.060	0.016	0.004								0.202
R17	0.122	0.062	0.013	0.008	0.004	0.004						0.213
R18	0.122	0.060	0.013	0.008	0.014							0.217
R19	0.122	0.060	0.013	0.013	0.014							0.222
R20 C/E	0.122	0.060	0.013	0.013	0.013	0.006						0.227

Comments:

Generator Datasheets

Generator Shim Packs

Date 3-24-20 Generator Serial No. 05HBSE01 Prepared by D. Johnson

Turbine Serial No. 4465 FSR #

Units recorded in English - inches

As Found

Shim Pack	Shim Pack - record thickness in inches											Total
L1 T/E	0.122	0.060	0.013	0.004								0.199
L2	0.122	0.061	0.013	0.003								0.199
L3	0.122	0.060	0.013	0.006								0.201
L4	0.122	0.061	0.013	0.006								0.202
L5	0.122	0.060	0.014	0.013								0.209
L6	Could not remove shim packs due to interference with stator cooling water pipes. Measurement is gap between stator foot and sole plate.											0.207
L7												0.207
L8	0.122	0.061	0.013	0.008								0.204
L9	0.122	0.060	0.013	0.008								0.203
L10	0.122	0.061	0.013	0.008								0.204
L11	0.122	0.061	0.014	0.008	0.003							0.208
L12	0.123	0.061	0.014	0.008	0.003							0.209
L13	0.122	0.061	0.014	0.008	0.004							0.209
L14	0.122	0.061	0.014	0.008	0.004							0.209
L15	0.122	0.061	0.014	0.008	0.004							0.209
L16	0.122	0.061	0.016	0.008	0.004							0.211
L17	0.122	0.061	0.014	0.008	0.004							0.209
L18	0.122	0.061	0.014	0.008	0.004	0.002						0.211
L19	0.122	0.060	0.013	0.013								0.208
L20 C/E	0.122	0.060	0.014	0.014								0.210

Comments:

Confidential

Generator Datasheets

Generator Shim Packs

Date 3-24-20 Generator Serial No. 05HBSE01 Prepared by D. Johnson

Turbine Serial No. 4465 FSR #

Units recorded in English - inches

As Found

Shim Pack	Shim Pack - record thickness in inches											Total
R1 T/E	0.122	0.060	0.014	0.014	0.004							0.214
R2	0.122	0.060	0.014	0.005								0.201
R3	0.123	0.060	0.014	0.006								0.203
R4	0.122	0.060	0.013	0.006								0.201
R5	0.122	0.060	0.013	0.006								0.201
R6	0.122	0.061	0.013	0.008								0.204
R7	0.121	0.061	0.013	0.008								0.203
R8	0.122	0.061	0.013	0.008								0.204
R9	0.120	0.060	0.013	0.008								0.201
R10	0.122	0.060	0.013	0.007	0.002							0.204
R11	0.119	0.060	0.014	0.008	0.002							0.203
R12	0.122	0.060	0.012	0.008	0.002							0.204
R13	0.123	0.060	0.014	0.008	0.004							0.209
R14	0.122	0.060	0.014	0.008	0.004							0.208
R15	0.122	0.060	0.013	0.008	0.004							0.207
R16	0.122	0.060	0.016	0.004								0.202
R17	0.122	0.062	0.013	0.008	0.004							0.209
R18	0.122	0.060	0.013	0.008	0.006							0.209
R19	0.122	0.060	0.013	0.013								0.208
R20 C/E	0.122	0.060	0.013	0.013								0.208

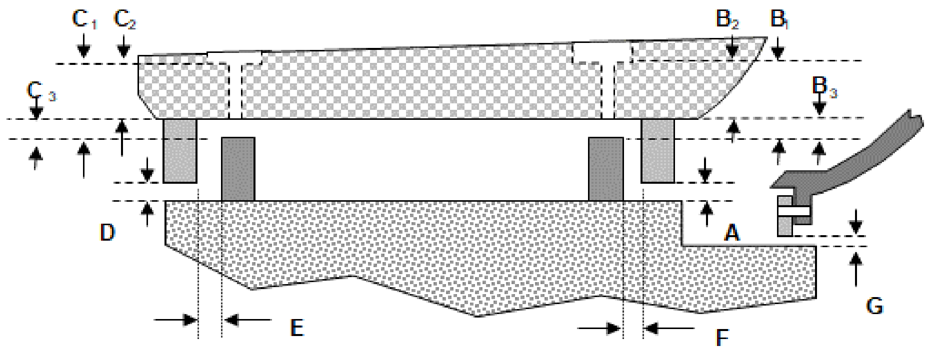
Comments:

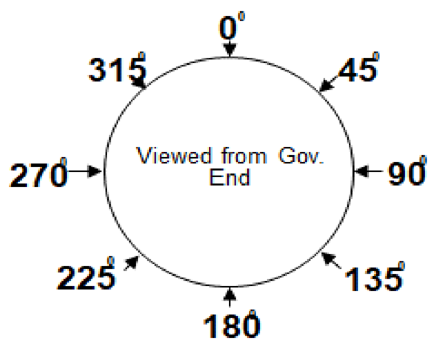
Generator Datasheets

(Westinghouse Datasheet)

Generator Blower Clearances

Date (m/d/y)	2/17/20	Turbine Serial Number	4465	Prepared by	C Mack
Plant	Comanche	Unit	3	Initial	
				Final	X





Degree	0	45	90	135	180	225	270	315
A	0.1200	0.120	0.075	0.050	0.045	0.070	0.090	0.120
B1		1.694		1.619		1.657		1.724
B2		1.562		1.574		1.604		1.612
B3		0.132		0.045		0.053		0.112
C1		1.704		1.623		1.649		1.719
C2		1.597		1.577		1.603		1.599
C3		0.107		0.046		0.046		0.120
D	0.0970	0.080	0.085	0.065	0.065	0.065	0.084	0.095
E								
F								
G								

Note* The B2 and C2 Readings should be stamped on the Blower assembly.
B1 minus B2 equals B3. Also C1 minus C2 equals C3.

Comments	

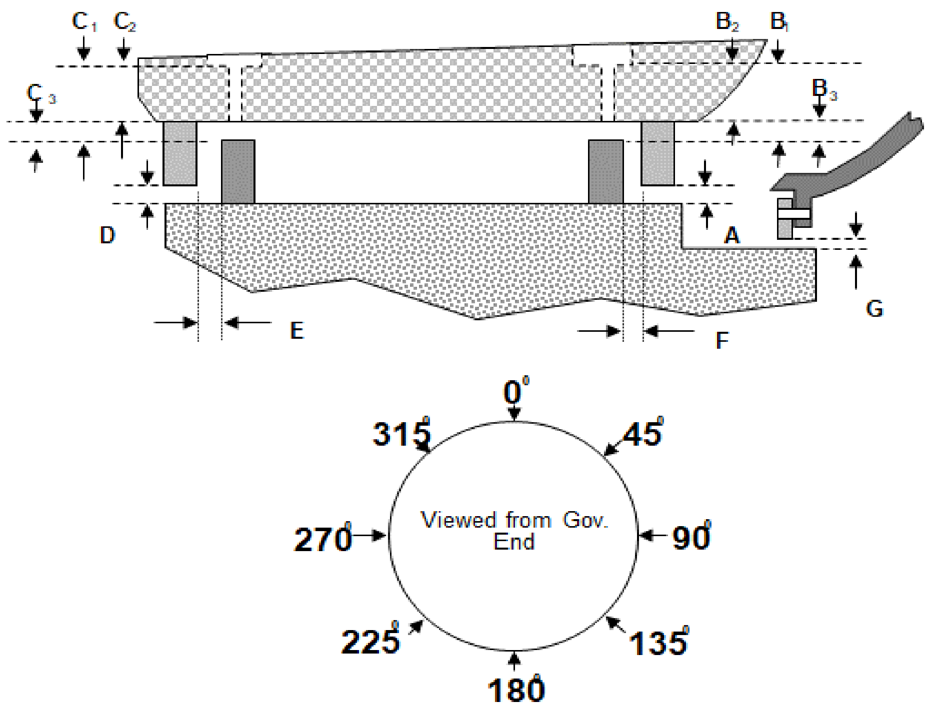
Confidential

Generator Datasheets

(Westinghouse Datasheet)

Generator Blower Clearances

Date (m/d/y)	2/17/20	Turbine Serial Number	4465	Prepared by	Cmack
Plant	Comanche	Unit	3	Initial	X
				Final	



Degree	0	45	90	135	180	225	270	315
A	0.1270	0.124	0.084	0.136	0.185	0.163	0.086	0.129
B1								
B2								
B3								
C1								
C2								
C3								
D								
E								
F								
G								

Note* The B2 and C2 Readings should be stamped on the Blower assembly.
B1 minus B2 equals B3. Also C1 minus C2 equals C3.

Comments	

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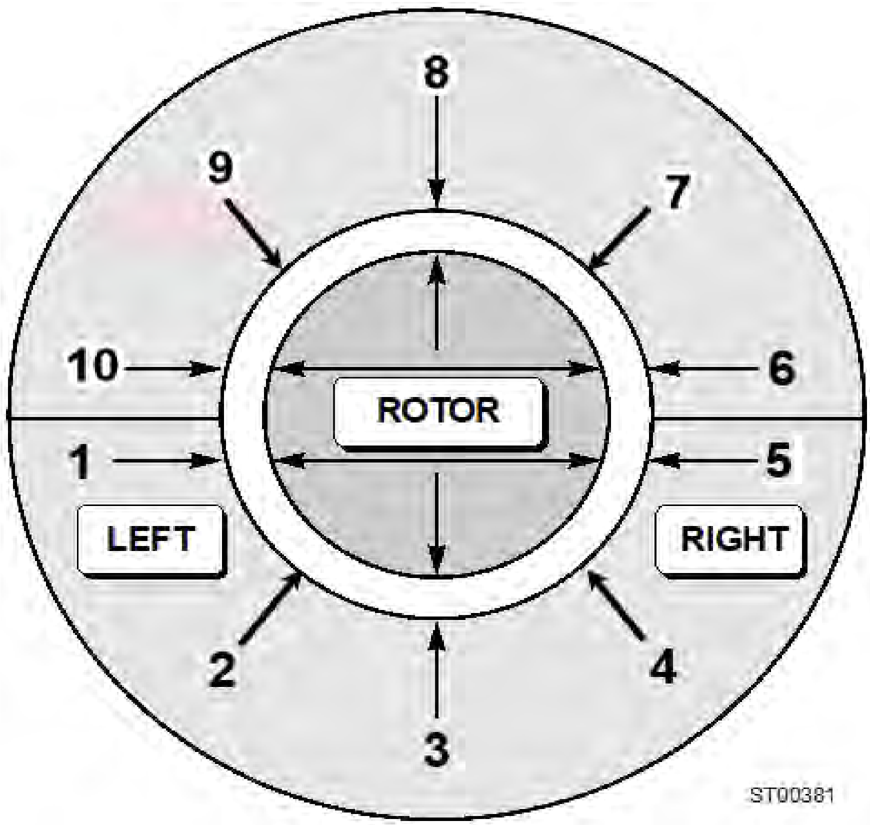
Generator Datasheets

(Westinghouse Datasheet)

Gas Gap Baffle
Radial Clearance

Date (m/d/y)	4/2/20	Turbine Serial Number	4465	Prepared by	C Mack
	Plant	Comanche	Unit	3	Initial
					Final X



	1	2	3	4	5	6	7	8	9	10
Radial Clearance	0.205	0.217	0.206	0.239	0.225	0.23	0.235	0.221	0.215	0.205

*** Radial clearance measurements taken at the splits between segments**

Comments	

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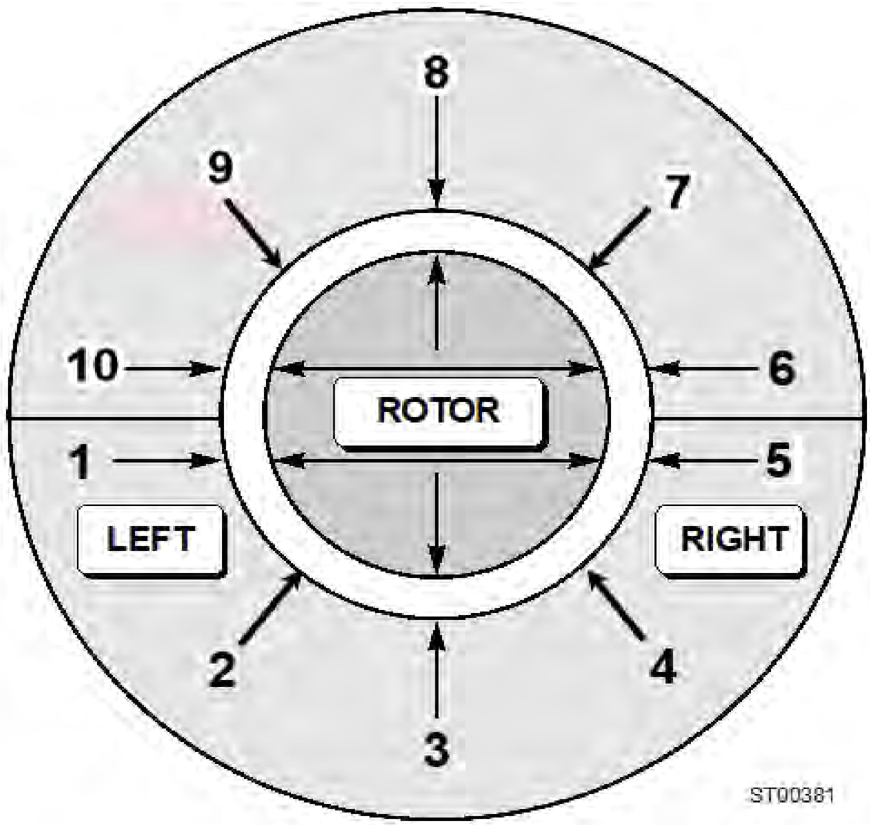
Generator Datasheets

(Westinghouse Datasheet)

Gas Gap Baffle
Radial Clearance

Date (m/d/y) 4/2/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3 Initial X
Final



	1	2	3	4	5	6	7	8	9	10
Radial Clearance	0.213	0.227	0.213	0.212	0.206	0.222	0.215	0.232	0.229	0.22

*** Radial clearance measurements taken at the splits between segments**

Comments	

Generator Datasheets

(Westinghouse Datasheet)

Bearing Bracket

Vertical Joint Step

Date (m/d/y) 4/21/20 Turbine Serial Number 4465 Prepared by C Mack

Plant Comanche Unit 3 Initial ____ Final X

As Found

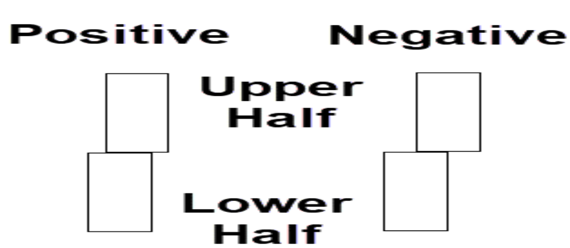
	Left Side	Right Side
Turbine End	0.0005	0.0005
Collector End	0.0005	0.0015

As Built

	Left Side	Right Side
Turbine End	0.0015	0.001
Collector End	0.000	0.001

A positive number indicates that the upper half above the lower half

A negative number indicate that the upper half is below the lower half



Comments	

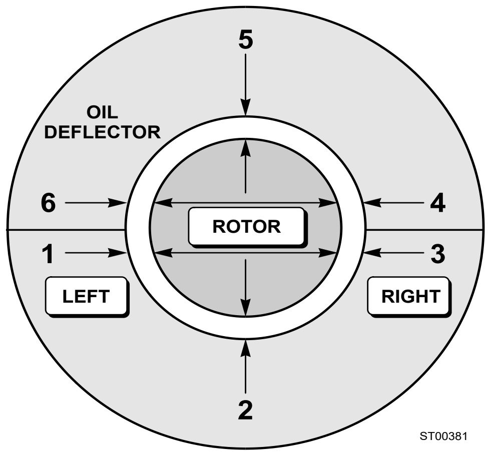
TC4F-36-022 *GE Energy Services* ***Company Proprietary Information***

Generator Datasheets

Oil Deflector
Alignment

Date (m,d,y) 4/4/2020 Turbine Serial No. 4465 Prepared by C Mack

Final



Deflector Location	POSITION (Mils)						CLEARANCE			IDEAL POSITION		
	1	2	3	4	5	6	Median	Min.	Max	Top	Bottom	Sides
GE Inner	0.025	0.009	0.024	0.019	0.026	0.021						
TE Inner	0.020	0.009	0.022	0.027	0.038	0.024						

Comments

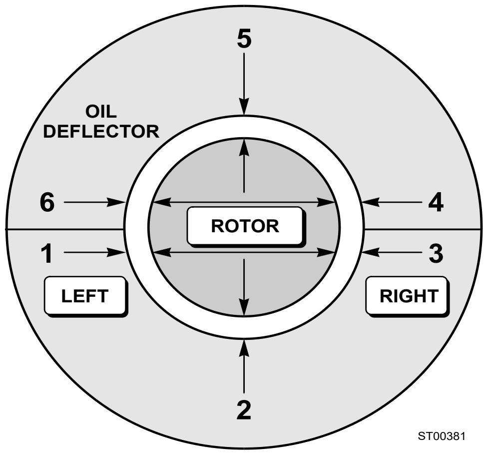
Inner Oil Deflector on Hydrogen Gland Seal Bracket

Generator Datasheets

Oil Deflector
Alignment

Date (m,d,y) 1/28/2020 Turbine Serial No. 4465 Prepared by C Mack

As Found



Deflector Location	POSITION (Mils)						CLEARANCE			IDEAL POSITION		
	1	2	3	4	5	6	Median	Min.	Max	Top	Bottom	Sides
T7 OB	0.019	0.010	0.021	0.035	0.041	0.013						
TE Inner	0.018	0.023	0.033	0.034	0.049	0.020						
GE Inner	0.026	0.007	0.013	0.013	0.035	0.030						
T8 OB	0.026	0.009	0.011									
T9 TE	0.006	0.005	0.005	0.011	0.015	0.008						
T9 EE	0.011	0.010	0.005									

Comments

TE & GE Inner Oil Deflectors on Hydrogen Gland Seal Brackets

4.1.3 Exciter - Mechanical

Part Description:

The exciter shaft is an integral part of the generator rotor. Two collector rings (also called slip rings) are fixed onto the shaft by interference fits. Removable carbon brushes ride on the rings and transmit excitation current to the rotating field. The brushes are held in position by stationary brush rigging that is bolted on a vertical split line. The brush rigging halves are set vertically by shims and bolted to the exciter base. There is a, pre-loaded, steady rest bearing at the end of the shaft, forward of the cooling fan impeller. The bearing is electrically isolated from exciter base. The entire assembly is housed in an enclosure.

The exciter enclosure was removed and the exciter was completely disassembled. The carbon brushes were removed and the brush rigging was stored by the customer's electricians. Pre-load of the steady rest bearing was measured and it was removed. The entire exciter base was removed and the shims were inventoried.

The pre-load of the bearing was found to be approximately 0.080". Design pre-load is 0.047", per OEM drawing AL93815. At reassembly the pre-load was set to approximately 0.060".

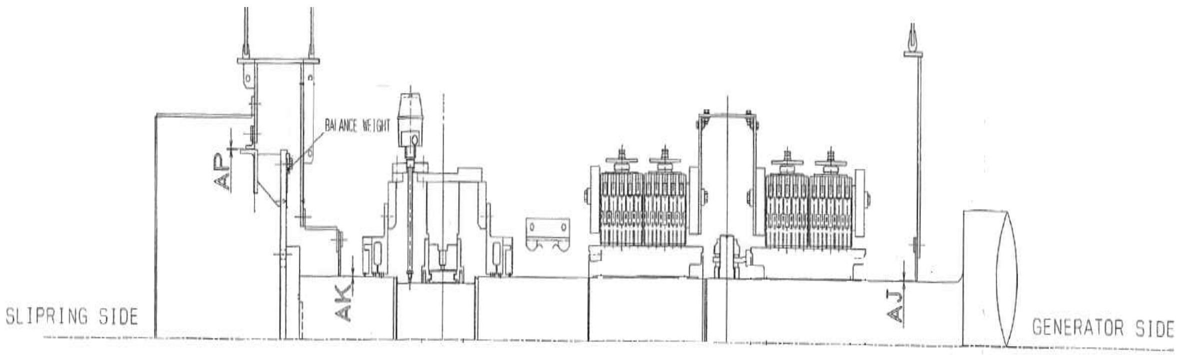
After the generator was aligned to the turbine. the exciter base was shimmed to adjust the pre-load of the steady rest bearing. Nuts were welded to the exciter sole plate and jack bolts were used rather than re-drilling and reaming new dowel holes. Clearances were set, per OEM drawing AL93815 at assembly.

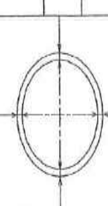
Exciter Datasheets

(Westinghouse Datasheet)

Exciter Clearances

Date (m/d/y)	5/30/20	Turbine Serial Number	4465	Prepared by	D. Johnson
	Plant	Comanche	Unit 3	Initial	
				Final	x





AP (top)

DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AP	0.095

AP (left)

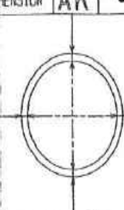
DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AP	0.102

AP (right)

DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AP	0.105

AP (bottom)

DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AP	0.100



AJ, AK CLEARANCE CIRCLE

AJ/AK (top)

DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AJ	0.135
	AK	0.110

AJ/AK (left)

DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AJ	0.145
	AK	0.100

AJ/AK (right)

DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AJ	0.143
	AK	0.165

AJ/AK (bottom)

DESIGN DIMENSION		0.0984 (2.5)
ALLOWABLE DIMENSION FOR ASSEMBLY		0.0787-0.1181 (2 - 3)
MEASURED DIMENSION	AJ	0.074
	AK	0.135

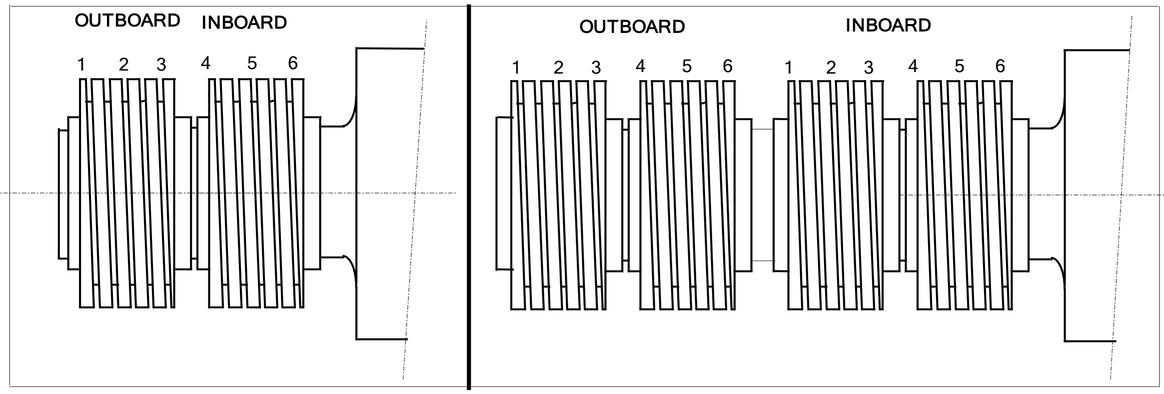
DIMENSION TO BE CHECKED ARE	DESIGN DIMENSION	ALLOWABLE DIMENSION FOR ASSEMBLY	MEASURED DIMENSION
VERTICAL CLEARANCE BETWEEN ROTOR AND BEARING	0.00886-0.0126 (0.225-0.319)	0.00886-0.0126 (0.225-0.319)	
ROTOR RAISED VALUE (SLIPRING BEARING POINT) H	0.0472 (1.20)	0.0453-0.0492 (1.15-1.25)	0.055 - 0.067

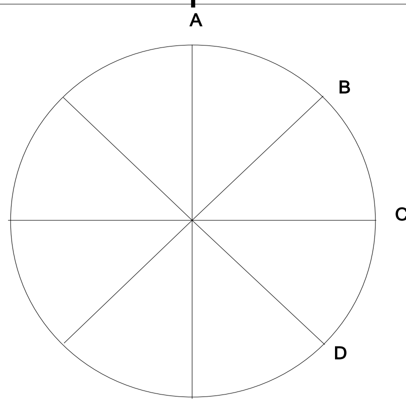
Comments	

Exciter Datasheets

Collector Ring Dimensional Check

Date(m/d/y) 3/12/2020 Serial No. 4465 Prepared by D. Johnson





Units recorded in: English - inches

Minimum Recommended Ring Diameter 14.94 **Minimum Groove Depth** 0.170

OUTBOARD RING				
Location	**A**	**B**	**C**	**D**
1	14.955	14.954	14.958	14.957
2	14.946	14.940	14.941	14.942
3	14.953			
4				
5				
6				
Min. Groove Depth =				

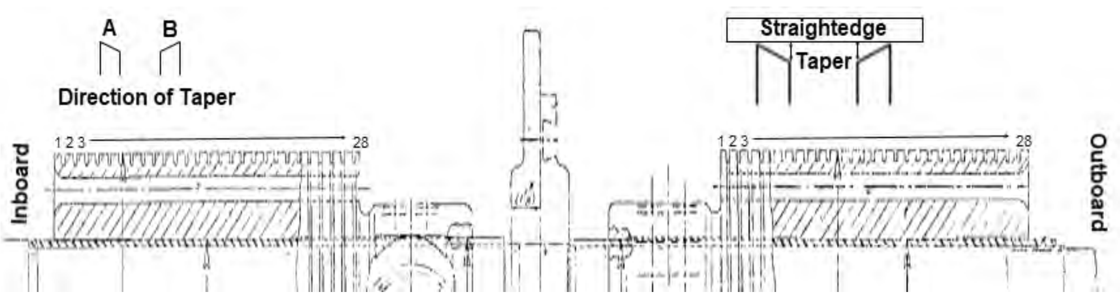
INBOARD RING				
Location	**A**	**B**	**C**	**D**
1				
2				
3				
4	14.959	14.959	14.956	14.956
5	14.944	14.945	14.946	14.944
6	14.955	14.956	14.956	14.958
Min. Groove Depth =				

Comments

Exciter Datasheets

Slipring Taper

Date (m/d/y)	3/12/20	Turbine Serial Number	4465	Prepared by	D. Johnson
	Plant	Comanche	Unit 3	Initial	x
				Final	x



Inboard Slipring			Outboard Slipring		
Rib #	Taper Magnitude	Direction of Taper	Rib #	Taper Magnitude	Direction of Taper
1	0		1	0.001	
2	0		2	0.001	
3	0		3	0.001	
4	0		4	0	
5	0		5	0	
6	0		6	0.003	
7	0.004		7	0.006	
8	0.006		8	0.006	
9	0.007		9	0.006	
10	0.005		10	0.005	
11	0.007		11	0.007	
12	0.005		12	0	
13	0.005		13	0.003	
14	0.005		14	0.002	
15	0.005		15	0.003	
16	0.005		16	0.005	
17	0.002		17	0	
18	0.002		18	0.002	
19	0.004		19	0.005	
20	0.002		20	0.005	
21	0.005		21	0.007	
22	0.002		22	0.009	
23	0.003		23	0.006	
24	0.002		24	0.008	
25	0.002		25	0.006	
26	0.002		26	0.006	
27	0.002		27	0.008	
28	0.003		28	0	
29	0		29	0	
30	0		30	0	
31	0		31	0	

Comments	

4.1.4 Hydrogen Seals

Part Description:

The hydrogen gland seals are made up of a hydrogen gland seal brackets and floating babbited seal rings. The hydrogen seal brackets are a two piece design with a horizontal parting flange. There is a bracket on each axial end of the generator that is mounted by vertical flange to the inboard side of each of the bearing brackets. The seal rings themselves ride on the generator rotor and float radially within the seal bracket. The seal brackets are electrically insulated from bearing brackets.

The upper half hydrogen gland seal brackets were removed from the lower halves after the upper half bearing brackets were removed. Seal ring squareness to the rotor was measured and the rings were removed. The lower half gland seal brackets were rolled to the top using the OEM jig, as shown on OEM drawing AK58613, and removed.

The hydrogen seal rings were found to be in poor condition with burnt/varnished oil present and pieces of babbit missing. The seal rings were sent out for refurbishment by the customer. When the seal rings returned, they were measured for radial and axial clearance and flatness. When installed in the seal brackets, parallelism to the rotor was checked. The inner oil deflectors were, which are integral to the seal brackets, were measured and found to be in suitable condition for continued service.

New vertical joint gaskets were cut for the seal brackets and installed at assembly. The inner oil deflector was aligned to the rotor, per OEM drawingAK99425. After the lower half vertical joint bolting was tightened, resistance measurements were taken at 500 V with a megger and found to be acceptable. The vertical joint bolting was tightened to 368 ft-lbs.

Due to the loss of oil event and subsequent disassembly, clearance measurements are no longer valid.

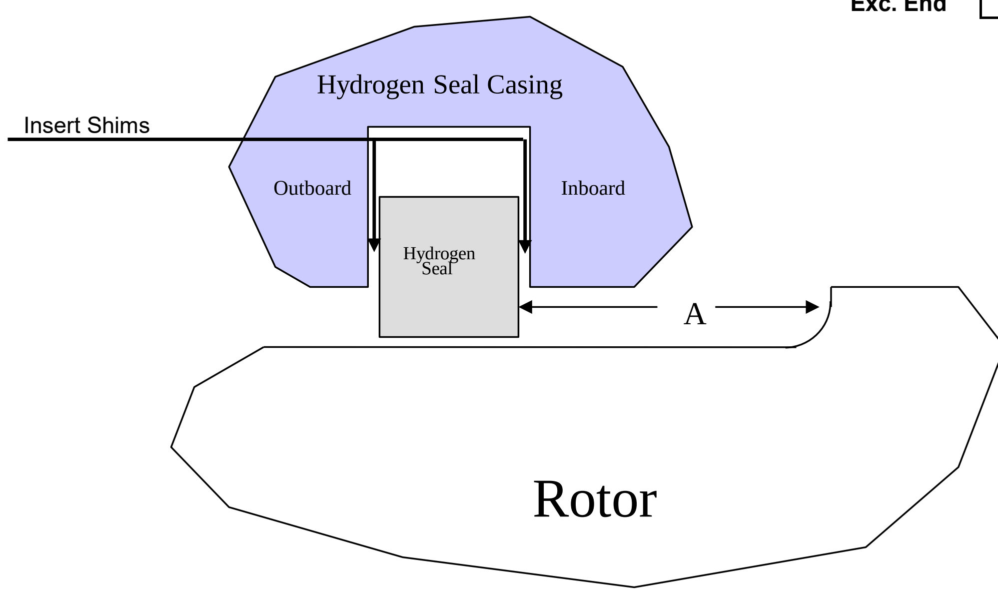
Hydrogen Seal Datasheets

Hydrogen Seal Squareness Check

Date (m/d/y) 2/15/2020 Turbine Serial Number 4465 Prepared by C Mack

Plant **Comanche** Unit **3** Initial
Final X

Turb. End
Exc. End X



	A			
Seal	**Left Side**	**Right Side**	**Top**	**Bottom**
Shimed to TE	5.309	5.309	5.305	
Amount of shim	0.009	0.007		

	A			
Shimed to CE	5.317	5.316	5.313	
Amount of shim	0.008	0.007		

Comments	

TC4F-36-007

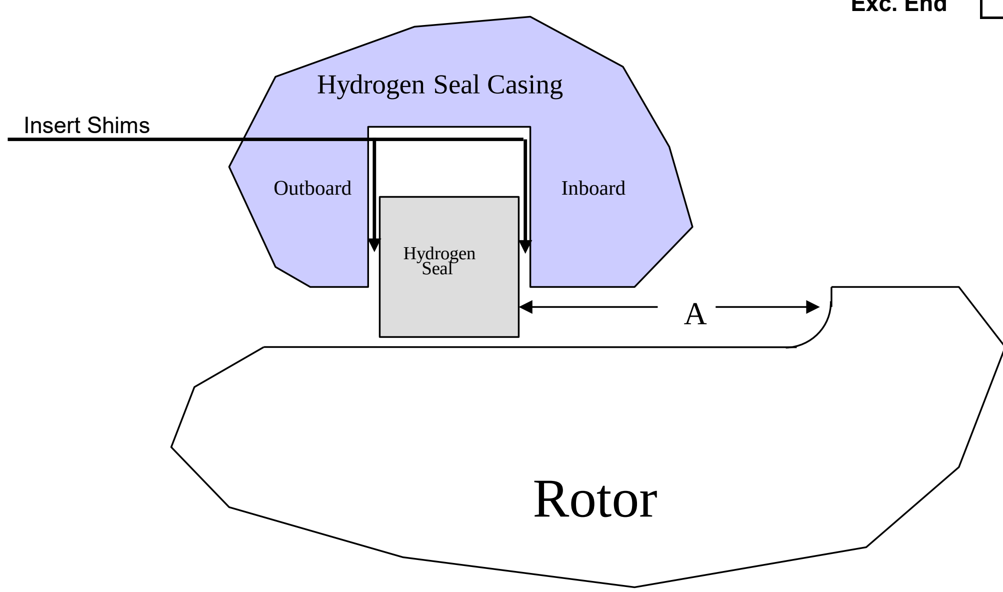
Hydrogen Seal Datasheets

Hydrogen Seal Squareness Check

Date (m/d/y) 2/15/2020 Turbine Serial Number 4465 Prepared by C Mack

Plant **Comanche** Unit **3** Initial X
Final

Turb. End	
Exc. End	X



	A			
Seal	**Left Side**	**Right Side**	**Top**	**Bottom**
Shimed to TE	4.086	4.086	4.088	
Amount of shim	0.007	0.007		

	A			
Shimed to CE	4.078	4.080	4.081	
Amount of shim	0.005	0.006		

Comments	

TC4F-36-007

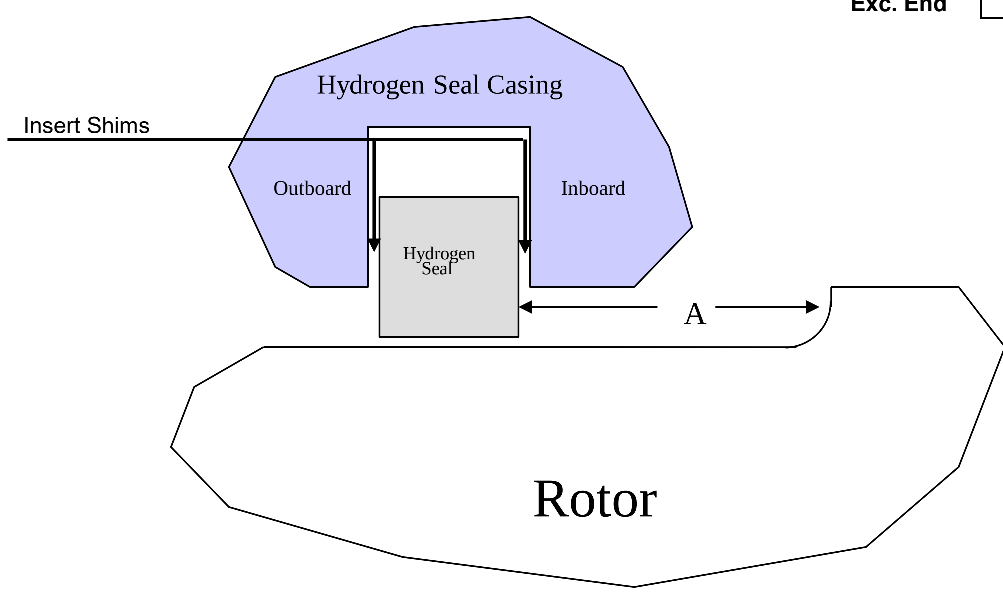
Hydrogen Seal Datasheets

Hydrogen Seal Squareness Check

Date (m/d/y) 2/15/2020 Turbine Serial Number 4465 Prepared by C Mack

Plant **Comanche** Unit **3** Initial ____ Final X

Turb. End X
Exc. End



	A			
Seal	**Left Side**	**Right Side**	**Top**	**Bottom**
Shimed to TE	4.688	4.682	4.687	
Amount of shim	0.008	0.006		

	A			
Shimed to CE	4.680	4.676	4.679	
Amount of shim	0.008	0.006		

Comments	

TC4F-36-007

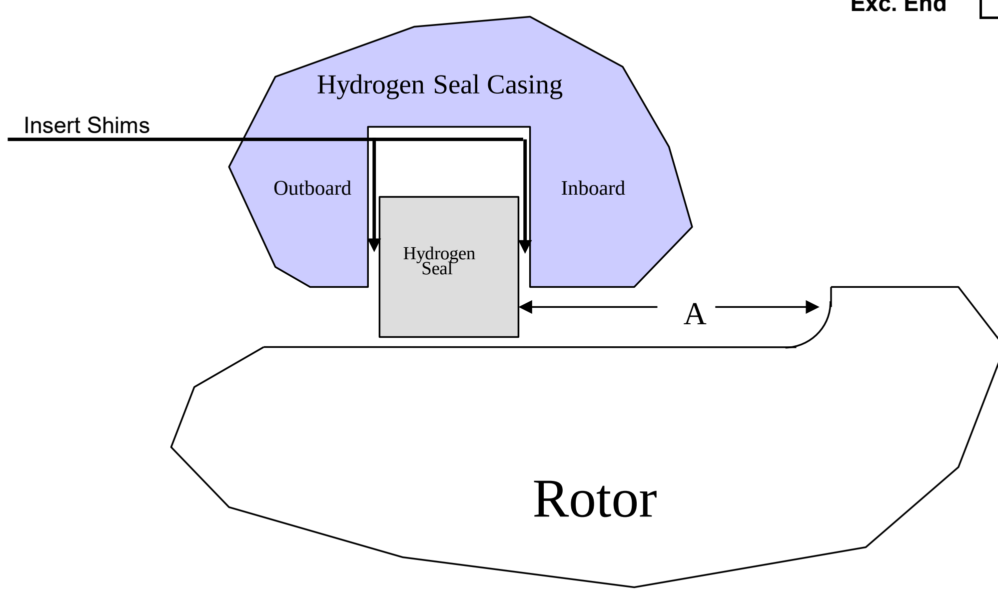
Hydrogen Seal Datasheets

Hydrogen Seal Squareness Check

Date (m/d/y) 2/15/2020 Turbine Serial Number 4465 Prepared by C Mack

Plant **Comanche** Unit **3** Initial X
Final

Turb. End X
Exc. End



	A			
Seal	**Left Side**	**Right Side**	**Top**	**Bottom**
Shimed to TE	5.937	5.936	5.938	
Amount of shim	0.006	0.006		

	A			
Shimed to CE	5.942	5.942	5.943	
Amount of shim	0.006	0.006		

Comments	

TC4F-36-007

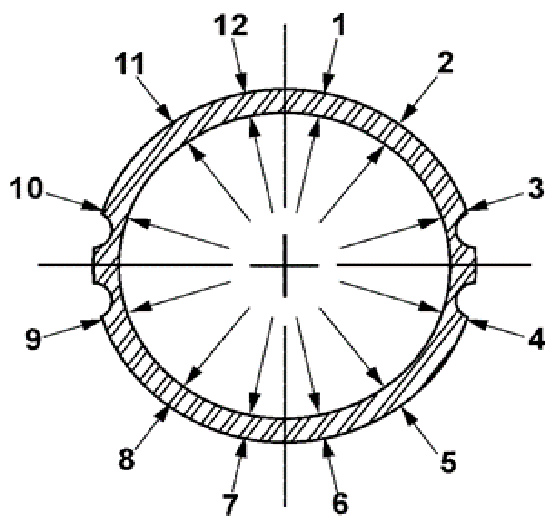
Hydrogen Seal Datasheets

(Westinghouse Datasheet)

Hydrogen Seal Ring Inspection

Date (m/d/y)	3/30/20	Turbine Serial Number	4465	Prepared by	C Mack
	Plant	Comanche	Unit 3	Initial	
				Final	X

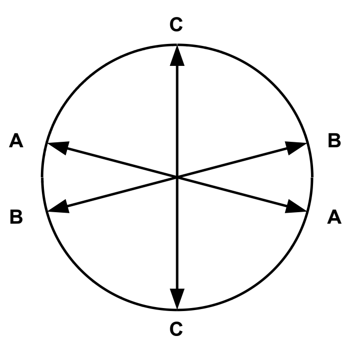
Turbine End ______
Collector End X



Hydrogen Seal Ring Flatness

Position	Feeler Gage Thickness Inner	Feeler Gage Thickness Outer
1	0.000	0.000
2	0.000	0.000
3	0.000	0.000
4	0.000	0.000
5	0.000	0.000
6	0.000	0.000
7	0.000	0.000
8	0.000	0.000
9	0.000	0.000
10	0.000	0.000
11	0.000	0.000
12	0.000	0.000

*** Feeler gage inserted 1/2"**



Hydrogen Seal Clearances

	Ring ID	Journal OD	Clearance
A	21.030	21.018	0.012
B	21.030	21.018	0.012
C	21.031	21.018	0.013

Axial Ring Clearance

	Upper Half			Lower Half		
	Left	Top	Right	Left	Bottom	Right
Ring Thickness	2.551	2.550	2.551	2.551	2.550	2.551
Groove Width	2.560	2.560	2.560	2.561	2.561	2.561
Clearance	0.009	0.010	0.009	0.010	0.011	0.010

Comments	

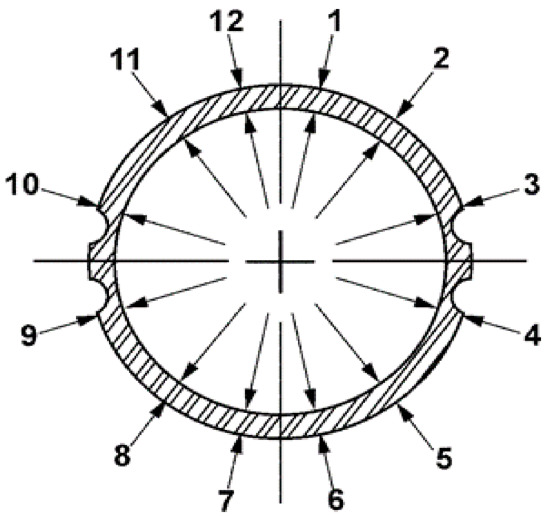
Hydrogen Seal Datasheets

(Westinghouse Datasheet)

Hydrogen Seal Ring Inspection

Date (m/d/y)	3/30/20	Turbine Serial Number	4465	Prepared by	C Mack
	Plant	Comanche	Unit 3	Initial	
				Final	X

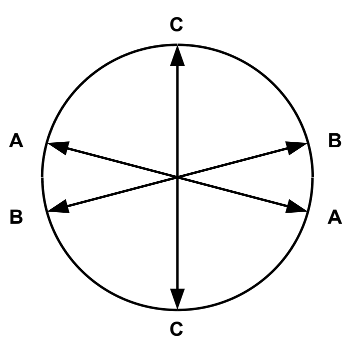
Turbine End X
Collector End



Hydrogen Seal Ring Flatness

Position	Feeler Gage Thickness	
	Inner	Outer
1	0.000	0.000
2	0.000	0.000
3	0.000	0.000
4	0.000	0.000
5	0.000	0.000
6	0.000	0.000
7	0.000	0.000
8	0.000	0.000
9	0.000	0.000
10	0.000	0.000
11	0.000	0.000
12	0.000	0.000

*** Feeler gage inserted 1/2"**



Hydrogen Seal Clearances

	Ring ID	Journal OD	Clearance
A	21.030	21.020	0.010
B	21.030	21.020	0.010
C	21.030	21.020	0.010

Axial Ring Clearance

	Upper Half			Lower Half		
	Left	Top	Right	Left	Bottom	Right
Ring Thickness	2.549	2.550	2.550	2.550	2.549	2.550
Groove Width	2.560	2.560	2.560	2.560	2.560	2.560
Clearance	0.011	0.010	0.010	0.010	0.011	0.010

Comments	

Confidential

Hydrogen Seal Datasheets

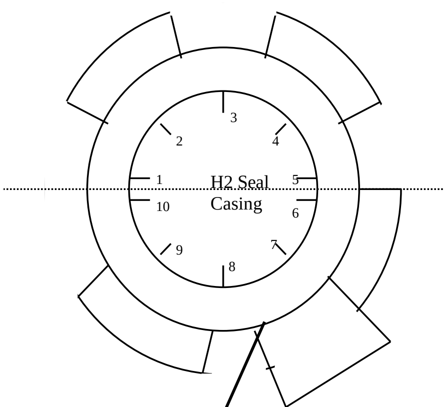
(Westinghouse Datasheet)

Hydrogen Seal Rings & Housing (Type 1)

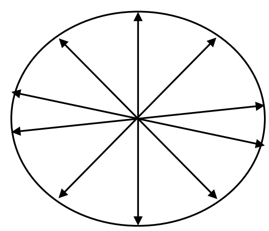
Date (m/d/y) 3/11/2020 Turbine Serial Numl 4465 Prepared by C Mack

Plant Comanche Unit 3

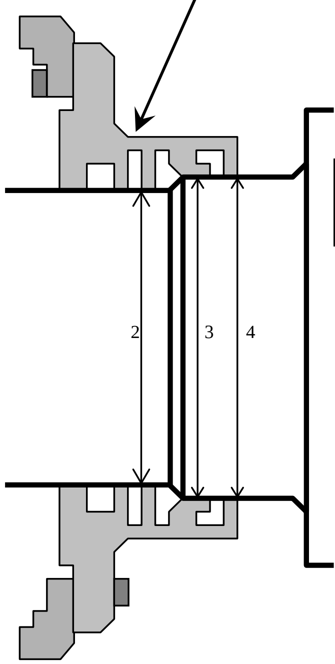
Turbine End
Collector End X

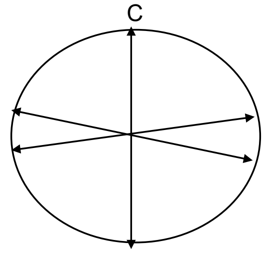


	Groove Width	Ring Width		Clear
1	2.559	2.546		0.013
2	2.560	2.546		0.014
3	2.560	2.546		0.014
4	2.560	2.546		0.014
5	2.560	2.546		0.014
6	2.559	2.546		0.013
7	2.560	2.546		0.014
8	2.560	2.546		0.014
9	2.560	2.546		0.014
10	2.559	2.546		0.013



			A	B	C	Avg.	Journal	Clear.
			21.028	21.026	21.026	21.026	21.020	0.006





Row	A	B	C	Avg	Journal	Clear.	Max. Clear.
2	21.062	21.063	21.061	21.062	21.020	0.042	0.043
3	22.646	22.645	22.647	22.646	22.594	0.052	0.053
4							

Comments	

Hydrogen Seal Datasheets

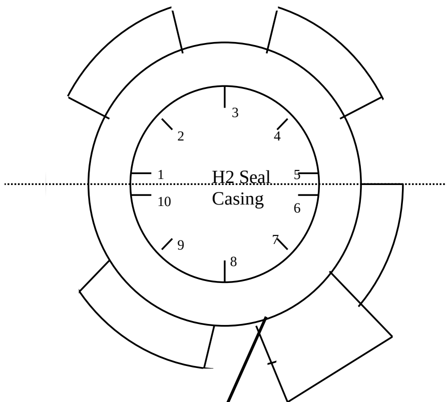
(Westinghouse Datasheet)

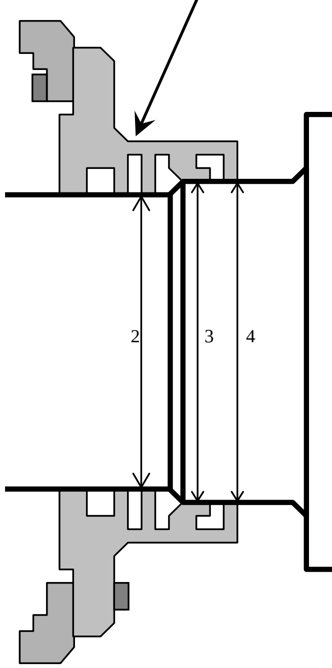
Hydrogen Seal Rings & Housing (Type 1)

Date (m/d/y) 3/11/2020 Turbine Serial Numl 4465 Prepared by C Mack

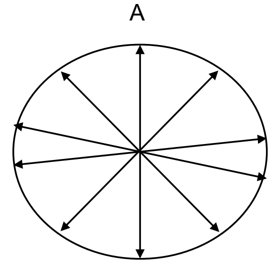
Plant Comanche Unit 3

Turbine End X
Collector End



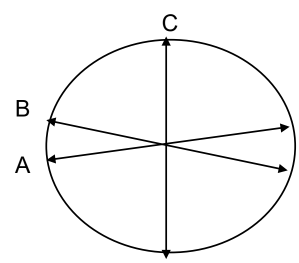


	Groove Width	Ring Width		Clear
1	2.559	2.551		0.008
2	2.560	2.551		0.009
3	2.560	2.551		0.009
4	2.559	2.551		0.008
5	2.559	2.551		0.008
6	2.559	2.551		0.008
7	2.559	2.551		0.008
8	2.559	2.551		0.008
9	2.559	2.551		0.008
10	2.559	2.551		0.008



H2 Seal Rings

			A	B	C	Avg.	Journal	Clear.
			21.032	21.030	21.030	21.030	21.018	0.012



Labyrinth Seals

Row	A	B	C	Avg	Journal	Clear.	Max. Clear.
2	21.068	21.068	21.067	21.068	21.018	0.050	0.050
3	22.649	22.650	22.647	22.649	22.594	0.055	0.056
4							

Comments	

Hydrogen Seal Ring Condition

Confidential

Collector End Hydrogen Seal Ring Condition – As Found

Confidential

Hydrogen Seal Ring Condition

Collector End Hydrogen Seal Ring Condition – As Found

Confidential

Hydrogen Seal Ring Condition

Turbine End Hydrogen Seal Ring Condition – As Found

Confidential

Hydrogen Seal Ring Condition

Turbine End Hydrogen Seal Ring Condition – As Found

4.2 Stator Visual Inspection

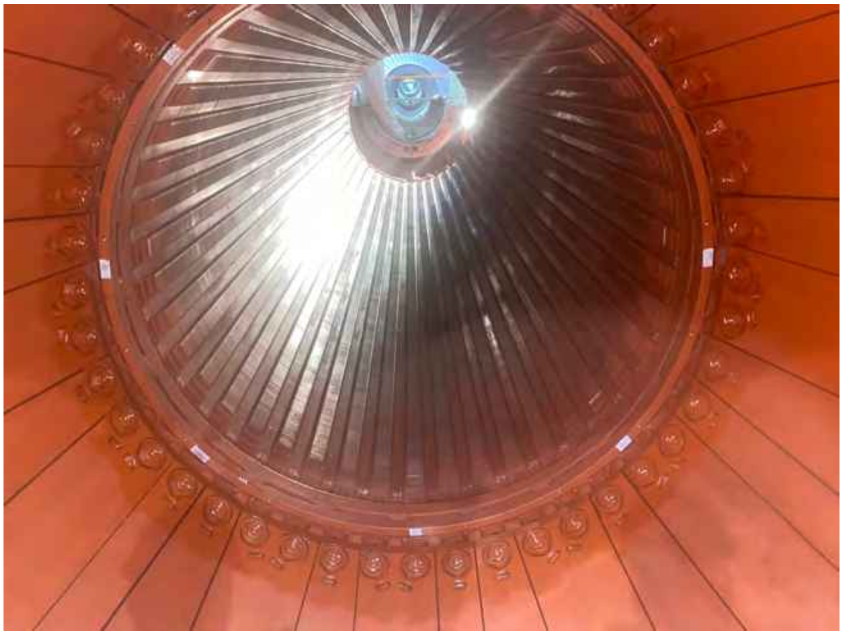
4.2.1 Stator Core/Laminations

Part Condition: Good

Part Description:

Upon visual inspection, the Stator Core appeared tight and free of smeared or damaged laminations. Core Compression Nuts were inspected for signs of greasing and Spring Bars were inspected for cracking via Borescope. There were no indications of greasing or movement present at the Core Nuts and no cracks were noted in the Spring Bars. An ELCID test was also performed to verify the integrity of the Core laminations. See ELCID test results under section 4.2 'Stator Tests'.

Core Compression Nuts were also subjected to a 500V Megger test. All passed at >100G:' within 1-minute.



Stator Core

4.2.1 Stator Core/Laminations

Core Compression Nuts

4.2.2 Stator End Winding Assembly

Part Condition: Good

Part Description:

The Stator End Winding was inspected for signs of dusting, greasing and overall movement/ vibration. There were no visual indications of loose blocking, ties or End Winding support hardware. Torque checks were also performed on the End Winding insulation and structural bolts, at the customer's request. For every nut that was checked, at least a 1/4 turn of movement was noted, with some allowing up to 3/4 of a turn. Based on this, the customer requested that we perform a full torque sequence on all End Winding insulation and structural bolts. Torque checks were performed satisfactorily.

Recommendation Status: Should be planned for next Outage

Recommendation Type: Repairs

Recommendation Description:

At the next outage in which the Rotor is removed, perform torque spot-checks on End Winding structural and insulation bolts. If torque checks are unsatisfactory and a full torque sequence is required, purchase and install new lock plates, as they should not be exercised a second time.

4.2.2 Stator End Winding Assembly

End Winding Insulation Bolts

End Winding Structural Plate Bolts

4.2.3 High Voltage Bushing Box

Part Condition: Good

Part Description:

The HV Bushing Box was inspected for signs of arcing and/or electrical heating at the Flex Link connections, greasing/dusting at block and tie locations, leaking gaskets, H2 embrittlement/corrosion of electrical surfaces and overall structural integrity. Aside from a minor amount of oily surface contamination, the integrity of all Bushing Box components was in good condition. All oil and surface contaminants were cleaned using lint-free rags and denatured alcohol. Bushings were also subjected to Hipotential testing at 68.9 KVDC. See results from Electrical testing under section 4.2 'DC Leakage & Hipot Test'.

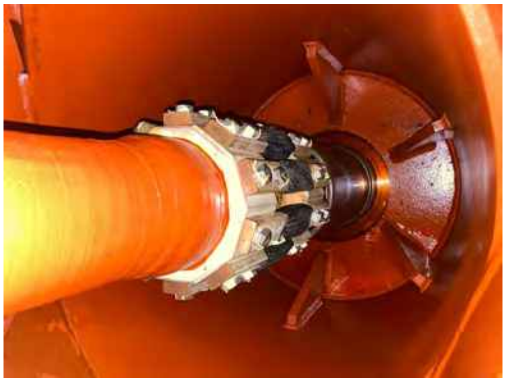
HVB Block & Tie (H2 Side)

HVB Surface Contamination (H2 Side)

HVB U-X (H2 Side)

HVB V-Y (H2 Side)

4.2.3 High Voltage Bushing Box



HVB W-Z (H2 Side)

HVB Air Side

4.3 Stator Tests

4.3.1 Stator DC Insulation Resistance & Polarization Index (PI) Test

Part Condition: Good

Part Description:

Each phase of the Armature was subjected to a 10KV DC insulation resistance test for 10 minutes and a Polarization Index was subsequently calculated in preparation for the DC Leakage test. Each phase passed and there were no signs of insulation breakdown. All data was recorded on attached data sheet D3162043.

Confidential

Stator DC Insulation Resistance_Co…

FieldCore a GE company

Stator Winding Insulation Resistance Test

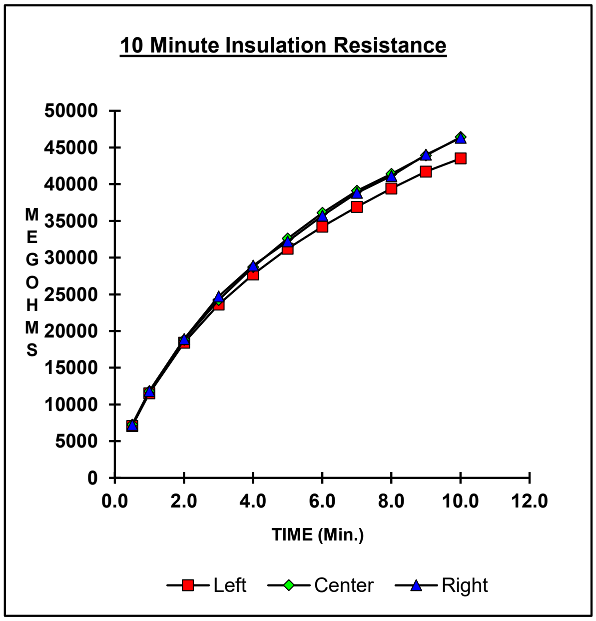
Generator Test and Inspection

Date	03/02/2020	Turbine No.:	04465-M00-0103	Prepared by:	Steve Maxwell
Equipment	WATER-COOLE	Generator No.:	05HBSE01		Joe Lewis
OEM	Mitsubishi	Stator Voltage:	27000	Project ID:	I01-044232

DC INSULATION RESISTANCE (Megohms) per TM2030

Voltage: 10000 Volts

Time(Min)	Left	Center	Right
0.5	7050	7230	7200
1.0	11500	11800	11800
2.0	18400	18800	18900
3.0	23600	24200	24700
4.0	27700	28700	28900
5.0	31200	32600	32200
6.0	34200	36100	35700
7.0	36900	39100	38800
8.0	39400	41400	41100
9.0	41700	43900	44000
10.0	43500	46400	46300
PI	**3.8**	**3.9**	**3.9**
Rule 1	Pass	Pass	Pass
Rule 2	Pass	Pass	Pass
After Hipot$_{1\ min}$			
Rule 3	**NA**	**NA**	**NA**



Conditions During Insulation Resistance	
Winding Temperature (°C)	22
Ambient Temprature (°C)	23
Relative Humidity (%)	64%

Insulation Type	Thermal Setting (i.e. Micapal, Isotenax, >1960)						
Corrected Resistance$_{1\ minute\ at\ 40°C\ IEEE43-2013}$	Left	9200	Center	9440	Right	9440	Megohms

HIGH VOLTAGE PROOF TEST per TM2050			
Test Series	DC	Recommended Test Voltage	Actual Test Voltage
Stator Voltage	27000.0 KV	DC 68850.0 KV	DC 68850.0 KV

NOTES
1.) Prior to any high voltage testing, fill in D316218 and get customer agreement on test voltages.
2.) For DC, the test is performed at the end of the DC Leakage Test, use D3162044.
3.) For AC, record results below.

AC HIPOT RESULTS	Left	Center	Right
Passed test at (KV) - 1 min.			
Failed test at [KV/Time(sec)]		N/A	
Excitation Voltage (Volts)			
Current (Amps)			

Conditions During HV Proof Test	
Winding Temperature (°C)	22
Ambient Temperature (°C)	23
Relative Humidity (%)	64%

Instrument Description	ID No.	CAL Exp. Date	COMMENTS
Megger	2251601	06/19/2020	

4.3.2 Stator Winding Resistance Test (DLRO)

Part Condition: Good

Part Description:

Using a Biddle 247001 Digital Low Resistance Ohmmeter, the resistance of each Armature phase was measured to ensure there were no loose or broken connections throughout the winding. Secondly, the 'as found' value was compared to the factory resistance value to ensure it was within specification. Test was completed satisfactorily and all data was recorded on attached data sheet D3162041.

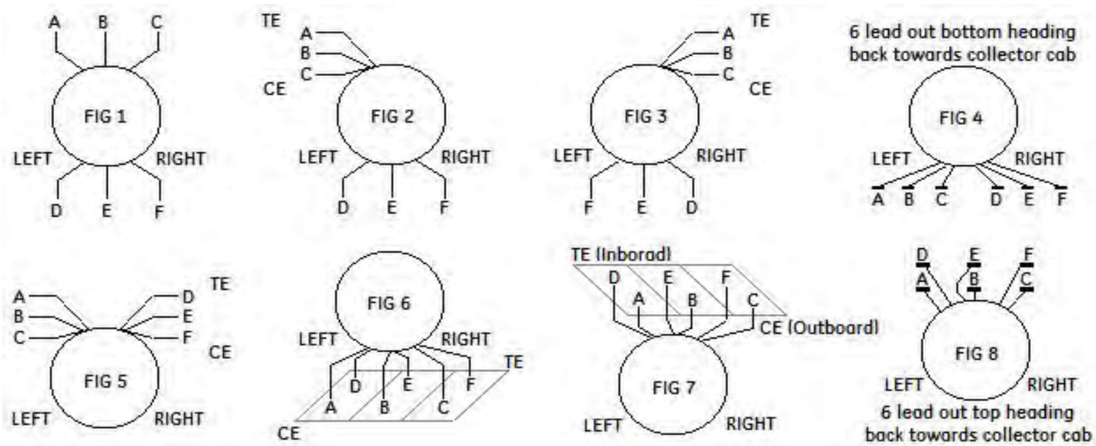
Stator Winding Resistance_Comanch…

FieldCore
a GE company

Armature Winding Resistance

Single Terminal

Date (m/d/y) 2/25/2020 Turbine Serial No. 04465-M00-0103 Prepared by Steve Maxwell
Generator Serial No. 05HBSE01 Project ID I01-044232



Applicable Figure	FIG 6	A	B	C	D	E	F
Terminal Position In Figure		W	V	U	Z	Y	X

Terminal Labels	Left	Center	Right	Line or Neutral Terminals	
Turbine End	W	V	U	Neutral Terminals	
Collector End	Z	Y	X	Line Terminals	
Customer Designation	W-Z	V-Y	U-X		
Resistance	0.001028	0.001035	0.001038	Temp ºC	20.5
Resistance Corrected to 25ºC	0.001046	0.001053	0.001056		
Factory Resistance at 25ºC	0.001068	0.001068	0.001068	Fact. Or Calc. Selectior	Factory
Prior Test Correct to 25ºC	0.001038	0.001047	0.001044	Date (mm/dd/yy)	10/13/2011

Test Equipment Information		Rule	A	B	C
Serial No. of Equipment	53321-1013	1	Pass		
Calibration date	6/21/2019	2	Pass	Pass	Pass
Calibration Due Date	6/21/2020	3	Pass	Pass	Pass
		4	NA	NA	NA

Rules:
1. The spread of copper resistance readings between the phases should be within 1%.
2. When comparing to historical test results each phase should be within +/- 1% of the previous reading for that phase.
3. When comparing to factory test results, each phase should be within +/- 2% of the original factory measurement for that phase.
4. When comparing to calculated values, each phase should be within +/- 5% of the calculated

Comments

D3162041 Sheet: (a) Rev 2.0 - 01/22/2020

4.3.3 DC Leakage & Hipot Test

Part Condition: Good

Part Description:

Using a Hipotronics (model 880PL-5mA) DC High Potential test set, a 15KVDC soak voltage was applied to each phase for 10 minutes and a polarization index and absorption ratio were subsequently calculated, based off of the recorded current values. The voltage was then increased by 3 KVDC increments at prescribed time intervals, based on the absorption ratio (N), up to 54KVDC. Finally, the Voltage was increased to the Hipot value of 68.9KVDC and held for one minute.

The final Hipot value of 68.9KVDC was based off of the AC RMS equivalent of 1.5 times the Generators Rated Voltage of 27KV (1.7 x 1.5 x 27KV), as requested by the Customer. Testing was completed satisfactorily and recorded on attached data sheet D3162044. The Hipot leakage on the center phase (V-Y) was the highest of all three phases at 415µA, however there were no signs of insulation breakdown in the armature winding or bushings.

Recommendation Status: Should be planned for next Outage

Recommendation Type: Services

Recommendation Description:

Continue to perform Stator Electrical testing and trend DC Leakage data at prescribed outage intervals, per the most current revision of GEK103566, "Creating an Effective Generator Maintenance Program"

DC Leakage & Hipot Test_Comanche …

FieldCore a GE company

Armature Insulation DC Leakage Test

Date(m/d/y):	3/2/2020	Generator Serial No.	05HBSE01	Prepared by	Stephen Maxwell
Customer:	Xcel Energy	Turbine Serial No.	04465-M00-0103		Joe Lewis
Manufacturer:	Mitsubishi			FSR No.	I01-044232

A 15 KV DC voltage was applied to each phase with the other two phases grounded for a period of 10 minutes. Readings were recorded at specific time intervals. On the basis of these readings a time schedule is established for reading stabilized leakage currents at successively higher voltage values up to a maximum value, approximately twice line-to-line voltage. The current readings are plotted as a function of voltage to determine if a nearly linear relationship exists, indicating a constant insulation resistance as a function of voltage.

Time	Left:	W-Z	Center:	V-Y	Right:	U-X
(Minutes)	μA	Megohm	μA	Megohm	μA	Megohm
0.50	1.80	8300	1.80	8300	1.80	8300
1.00	1.20	13000	1.50	10000	1.40	11000
1.50	0.90	17000	1.20	13000	1.00	15000
2.00	0.80	19000	0.90	17000	0.90	17000
3.00	0.70	21000	0.80	19000	0.80	19000
3.16	0.65	23000	0.75	20000	0.70	21000
4.00	0.55	27000	0.65	23000	0.60	25000
5.00	0.50	30000	0.55	27000	0.50	30000
6.00	0.40	38000	0.45	33000	0.40	38000
7.00	0.30	50000	0.35	43000	0.30	50000
8.00	0.25	60000	0.25	60000	0.25	60000
9.00	0.20	75000	0.20	75000	0.20	75000
10.00	0.15	100000	0.15	100000	0.15	100000
PI	8.00		10.00		9.33	
N	2		2		2	

Winding Temp (ºC)
23

Wet Bulb (ºF)
N/A

Dry Bulb (ºF)
73.4

Relative Humidity
24.8%

% of	Left:	W-Z		Center:	V-Y		Right:	U-X	
15 KV	Time	KV	μA	Time	KV	μA	Time	KV	μA
100	10'	15	0.15	10'	15	0.15	10'	15	0.15
120	13'14"	18	0.50	13'14"	18	0.40	13'14"	18	0.40
140	15'56"	21	0.80	15'56"	21	0.70	15'56"	21	0.70
160	18'17"	24	1.30	18'17"	24	1.20	18'17"	24	1.20
180	20'23"	27	2.00	20'23"	27	2.20	20'23"	27	1.60
200	22'19"	30	2.40	22'19"	30	6.50	22'19"	30	2.00
220	24'4"	33	2.80	24'4"	33	8.00	24'4"	33	3.20
240	25'41"	36	3.40	25'41"	36	14.00	25'41"	36	6.00
260	27'12"	39	34.00	27'12"	39	25.00	27'12"	39	22.00
280	28'37"	42	42.00	28'37"	42	31.00	28'37"	42	26.00
300	29'56"	45	46.00	29'56"	45	36.00	29'56"	45	24.00
320	31'11"	48	50.00	31'11"	48	39.00	31'11"	48	22.00
340	32'23"	51	58.00	32'23"	51	42.00	32'23"	51	28.00
360	33'31"	54	64.00	33'31"	54	48.00	33'31"	54	32.00
380									
400									
420									
	HIPOT	68.9	90.00	**HIPOT**	68.9	430.00	**HIPOT**	68.9	315.00

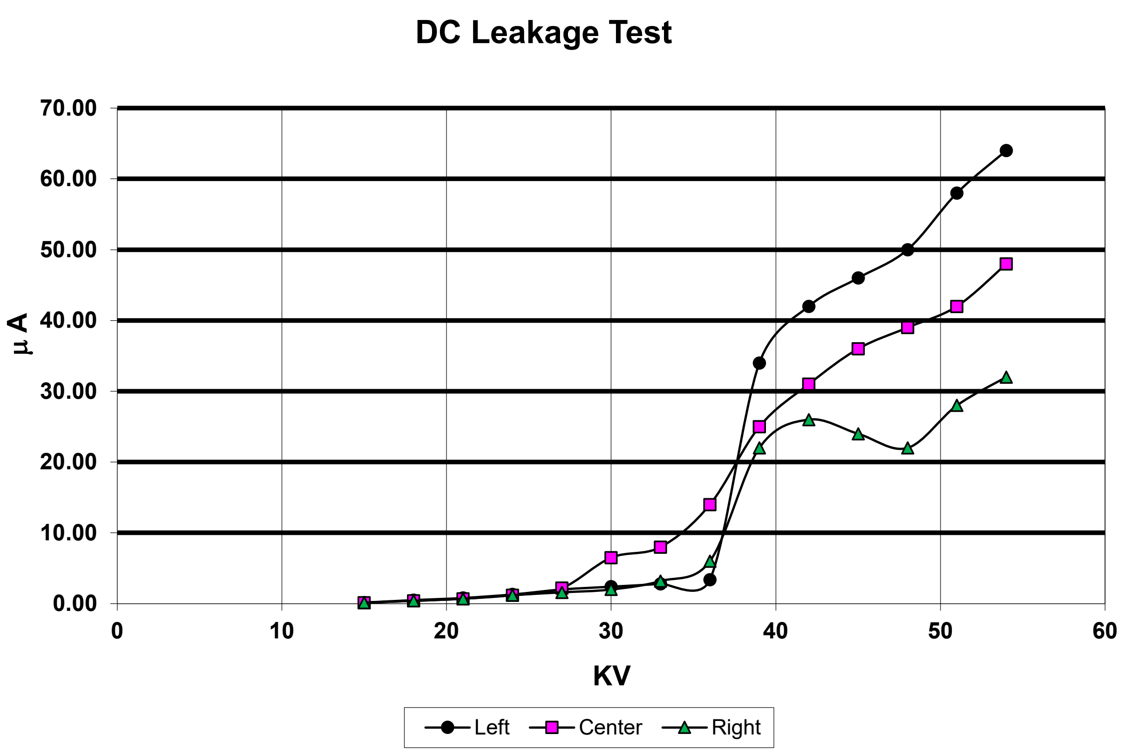
Confidential

DC Leakage & Hipot Test_Comanche ...

FieldCore a GE company

Armature Insulation DC Leakage Test

Date(m/d/y)	3/2/2020	Generator Serial No.	05HBSE01	Prepared by	Stephen Maxwell
Customer	Xcel Energy	Turbine Serial No.	465-M00-0103		Joe Lewis
Manufacture	Mitsubishi			FSR No.	I01-044232



Comments:
Serial No. of Equipment: P0406025 Calibration Date: 6/19/2019 Calibration Due Date: 6/19/2020

4.3.4 ELCID Test

Part Condition: Good

Part Description:

Using an IRIS™ Electromagnetic Core Imperfection Detector (ELCID), the Stator Core was excited to approximately 4% of its rated Flux. A trolley with an attached Chattock was used to measure for circulating currents throughout each Core Iron package in every slot, in order to detect smeared or shorted lamination's throughout the Core Iron. Depending on the level of contact between the Key Iron and the dovetail in locations where Belly Bands are located, false positive indications may exist. Regardless, there were no indications greater than 100mA in any slot, which satisfies GE Engineering's threshold for circulating currents in Stator Core Iron. All data was recorded in the attached ELCID Report.

Recommendation Status: Should be planned for next Outage

Recommendation Type: Services

Recommendation Description:

Perform ELCID testing at the next available outage in which the Rotor is removed, in order to verify the integrity of the Stator Core Iron.

Confidential

ELCID Report_Comanche U3_2-26-20…

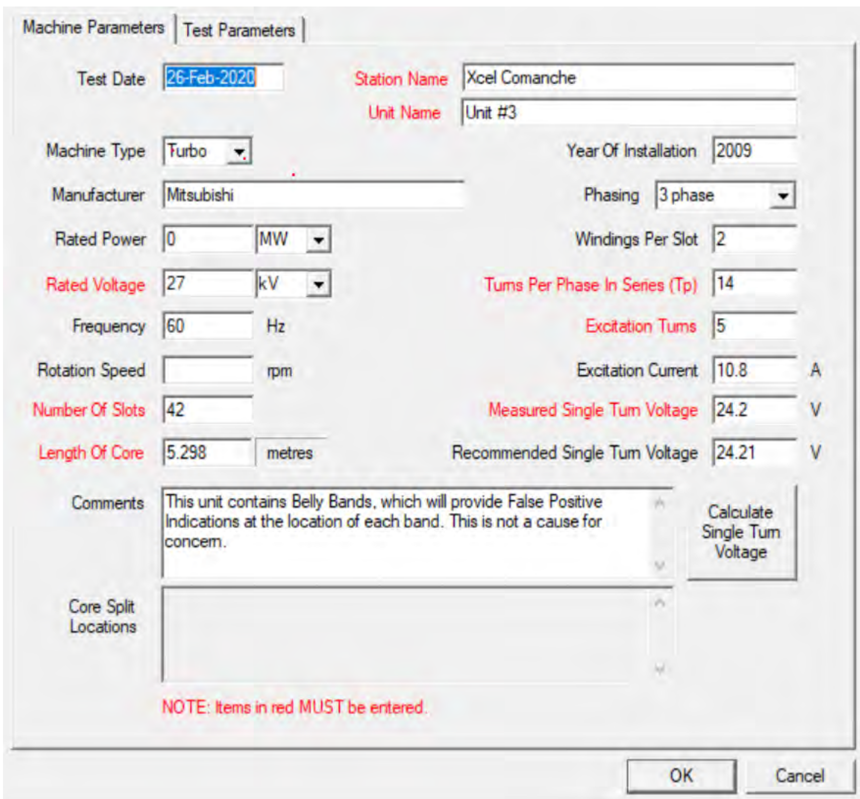
FieldCore
a GE company

ELCID Test Data

ELCID (As Found)

Date	2/26/2020	Turbine Serial No.	04465-M00-0103	Prepared by:	Steve Maxwell
		Generator Serial No.	05HBSE01	Customer:	Xcel Energy
				Station:	Comanche U3

Machine Parameters


Machine Parameters | Test Parameters

Test Date: 26-Feb-2020
Station Name: Xcel Comanche
Unit Name: Unit #3
Machine Type: Turbo
Year Of Installation: 2009
Manufacturer: Mitsubishi
Phasing: 3 phase
Rated Power: 0 MW
Windings Per Slot: 2
Rated Voltage: 27 kV
Turns Per Phase In Series (Tp): 14
Frequency: 60 Hz
Excitation Turns: 5
Rotation Speed: rpm
Excitation Current: 10.8 A
Number Of Slots: 42
Measured Single Turn Voltage: 24.2 V
Length Of Core: 5.298 metres
Recommended Single Turn Voltage: 24.21 V
Comments: This unit contains Belly Bands, which will provide False Positive Indications at the location of each band. This is not a cause for concern.
Calculate Single Turn Voltage
Core Split Locations:
NOTE: Items in red MUST be entered.
OK | Cancel

Power Generation Services

Comments:	
Elcid Initial (as found)	

ELCID Report_Comanche U3_2-26-20…

FieldCore
a GE company

ELCID Test Data

ELCID (As Found)

Date 2/26/2020	Turbine Serial No. 04465-M00-0103	Prepared by:	Steve Maxwell
	Generator Serial No. 05HBSE01	Customer:	Xcel Energy
		Station:	Comanche U3

Description of Test

An Electro Magnetic Core Imperfection Detection Test was performed on all core slots. The data was collected and recorded using the provided IRIS ELAN software. An analysis of the data did not reveal any areas that exceeded the allowable threshold of 100mA. The ELCID test indicates areas on the inside diameter of the core iron surface that are electrically connected by smeared or damaged core laminations. These core laminations are individually varnished so that the varnish film provides an insulation barrier to its neighboring core lamination. This insulating layer minimizes circulating currents and subsequent heating in the iron. Excessive heating in the iron has the potential of degrading the stator bars, which are in contact with the core iron surfaces. A 4% flux is induced in the iron and a circulating current will flow if the iron has been inadvertently smeared electrically together. An action level of 100 milliamps is set at which point core iron repairs will be performed to remove the local circulating currents between a gouged or smeared area.

The **Black trace** indicates the trolley movement was from the CE (Collector End) to TE (Turbine End)
Red color indicates >100 milliamp trace

The **Blue trace** indicates the trolley movement was from the TE (Turbine End) to CE (Collector End) **Orange color indicates >100 milliamp trace**

No slots had any indications equal to or greater 100 ma during this test.
The following page (peaks) indicates the highest readings during the performance of the test.

Y axis indications milliamps, X axis is axial location in the core

Comments:

Initial, 'as found' ELCID.

FieldCore
a GE company

ELCID Test Data
ELCID (As Found)

Date 2/26/2020

Turbine Serial No. 04465-M00-0103
Generator Serial No. 05HBSE01

Prepared by: Steve Maxwell
Customer: Xcel Energy
Station: Comanche U3

Highest Peak Recorded

Peak Analysis

1	2	3	4	5	6	7	8	9	10
-41	50	-68	46	69	-44	45	43	45	56
11	12	13	14	15	16	17	18	19	20
48	55	65	66	-32	-28	35	32	-32	35
21	22	23	24	25	26	27	28	29	30
34	35	34	42	36	38	49	44	44	54
31	32	33	34	35	36	37	38	39	40
-50	44	41	-54	33	-43	-31	-53	-27	76
41	42								
-44	-27								

Peak Value Threshold 0

Copy to Clipboard | Notes | Recalculate | Cancel

Comments:
No indications >100mA. Highest current values in each slot are associated with Belly Bands.

ELCID Report_Comanche U3_2-26-2020

FieldCore
a GE company

ELCID Test Data

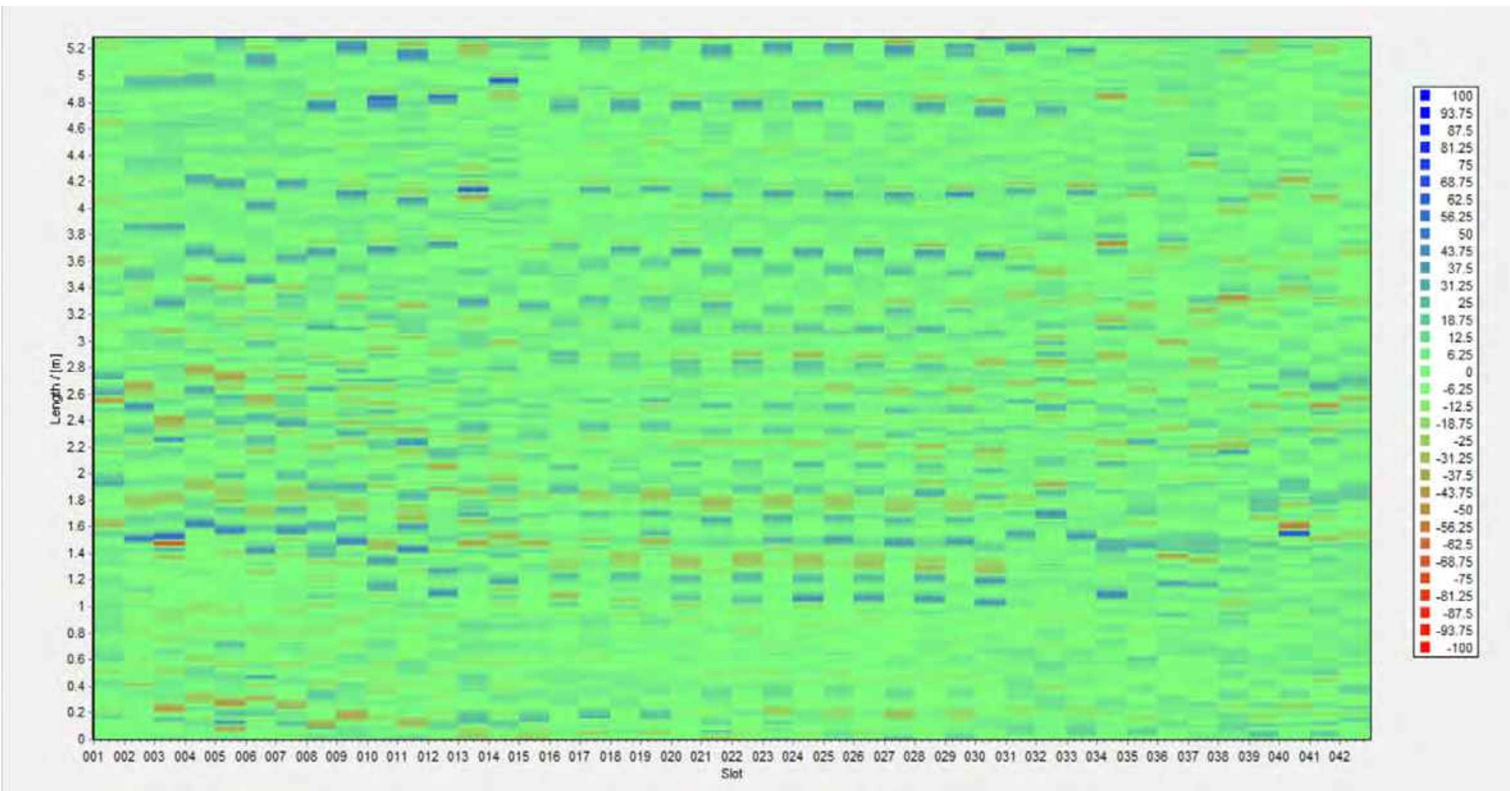
ELCID (As Found)

Date 2/26/2020

Turbine Serial No. 04465-M00-0103
Generator Serial No. 05HBSE01

Prepared by: Steve Maxwell
Customer: Xcel Energy
Station: Comanche U3

Core Visualization



ELCID Report_Comanche U3_2-26-2020

FieldCore
a GE company

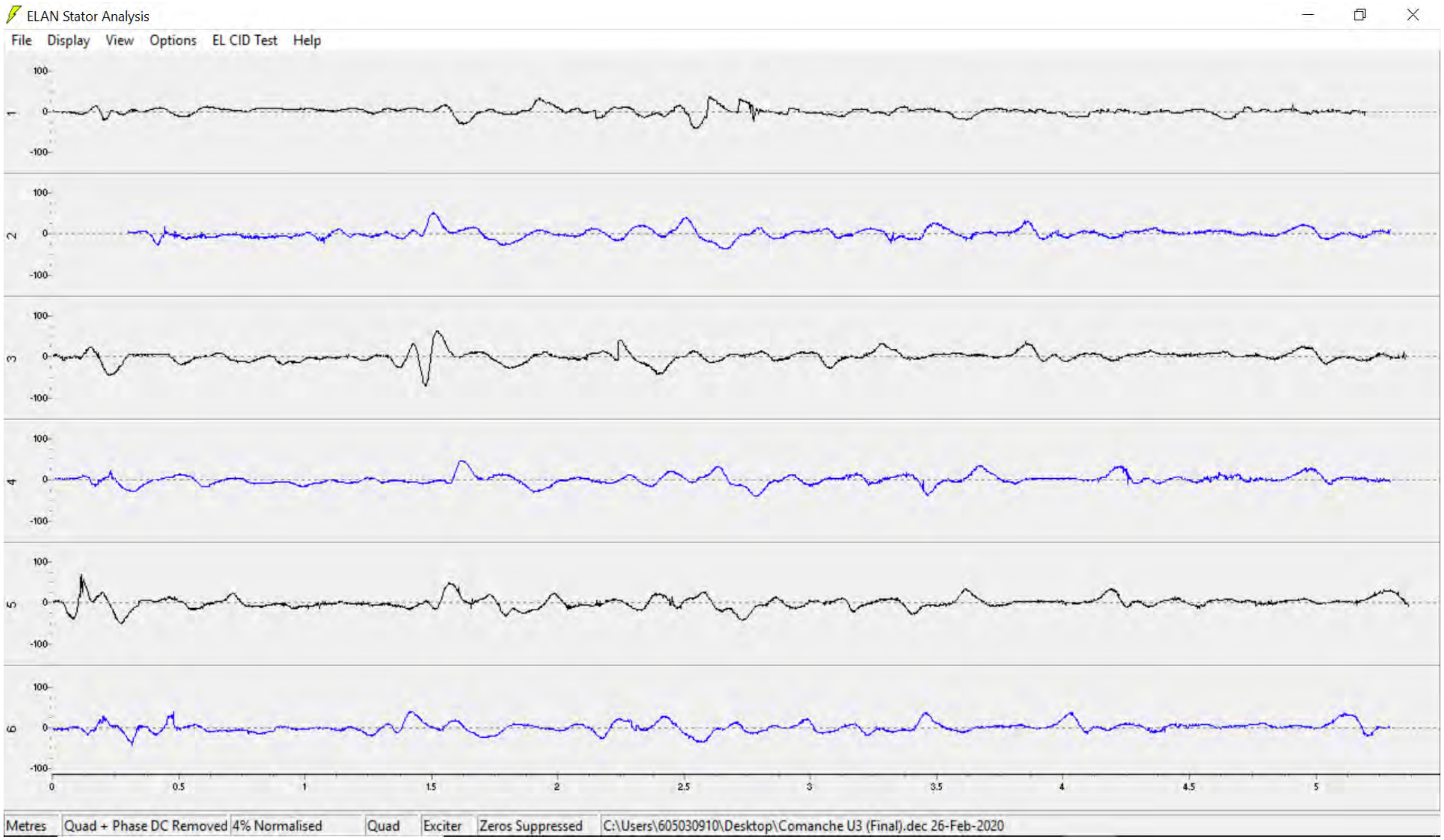
ELCID Test Data
ELCID (As Found)

Date 2/26/2020

Turbine Serial No. 04465-M00-0103
Generator Serial No. 05HBSE01

Prepared by: Steve Maxwell
Customer: Xcel Energy
Station: Comanche U3

Slots 1-6



ELCID Report_Comanche U3_2-26-2020

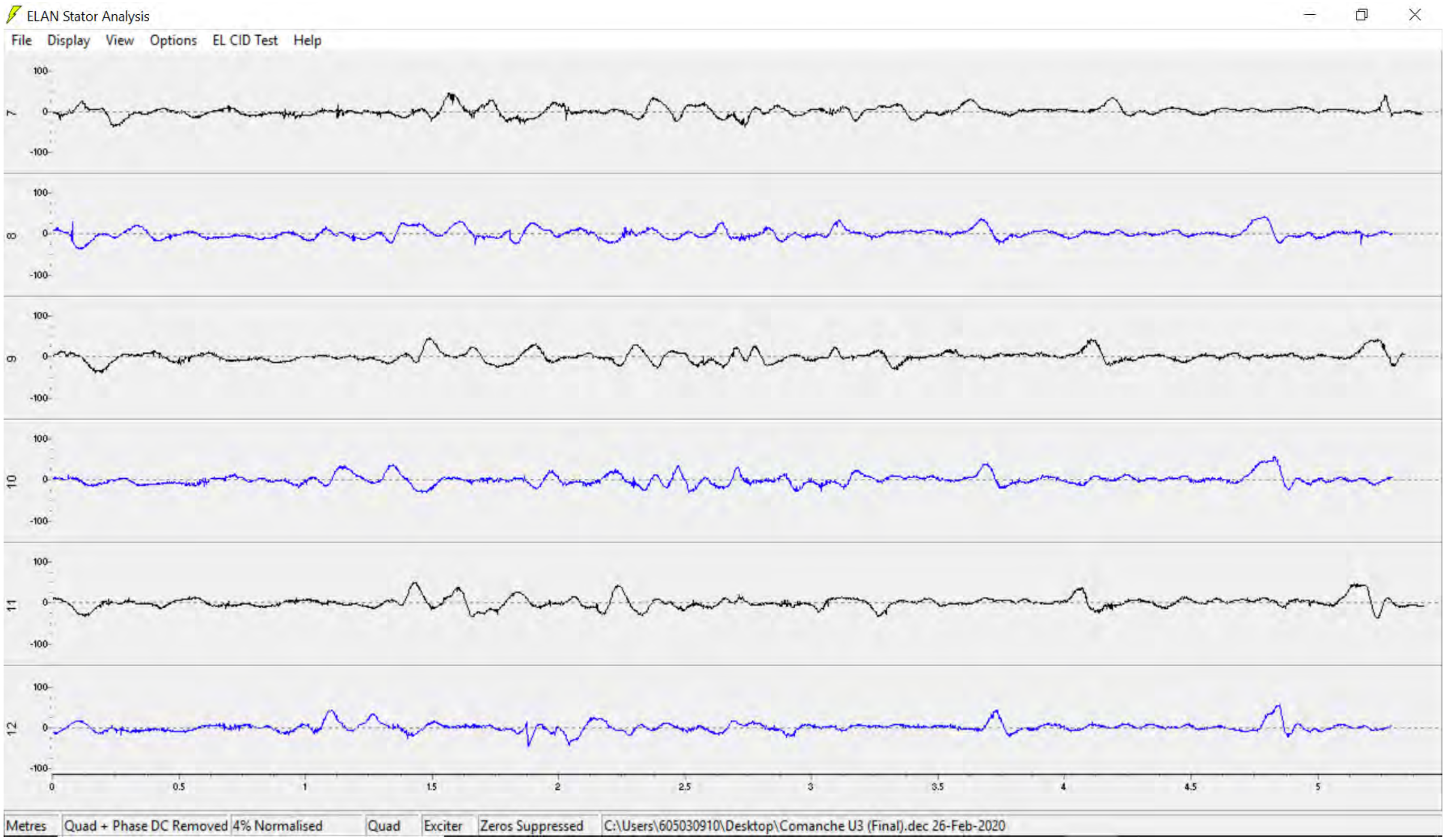
FieldCore a GE company

ELCID Test Data

ELCID (As Found)

Date	2/26/2020	Turbine Serial No.	04465-M00-0103	Prepared by:	Steve Maxwell
		Generator Serial No.	05HBSE01	Customer:	Xcel Energy
				Station:	Comanche U3

Slots 7-12



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ELCID Report_Comanche U3_2-26-2020

FieldCore
a GE company

ELCID Test Data

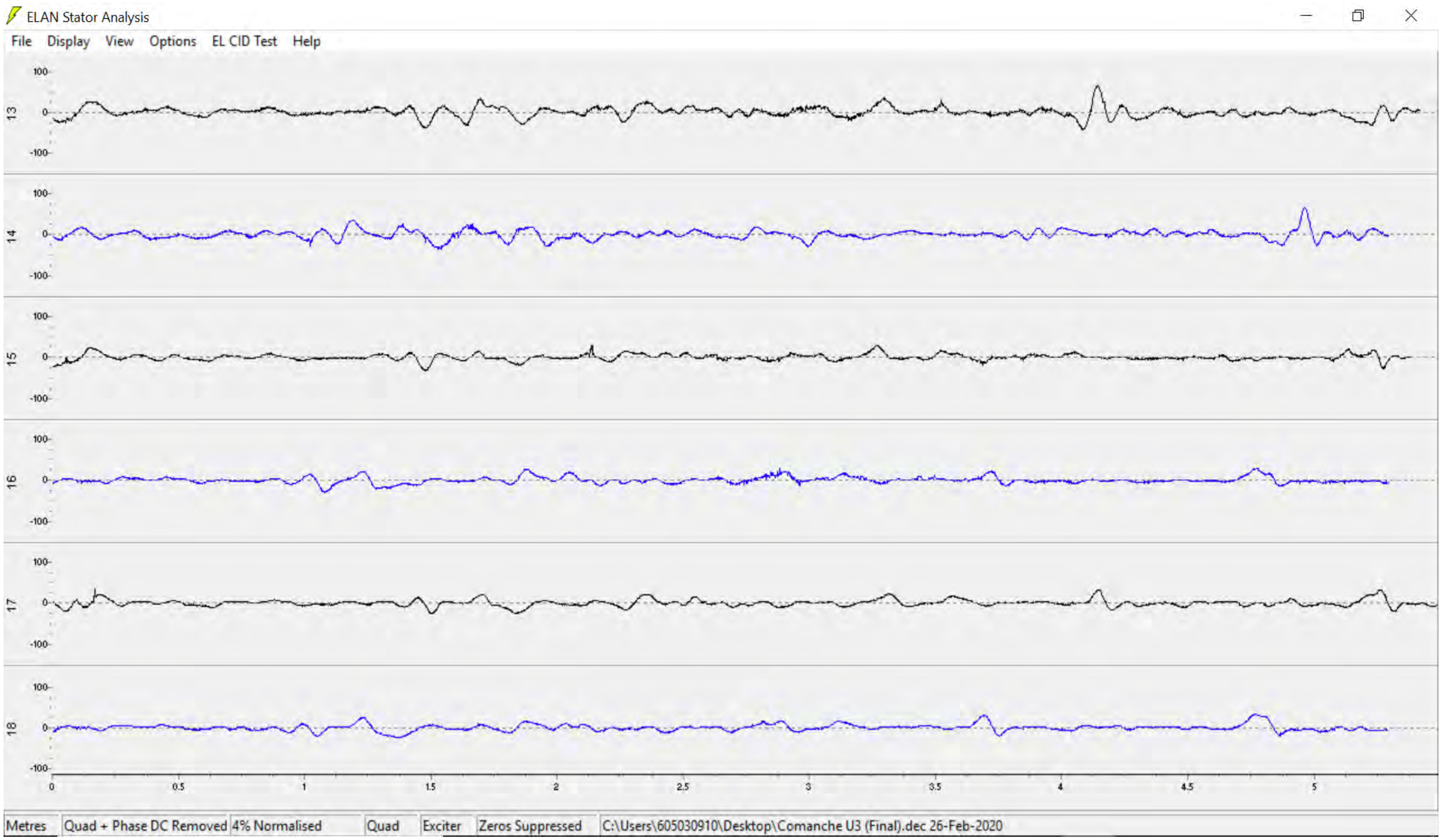
ELCID (As Found)

Date 2/26/2020

Turbine Serial No. 04465-M00-0103
Generator Serial No. 05HBSE01

Prepared by: Steve Maxwell
Customer: Xcel Energy
Station: Comanche U3

Slots 13-18



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ELCID Report_Comanche U3_2-26-2020

FieldCore
a GE company

ELCID Test Data

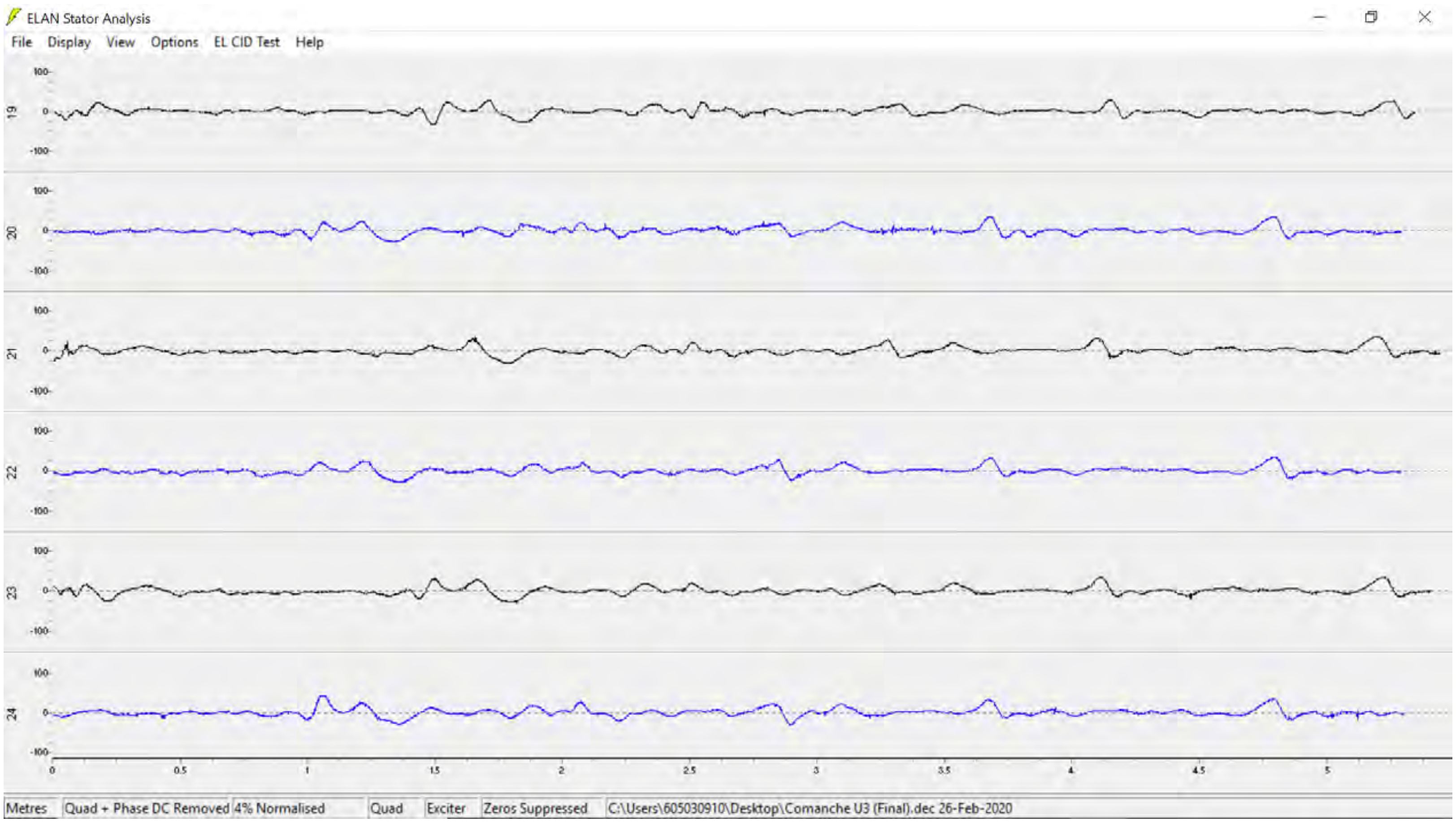
ELCID (As Found)

Date 2/26/2020

Turbine Serial No. 04465-M00-0103
Generator Serial No. 05HBSE01

Prepared by: Steve Maxwell
Customer: Xcel Energy
Station: Comanche U3

Slots 19-24



ELCID Report_Comanche U3_2-26-2020

FieldCore a GE company

ELCID Test Data

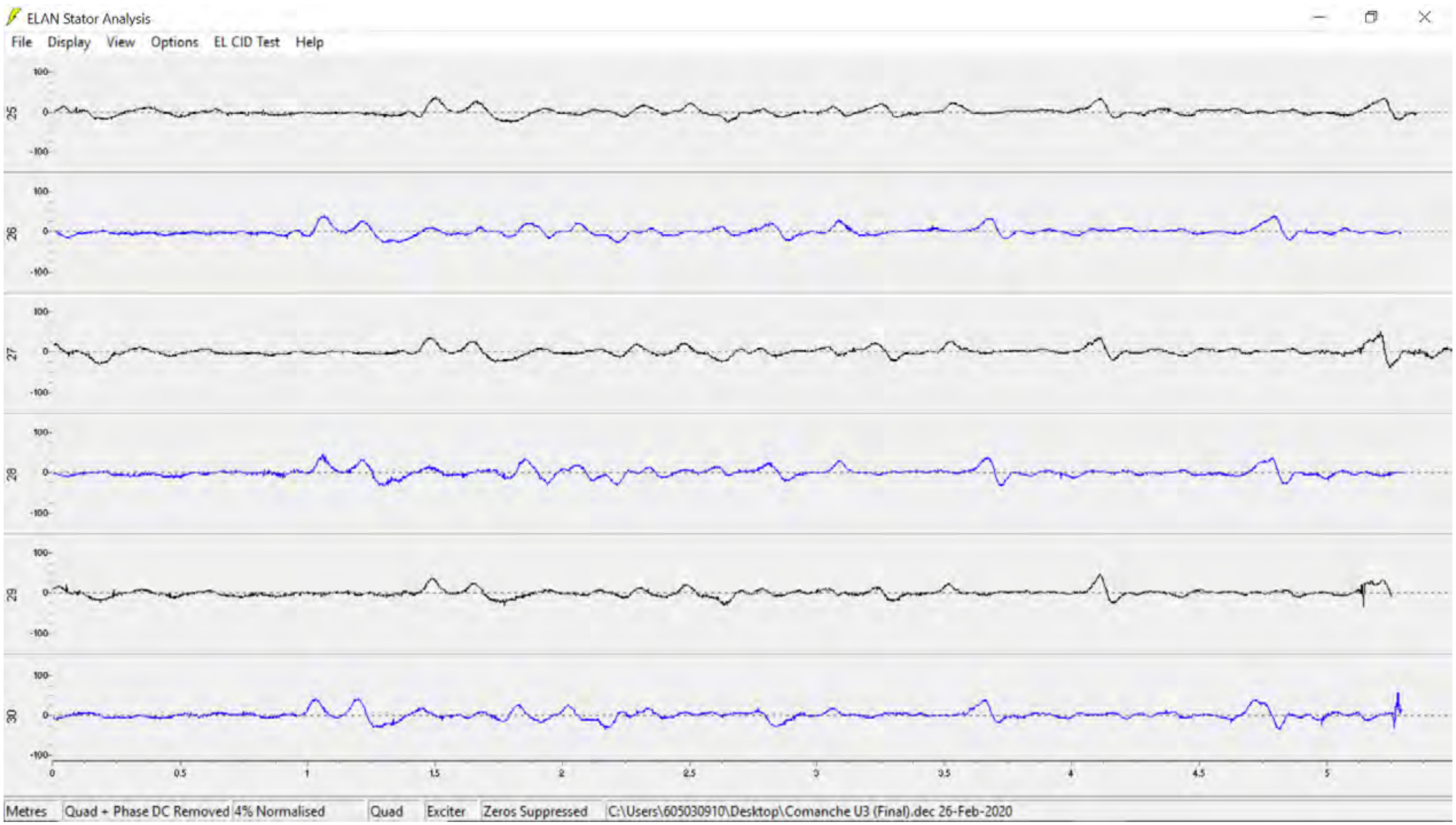
ELCID (As Found)

Date 2/26/2020

Turbine Serial No. 04465-M00-0103
Generator Serial No. 05HBSE01

Prepared by: Steve Maxwell
Customer: Xcel Energy
Station: Comanche U3

Slots 25-30



Confidential

ELCID Report_Comanche U3_2-26-2020

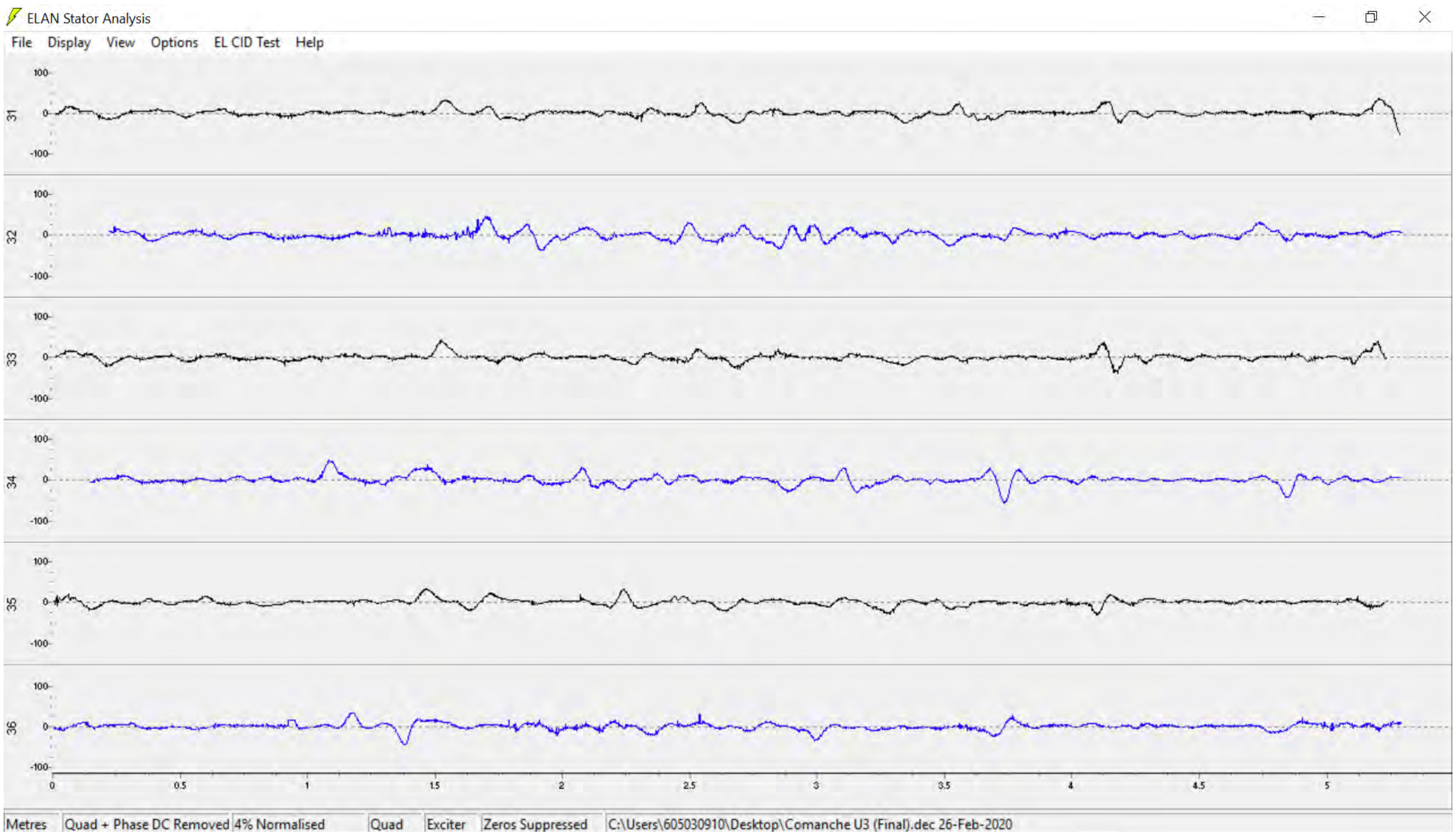
FieldCore
a GE company

ELCID Test Data

ELCID (As Found)

Date	2/26/2020	Turbine Serial No.	04465-M00-0103	Prepared by:	Steve Maxwell
		Generator Serial No.	05HBSE01	Customer:	Xcel Energy
				Station:	Comanche U3

Slots 31-36



ELCID Report_Comanche U3_2-26-2020

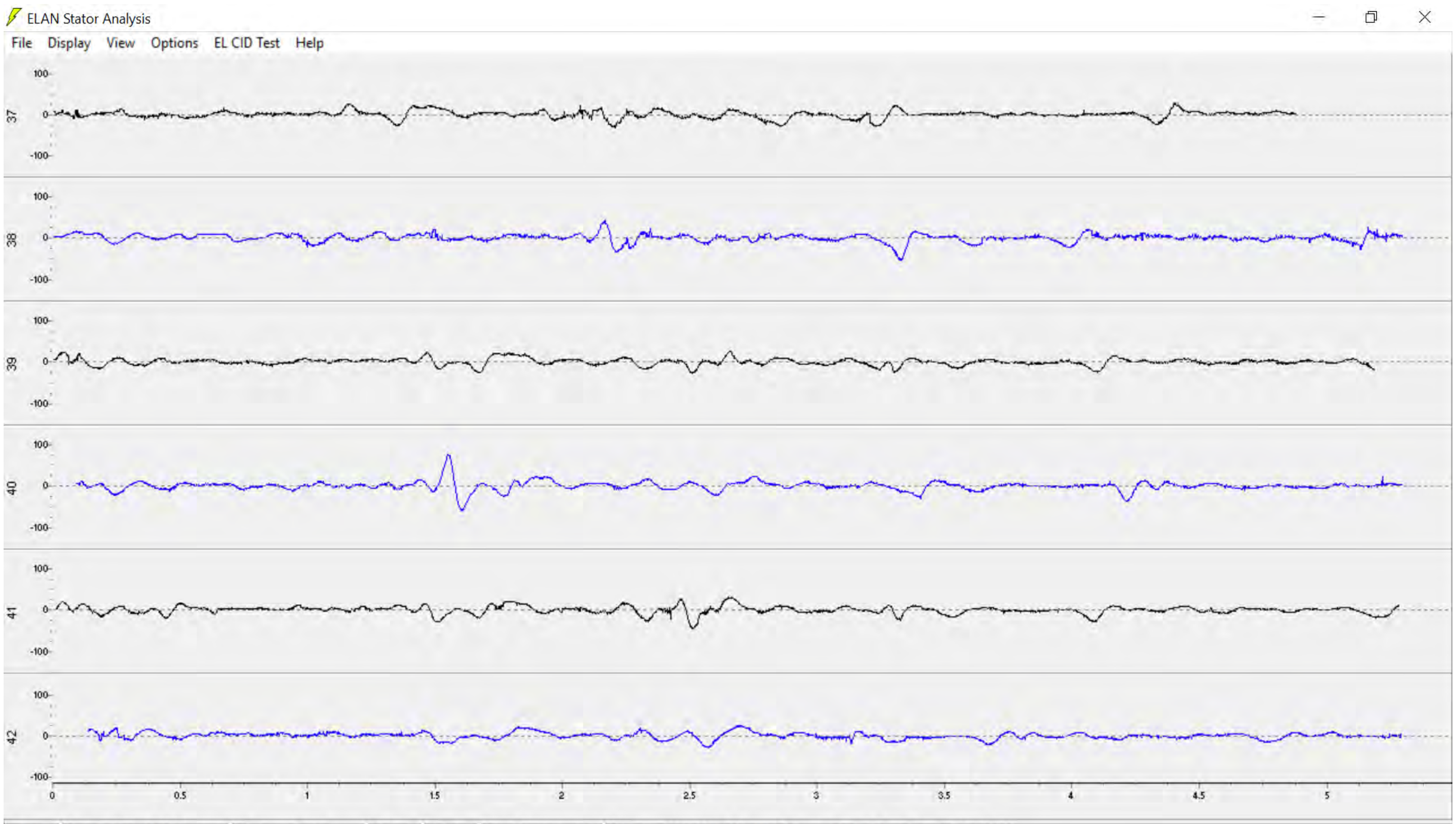
FieldCore a GE company

ELCID Test Data

ELCID (As Found)

Date	2/26/2020	Turbine Serial No.	04465-M00-0103	Prepared by:	Steve Maxwell
		Generator Serial No.	05HBSE01	Customer:	Xcel Energy
				Station:	Comanche U3

Slots 37-42



4.3.5 RTD Resistance & Megger Test

Part Condition: Good

Part Description:

All Generator Resistance Temperature Detectors were measured using a calibrated Fluke 87V Multi-Meter. Once it was determined that all RTD's were reading within specification and not grounded, they were adjoined together using bare copper wire and subjected to a 500VDC Megger test to ensure that the harness insulation was intact and that there were no grounds in the RTD wiring. All RTD's read correctly and there were no signs of degradation in the harness insulation. This unit contains single-element, **Platinum 100:RTDs**. All data was recorded on data sheet **D316402**.

RTD Measurements (Single Element…

RTD Test

Copper, Nickel or Platinum

Date 2/22/2020 Generator Serial No. 05HBSE01 Prepared By Steve Maxwell
Joe Lewis

Turbine Serial No. 04465-M00-0103 FSR No. I01-044232

RTD TEST

A B C

Winding Temperature: 19.6 ºC
Device: Fluke 287

Type **must** be entered as follows: **C**, **N**, or **P**. ***See Note below.**

RTD No.	Type * C-N-P	RESISTANCE AB	AC	BC	(AB+AC)/2 - BC	Indicated Temp.	Remarks
1	P	108.37	108.36	0.51	107.86	20.03	
2	P	108.45	108.46	0.66	107.80	19.88	
3	P	108.13	108.13	0.24	107.89	20.12	
4	P	108.29	108.29	0.49	107.80	19.89	
5	P	108.40	108.30	0.47	107.88	20.09	
6	P	108.01	108.00	0.23	107.78	19.83	
7	P	108.28	108.28	0.47	107.81	19.92	
8	P	108.33	108.33	0.61	107.72	19.69	
9	P	107.97	107.96	0.20	107.77	19.80	
10	P	108.24	108.24	0.45	107.79	19.86	
11	P	108.29	108.28	0.59	107.70	19.62	
12	P	107.97	107.97	0.20	107.77	19.81	
13	P	108.25	108.25	0.45	107.80	19.89	
14	P	108.27	108.27	0.60	107.67	19.56	
15	P	107.90	107.91	0.21	107.70	19.62	
16	P	108.16	108.15	0.46	107.70	19.62	
17	P	108.25	108.26	0.61	107.65	19.49	
18	P	107.85	107.85	0.21	107.64	19.48	
19	P	108.16	108.15	0.47	107.69	19.60	
20	P	108.26	108.26	0.61	107.65	19.51	
21	P	107.97	107.96	0.22	107.75	19.75	
22	P	108.15	108.15	0.50	107.65	19.51	
23	P	108.28	108.27	0.74	107.54	19.21	
24	P	107.99	107.99	0.23	107.76	19.79	
25	P	108.16	108.16	0.50	107.66	19.53	

RTD INSULATION RESISTANCE (MEGOHMS) @ 500.00 volts. DC

#		thru #		=			
#	1	thru #	42	=	7470	megohms	* **Note: Type must be entered as:**
#		thru #		=		megohms	**C, N, or P (only)**
#		thru #		=		megohms	**C** = Copper
#		thru #		=		megohms	**N** = Nickel
#		thru #		=		megohms	**P =** Platinum

Megger Serial No: 2251601 **Calibration Date: 06/21/19** **Due Date: 06/21/20**

RTD Measurements (Single Element…

RTD Test
Copper, Nickel or Platinum

Date 2/22/2020 Generator Serial No. 05HBSE01 Prepared By Steve Maxwell
Joe Lewis
Turbine Serial No. 04465-M00-0103 FSR No. #REF!

RTD TEST

A B C

Winding Temperature: 19.6 ºC
Device: Fluke 287

Type **must** be entered as follows: **C**, **N**, or **P**. ***See Note below.**

RTD No.	Type * C-N-P	RESISTANCE AB	AC	BC	(AB+AC)/2 - BC	Indicated Temp.	Remarks
26	P	108.29	108.29	0.63	107.66	19.53	
27	P	107.96	107.96	0.25	107.71	19.66	
28	P	108.19	108.19	0.51	107.68	19.58	
29	P	108.31	108.30	0.65	107.66	19.52	
30	P	107.87	107.86	0.26	107.61	19.39	
31	P	108.24	108.24	0.53	107.71	19.66	
32	P	108.35	108.34	0.67	107.68	19.57	
33	P	108.09	108.08	0.27	107.82	19.93	
34	P	108.29	108.30	0.54	107.76	19.78	
35	P	108.39	108.38	0.66	107.73	19.70	
36	P	108.02	108.02	0.27	107.75	19.76	
37	P	108.27	108.27	0.51	107.76	19.79	
38	P	108.39	108.39	0.66	107.73	19.71	
39	P	108.01	108.00	0.24	107.77	19.80	
40	P	108.33	108.33	0.49	107.84	19.99	
41	P	108.40	108.39	0.63	107.77	19.80	
42	P	107.99	107.99	0.23	107.76	19.79	
43							
44							
45							
46							
47							
48							
49							
50							

RTD INSULATION RESISTANCE (MEGOHMS) @ 500.00 volts. DC

#		thru #		=		
#	1	thru #	42	=	7470	megohms
#		thru #		=		megohms
#		thru #		=		megohms
#		thru #		=		megohms
#		thru #		=		megohms

* **Note: Type must be entered as:**
C, N, or P (only)
C = Copper
N = Nickel
P = Platinum

4.3.6 Wedge Tightness Test

Part Condition: Good

Part Description:

A wide sample of wedges were tapped using both, a 2 oz. Hammer and a Proceq (Equotip 2) wedge hardness tester with an attached 'SVP-40' tapping device, to determine a correlating criteria range (in Leebs) for loose, hollow and tight wedges. Once that criteria was established, all wedges were tapped a total of 3 times with the 'SVP 40' device; once on the collector side, once in the center and once at the turbine side of each wedge. Prior to performing the wedge tap test, calibration of the 'SVP-40' was verified using a test block with known hardness (845 +/- 12 Leebs). The average of all three taps was then recorded for every wedge (with the exception of the last 3 TE wedges in slot 12, due to the flux probe) and plotted in the attached spread sheet. There were a total of 3 hollow wedges and 2 loose wedges found (none of which were adjacent to one another), indicating that the Stator wedges are tight in the dovetail.

Recommendation Status: Should be planned for next Outage

Recommendation Type: Services

Recommendation Description:

Perform Wedge Tap testing at the next available outage in which the Generator Rotor is removed, in order to trend wedge tightness data and ensure Stator wedges are not loosening over time.

Confidential

Wedge Map_Comanche U3 (Final)

Gen #

Wedge Map - Xcel Comanche U3

WEDGE: CE >>> TE

SLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	
1	792	788	756	796	807	804	791	795	775	766	775	773	787	795	787	778	781	790	770	758	795	784	776	806	765	788	801	764	752	780	750	791	795	750	764	788	792	1
2	783	760	809	807	817	802	799	788	799	796	805	795	795	788	779	782	811	793	796	787	799	792	804	800	806	796	802	802	801	801	798	783	795	772	769	779	781	2
3	786	788	806	799	807	771	754	785	786	794	795	770	797	771	786	796	789	785	789	793	760	786	766	778	774	789	782	785	796	792	786	787	774	770	765	777	774	3
4	803	817	820	814	817	811	789	803	792	799	811	805	806	782	811	799	770	763	756	804	800	794	794	789	799	796	783	797	806	781	785	756	770	776	763	754	763	4
5	795	796	814	793	778	801	790	781	785	788	801	802	800	782	781	792	763	778	788	763	799	779	788	760	762	792	785	783	817	790	788	795	792	770	783	758	769	5
6	810	809	800	789	808	794	798	750	787	803	777	784	760	801	798	783	795	772	769	788	787	796	773	766	783	799	781	783	784	777	779	783	793	784	794	767	775	6
7	793	792	758	803	817	820	814	765	779	766	789	801	778	792	792	798	799	783	795	750	791	779	759	761	794	788	766	756	782	770	766	760	775	779	762	760	768	7
8	781	785	756	799	791	789	783	765	768	803	791	793	782	576	796	790	804	776	783	784	778	801	790	788	781	785	788	775	780	764	767	758	765	778	771	756	790	8
9	790	788	795	776	787	804	785	793	801	803	807	812	806	814	801	798	802	779	752	752	808	794	798	806	787	756	798	788	770	782	773	777	788	778	779	782	782	9
10	792	813	812	819	802	800	806	805	814	795	808	809	822	808	800	801	780	802	798	778	794	802	802	783	787	757	768	779	781	756	752	773	789	769	762	766	753	10
11	824	794	805	767	786	792	799	795	801	805	814	815	810	799	803	793	788	787	788	801	788	784	799	751	771	757	776	752	796	785	782	783	764	764	764	799	791	11
12	818	811	824	794	804	805	775	764	786	819	811	809	792	809	808	796	796	788	773	807	806	796	772	804	752	770	760	776	781	779	778	787	764	805	FLUX PROBE			12
13	810	813	829	820	811	789	799	787	810	806	803	768	756	777	792	771	799	799	801	777	804	779	802	789	797	801	801	761	765	761	772	751	785	793	780	766	754	13
14	773	766	792	804	750	794	794	776	806	765	788	801	764	752	780	750	791	750	791	795	750	764	788	792	773	766	783	799	781	783	784	798	658	796	792	786	787	14
15	807	771	786	766	798	779	788	799	800	806	788	802	799	801	801	798	783	798	783	795	772	769	779	781	807	771	754	785	786	794	795	770	797	771	786	796	789	15
16	817	811	794	794	786	796	773	766	778	774	789	782	785	796	792	786	787	786	787	774	770	765	777	774	817	811	789	803	792	799	811	805	806	782	811	799	770	16
17	803	807	779	788	785	779	759	783	806	799	807	771	754	785	786	794	817	770	776	787	804	785	793	801	803	807	812	806	814	801	798	802	779	752	752	808	794	17
18	795	808	796	773	788	801	790	817	820	814	809	811	789	803	792	799	811	805	819	802	800	806	805	814	795	808	809	822	808	800	801	780	802	798	778	794	802	18
19	805	814	779	759	779	794	798	796	814	793	778	801	790	781	785	788	801	802	767	786	792	799	795	801	805	814	815	810	799	803	612	788	787	788	801	788	784	19
20	819	811	801	790	766	802	802	809	800	789	812	794	798	750	787	803	777	784	794	804	805	775	764	786	819	811	809	792	809	808	796	796	788	773	807	806	796	20
21	775	766	794	798	767	784	799	792	758	803	817	820	814	765	779	766	789	801	756	796	807	804	791	795	775	766	775	773	787	795	787	778	781	790	770	758	795	21
22	799	796	802	802	773	796	772	785	756	799	791	789	783	765	768	803	791	793	809	807	817	802	799	788	799	796	805	795	795	788	779	782	811	793	796	787	799	22
23	791	795	784	799	752	806	765	788	801	764	752	780	794	776	806	765	788	801	764	752	780	750	791	750	791	795	750	770	797	771	786	796	789	785	789	793	760	23
24	801	790	796	772	782	800	806	796	802	802	801	801	788	799	800	806	788	802	807	801	801	798	783	798	783	795	772	764	788	792	807	771	754	785	786	794	817	24
25	782	785	779	802	778	778	774	789	782	785	796	792	773	766	778	774	789	782	785	796	792	786	654	786	787	774	770	769	779	781	809	811	789	803	792	799	811	25
26	786	794	789	797	801	789	799	796	783	797	806	781	759	783	806	799	807	771	799	785	786	794	817	770	776	787	804	765	777	774	778	801	790	781	785	788	801	26
27	792	799	792	773	766	760	762	792	785	783	817	790	819	802	800	806	805	814	795	808	809	822	808	800	801	767	784	785	793	801	789	782	785	796	792	773	790	27
28	814	801	781	807	771	766	783	799	781	783	784	777	767	786	792	799	795	801	805	814	815	810	799	803	793	773	796	806	805	814	785	786	794	795	770	797	771	28
29	808	800	774	817	811	761	794	770	766	756	782	770	794	804	805	775	764	786	819	811	809	792	809	808	796	752	806	799	795	801	803	792	799	811	805	806	782	29
30	799	803	801	803	807	788	781	804	788	775	780	764	820	811	789	799	787	810	806	803	768	756	777	792	771	782	800	775	764	786	806	814	801	798	802	779	752	30
31	809	808	814	795	808	806	787	756	798	788	770	814	804	750	794	794	776	806	765	788	801	764	752	780	750	778	778	804	791	795	822	808	800	801	780	802	798	31
32	787	795	801	805	814	783	787	757	768	779	781	756	811	805	819	802	800	806	805	814	795	808	809	822	808	801	789	802	799	788	810	799	803	793	788	787	788	32
33	797	801	786	819	811	751	771	819	776	752	796	801	801	802	767	786	792	799	795	801	805	814	815	810	799	766	760	750	791	750	792	809	808	796	796	788	773	33
34	773	766	795	775	766	797	752	770	760	776	781	779	777	784	794	804	805	775	764	786	819	811	809	792	809	771	766	798	783	798	773	787	795	787	778	781	790	34
35	807	771	788	799	796	789	797	801	801	761	765	798	803	793	788	787	788	801	788	784	786	766	798	779	788	811	761	786	787	786	795	795	788	779	782	811	793	35
36	817	811	750	791	795	792	773	766	783	799	781	783	808	796	796	788	773	807	806	796	794	794	786	796	773	766	778	794	817	770	785	796	792	773	807	806	796	36
37	803	807	798	783	795	780	807	810	754	785	786	799	795	787	778	781	790	770	758	795	779	788	785	779	759	783	806	822	808	800	754	785	786	801	777	804	779	37
38	795	808	786	787	774	774	817	811	789	803	792	799	806	805	792	773	766	807	771	754	796	773	788	801	790	817	820	814	809	811	789	803	792	791	795	750	764	38
39	805	814	770	776	787	801	803	807	812	806	814	801	799	795	781	807	771	809	811	789	779	759	779	794	798	796	814	793	778	801	790	781	785	783	795	772	769	39
40	819	811	800	801	780	814	795	808	809	822	808	800	775	764	774	817	811	778	801	790	801	790	766	802	802	809	800	789	812	794	798	750	787	787	774	770	765	40
41	775	766	799	791	789	801	805	814	815	810	799	803	804	791	801	803	807	812	794	798	794	798	767	784	799	792	758	803	817	820	814	765	779	776	787	804	785	41
42	792	799	512	752	780	786	819	811	809	792	809	808	802	799	814	795	808	817	820	814	801	805	814	815	810	799	803	793	788	787	788	801	788	785	796	792	773	42
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	

4.3.7 Top Ripple Spring Flatness Checks

Part Description:

A depth mic was used to measure the flatness of the Top Ripple Springs across slots 9,19 & 29. All Ripples were within tolerance.

Top Ripple Spring Flatness Checks_3…

FieldCore
a GE company

Top Ripple Spring Flatness Checks

Date: 3/5/2020 Turbine S/N: 04465-M00-0103 Prepared By: Steve Maxwell
Generator S/N: 05HBSE01 FSR No. I01-044232

SLOT NUMBER	Wedge Number			MIN	MAX	AVERAGE	STATUS
	9	19	29				
1	0.5260	0.5265	0.5250	0.5250	0.5265	0.5255	OK
2	0.5246	0.5215	0.5310	0.5215	0.5310	0.5247	OK
3	0.5160	0.5275	0.5445	0.5160	0.5445	0.5293	OK
4	0.5428	0.5435	0.5470	0.5428	0.5470	0.5444	OK
5	0.5185	0.5210	0.5165	0.5165	0.5210	0.5180	OK
6	0.5265	0.5284	0.5310	0.5265	0.5310	0.5286	OK
7	0.5405	0.5416	0.5412	0.5405	0.5416	0.5411	OK
8	0.5335	0.5342	0.5339	0.5335	0.5342	0.5339	OK
9	0.5370	0.5362	0.5368	0.5362	0.5370	0.5364	OK
10	0.5260	0.5289	0.5276	0.5260	0.5289	0.5275	OK
11	0.5265	0.5274	0.5269	0.5265	0.5274	0.5269	OK
12	0.5210	0.5219	0.5206	0.5206	0.5219	0.5210	OK
13	0.5200	0.5206	0.5212	0.5200	0.5212	0.5206	OK
14	0.5455	0.5468	0.5461	0.5455	0.5468	0.5461	OK
15	0.5390	0.5382	0.5388	0.5382	0.5390	0.5384	OK
16	0.5270	0.5299	0.5308	0.5270	0.5308	0.5292	OK
17	0.5225	0.5229	0.5236	0.5225	0.5236	0.5230	OK
18	0.5340	0.5351	0.5344	0.5340	0.5351	0.5345	OK
19	0.5375	0.5381	0.5369	0.5369	0.5381	0.5373	OK
20	0.5315	0.5311	0.5324	0.5311	0.5324	0.5315	OK
21	0.5245	0.5251	0.5240	0.5240	0.5251	0.5244	OK
22	0.5230	0.5236	0.5243	0.5230	0.5243	0.5236	OK
23	0.5225	0.5231	0.5218	0.5218	0.5231	0.5222	OK
24	0.5290	0.5298	0.5284	0.5284	0.5298	0.5289	OK
25	0.5205	0.5196	0.5212	0.5196	0.5212	0.5201	OK
26	0.5210	0.5218	0.5208	0.5208	0.5218	0.5211	OK
27	0.5361	0.5381	0.5377	0.5361	0.5381	0.5373	OK
28	0.5250	0.5262	0.5254	0.5250	0.5262	0.5255	OK
29	0.5225	0.5231	0.5229	0.5225	0.5231	0.5228	OK
30	0.5265	0.5271	0.5281	0.5265	0.5281	0.5272	OK
31	0.5465	0.5473	0.5469	0.5465	0.5473	0.5469	OK
32	0.5390	0.5384	0.5378	0.5378	0.5390	0.5380	OK
33	0.5370	0.5378	0.5381	0.5370	0.5381	0.5376	OK
34	0.5255	0.5261	0.5269	0.5255	0.5269	0.5262	OK
35	0.5345	0.5351	0.5358	0.5345	0.5358	0.5351	OK
36	0.5300	0.5318	0.5308	0.5300	0.5318	0.5309	OK

4.4 Hydraulic Integrity Testing (HIT)

4.4.1 Pressure & Vaccum Decay Testing

Part Condition: Good

Part Description:

Hydraulic integrity testing was performed to verify the tightness and integrity of the liquid cooled Stator Winding and as part of the prerequisites for performing Electrical testing on the Stator. The winding was first gravity drained, then blown down using warm, dry air for several shifts, in order to remove most of the moisture. Each cooling header was blown down separately, followed by blowing across the machine in both directions to remove water from crevices in the Stator Bar clips and other low-flow areas. Once the majority of water was removed, a Vacuum pump was used to draw the remaining moisture out of the machine for approximately 48 hours at 10 Torr. Once the winding was completely dry, the Generator drains were blanked at the Belly and a volume calculation was performed in preparation for Vacuum & Pressure decay testing.

For Pressure Decay testing, the winding was pressurized to approximately 60 psi for 24 hours. During the test period, winding pressure, barometric pressure and temperature were trended every hour and a final leak rate was calculated. Pressure decay test passed at 0.32 ft3/day. The allowable limit per GE's guidelines are 1.0 ft3/day.

For Vacuum Decay testing, a hard vacuum was pulled on the winding (<50 microns) and the winding was allowed to settle for approximately 15 minutes for thermal stabilization purposes. Vacuum level was trended for 75 minutes and a subsequent leak rate was calculated. Vacuum decay test passed at 1.1058 ft3/day. The allowable limit per GE's guidelines are 3.0 ft3/day.

Recommendation Status: Should be planned for next Outage

Recommendation Type: Services

Recommendation Description:

Continue to perform hydraulic integrity testing to verify the tightness of the Stator Winding during every outage and prior to electrical testing, unless testing on a Nitrogen blanket.

Stator Vacuum & Pressure Decay Te…

FieldCore a GE company

Vacuum Decay Test

Date(m/d/y) 3/3/2020

Generator Serial No. 05HBSE01
Turbine Serial No. 04465-M00-0103

Prepared by Steve Maxwell
Joe Lewis
FSR No. I01-044232

Measure and Record Test Volume per 503HA120:
Test Volume V= 26.02 Cu. Ft.

Measure and record winding pressure (in Microns) in 5 minute intervals for 1 hour.
T = Time (Minutes)
P = Pressure (Microns)

Data Point	Time	Press.	value	change	variance
0	0	200.0	200.000		
1	5	215.0	215.000	-15.0	3.1
2	10	229.0	229.000	-14.0	0.7
3	15	241.0	241.000	-12.0	0.3
4	20	254.0	254.000	-13.0	1.1
5	25	268.0	268.000	-14.0	3.6
6	30	278.0	278.000	-10.0	2.0
7	35	292.0	292.000	-14.0	4.4
8	40	302.0	302.000	-10.0	2.8
9	45	313.0	313.000	-11.0	2.3
10	50	324.0	324.000	-11.0	1.7
11	55	338.0	338.000	-14.0	4.1
12	60	347.0	347.000	-9.0	1.5
13	65	355.0	355.000	-8.0	2.0
14	70	364.0	364.000	-9.0	4.6
15	75	374.0	374.000	-10.0	6.2
16					
17					
18					
19					
20					
21					
22					
23					
24					

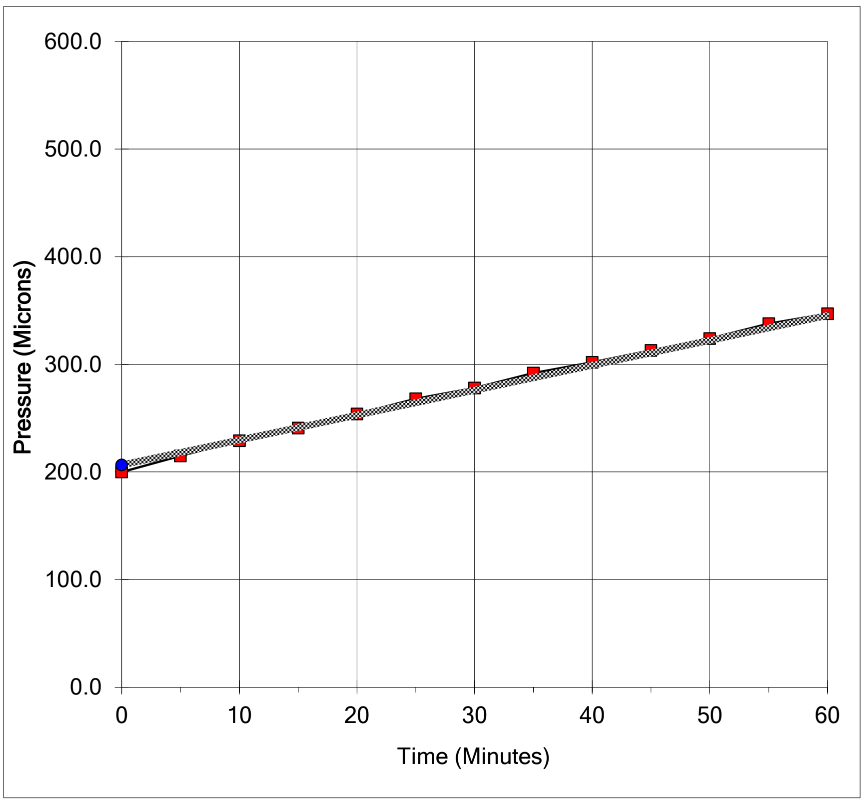
Test Volume Leakage Rate = 1.1058 Cu. Ft. / Day
HitSKID & Hose Leakage Rate = 0 Cu. Ft. / Day
Net Stator Leakage = 1.1058 Cu. Ft. / Day PASSED TEST

Stator Vacuum & Pressure Decay Te…

FieldCore a GE company

Vacuum Decay Test

Date(m/d/y)	3/3/2020	Turbine Serial No.	05HBSE01	Prepared by	Steve Maxwell
		Generator Serial No.	04465-M00-0103	Sketch No.	Joe Lewis
		Field Serial No.		FSR No.	I01-044232



Test Volume Leakage Rate =	1.1058	Cu. Ft. / Day	
HitSKID & Hose Leakage Rate =	0	Cu. Ft. / Day	
Net Stator Leakage =	1.1058	Cu. Ft. / Day	PASSED TEST

Comments:	

Stator Vacuum & Pressure Decay Te…

FieldCore a GE company

Pressure Decay Test

Date(m/d/y) 3/3/2020

Generator Serial No. 05HBSE01
Turbine Serial No. 04465-M00-0103

Prepared by Steve Maxwell
Joe Lewis
FSR No. I01-044232

Test Volume V= 26.02 Cu. Ft.

Measure and record the following every hour:

Volume Calculations
V1= 207.58 gallons
P1= 65.10 psig
P2= 33.60 psig

Data Point	Hours into Test	Test Pressure	Barometric Pressure	Winding Temp1	Winding Temp2	Winding Temp3	Avg Temp	value	chg	variance
0	0.0	57.70	29.172	18.9	18.8	18.9	18.9	3133		
1	1.0	57.70	29.147	19.0	18.8	18.9	18.9	3132	1.07	4.48
2	2.0	57.67	29.122	19.2	19.1	19.2	19.2	3128	4.70	0.10
3	3.0	57.65	29.106	19.4	19.3	19.3	19.3	3125	2.99	2.58
4	4.0	57.64	29.083	19.4	19.2	19.4	19.3	3124	0.92	3.18
5	5.0	57.64	29.071	19.5	19.3	19.5	19.4	3122	1.32	4.19
6	6.0	57.62	29.054	19.4	19.2	19.4	19.3	3122	0.16	4.03
7	7.0	57.60	29.025	19.4	19.2	19.3	19.3	3121	1.13	4.85
8	8.0	57.58	29.023	19.2	19.1	19.1	19.1	3122	-0.87	3.66
9	9.0	57.55	29.021	19.1	18.9	19.0	19.0	3122	-0.08	3.26
10	10.0	57.52	29.019	18.9	18.7	18.9	18.8	3122	-0.43	2.51
11	11.0	57.49	29.008	18.7	18.6	18.8	18.7	3122	0.11	2.31
12	12.0	57.47	28.958	18.5	18.4	18.6	18.5	3122	-0.20	1.79
13	13.0	57.46	28.961	18.2	18.1	18.3	18.2	3125	-2.84	1.38
14	14.0	57.44	28.960	17.9	17.8	17.9	17.9	3128	-2.69	4.38
15	15.0	57.43	28.961	17.7	17.6	17.7	17.7	3130	-1.74	6.44
16	16.0	57.41	28.959	17.5	17.3	17.5	17.4	3131	-1.60	8.35
17	17.0	57.41	28.958	17.4	17.2	17.4	17.3	3132	-1.06	9.73
18	18.0	57.40	28.921	17.5	17.3	17.4	17.4	3130	1.95	8.09
19	19.0	57.40	28.899	17.7	17.5	17.6	17.6	3128	2.63	5.79
20	20.0	57.39	28.881	18.0	17.8	17.9	17.9	3124	4.05	2.06
21	21.0	57.38	28.870	18.3	18.1	18.2	18.2	3120	3.89	1.52
22	22.0	57.38	28.864	18.6	18.4	18.5	18.5	3117	3.34	4.54
23	23.0	57.37	28.850	18.9	18.7	18.8	18.8	3113	3.94	8.16
24	24.0	57.36	28.88	19.0	18.9	19.0	19.0	3111	1.61	9.45

Test Volume Leakage Rate = 0.32 Cu. Ft. / Day PASSED TEST

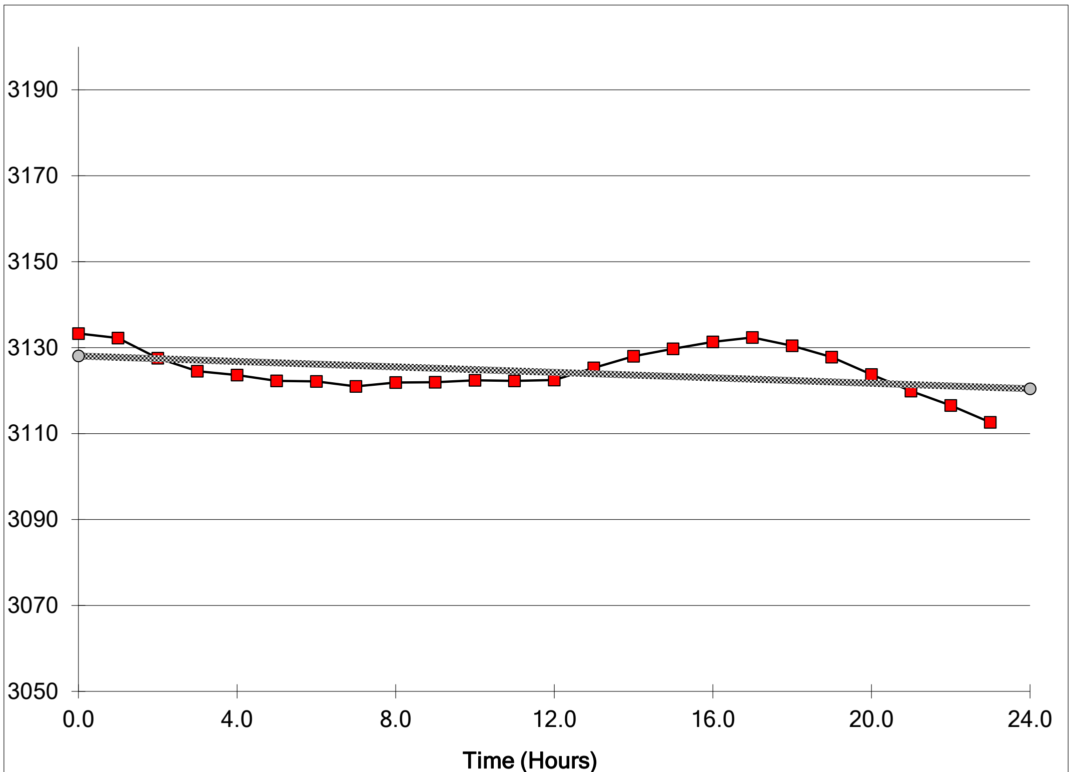
Stator Vacuum & Pressure Decay Te…

Pressure Decay Test

Date(m/d/y) 3/3/2020

Generator Serial No. 05HBSE01
Turbine Serial No. 04465-M00-0103

Prepared by Steve Maxwell
Joe Lewis
FSR No. I01-044232



Test Volume Leakage Rate = 0.32 Cu. Ft. / Day PASSED TEST

Comments:	

4.5 Field Visual Inspection

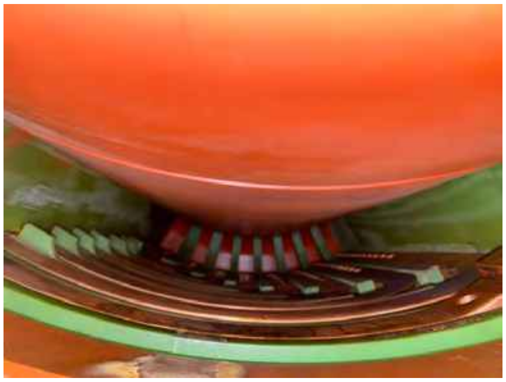
4.5.1 Field Visual Inspection

Part Condition: Good

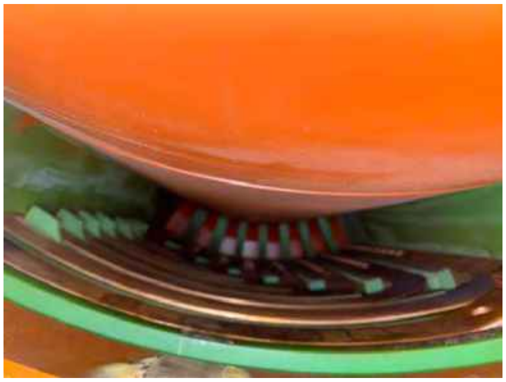
Part Description:

A visual inspection was completed on the following Field components; Retaining Rings, Field Body, Body Wedges, Creepage Blocks & Vent holes, End Winding blocking and turn insulation, Main Leads, Pole to Pole & Coil to Coil jumpers and Collector Rings. The Field Body and Retaining Rings were cleaned using lint-free rags and denatured alcohol. The Collector Rings and ventillation holes were littered with carbon dust, so they were vacuumed and thoroughly cleaned with denatured alcohol. Collector Rings appeared to be in good condition with uniform wear. No other issues were noted during Field visual inspection.

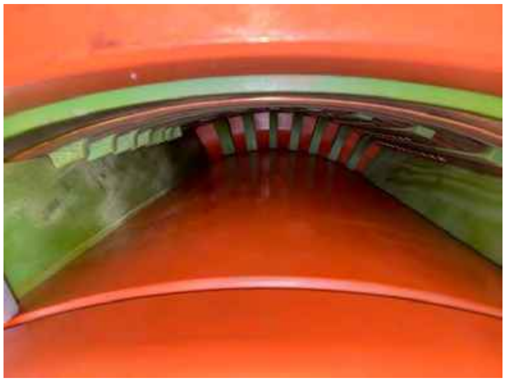
End Winding-1



End Winding-2



End Winding-3

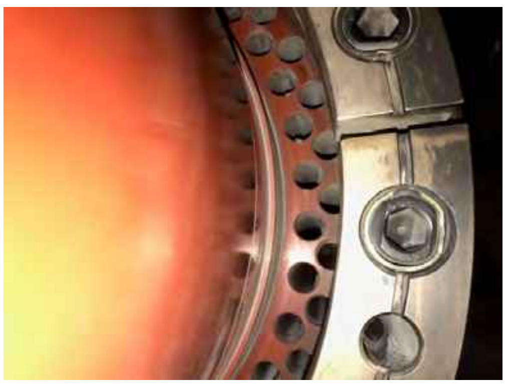


End Winding-4

4.5.1 Field Visual Inspection

Main Lead

Field



Collector Vent Holes

Collector Rings

4.6 Field Electrical Testing

4.6.1 Winding Copper Resistance

Part Condition: Good

Part Description:

Using a Biddle 247001 Digital Low Resistance Ohmmeter, the Field winding resistance was measured to ensure there were no loose or broken connections throughout the winding. Secondly, the ‘as found’ value was compared to the factory resistance value to ensure it was within specification. Test was completed satisfactorily and recorded on attached data sheet D316303.

4.6.2 AC Impedance Test

Part Condition: Good

Part Description:

An adjustable AC Power Source was applied to the Field Collector Rings in increments of 10V and subsequent Voltage and Current data was recorded and plotted on data sheet D316303. The Voltage vs. Current curve was linear, suggesting there are no shorted turns in the Field Winding.

4.6.3 Megger Test with Polarization Index (PI)

Part Condition: Good

Part Description:

The Field Collector Rings were subjected to a 500VDC Megger, to test for any signs of insulation breakdown and/or grounds in the winding. Test was completed satisfactorily with a Polarization Index of 6.5, indicating that the turn to turn insulation is in good condition and there are no grounds in the Field Winding. All data recorded on attached data sheet D316303.

Recommendation Status: Should be planned for next Outage

Recommendation Type: Services

Recommendation Description:

Continue Field Electrical testing at prescribed intervals per the most current revision of GEK103566, "Creating an Effective Generator Maintenance Program"

Confidential

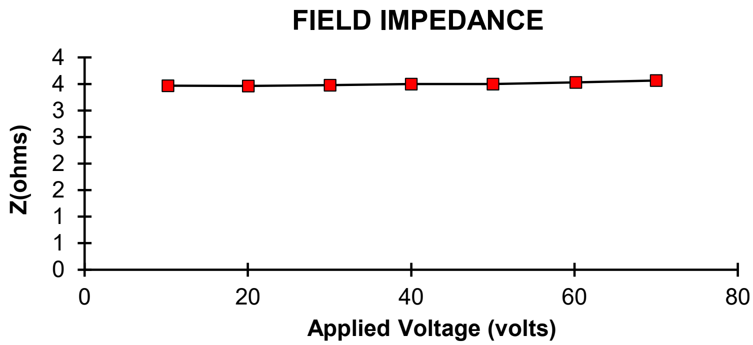
Field Measurements_Comanche U3

Field Measurements

Date	2/24/2020	Generator S/N:	05HBSE01	Prepared by:	Steve Maxwell
Equipment	WATER-COOLE	Turbine S/N:	04465-M00-0103	Project ID:	I01-044232
OEM	Mitsubishi				

FIELD IMPEDANCE (TM4020)

Voltage	Amps	Z (ohms)
10.23	2.95	3.47
20.04	5.79	3.46
30.07	8.65	3.48
40.00	11.44	3.50
50.02	14.30	3.50
60.16	17.04	3.53
70.00	19.64	3.56



Ambient Temperature	21.6° C
Relative Humidity	34.0%

INSULATION RESISTANCE AT 500V (TM4030)

Time (min)	R (megohms)
0.50	10500
1	24300
2	49900
3	72000
4	75700
5	83200
6	116000
7	136000
8	141000
9	147000
10	158000
PI	6.5

FIELD WINDING RESISTANCE (TM4010)

Winding Temp.s (°C)		Resistance (ohms)	0.0780
CE	21.6	Correct to 25 °C	**0.079**
Near CE	21.6	Historical Resistance Readings	
Centerline	21.6	Prior Test @25 °C	0.0800
Near TE	21.6	Date	10/13/2011
TE	21.6	Factory @25 °C	0.0799
Average	21.6	Reading Checks per TM4010	
		Previous Test	PASS
		Factory *(or Calculated)*	PASS

Instrument Description	ID No.	CAL Due:	Comments
Megger	2251601	06/21/2020	
Digital Low Resistance Ohmmeter	1210019	06/21/2020	

D316303 Sheet: (a) Rev 2.2 - 09/25/2019