(1)

Nebraska Public Power District

Always there when you need us

NLS2004126
October 7, 2004

Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

Subject: Service Water Pump Test Report
Cooper Nuclear Station, Docket 50-298, DPR-46

The purpose of this letter is to submit the enclosed report concerning the recent service water pump test. This report was verbally requested by the Nuclear Regulatory Commission (NRC) during a Regulatory Conference held in your offices on September 27, 2004. Nebraska Public Power District (NPPD) requests that the NRC withhold from public disclosure the report as it contains information proprietary to NPPD, the owner of the report. An affidavit is attached to this letter which sets forth the basis on which the report may be withheld from public disclosure by the NRC and addresses, with specificity, the considerations listed in paragraph (b)(4) of 10 CFR 2.390.

As further discussed in the affidavit:

1) The entire report is held in confidence by its owner, NPPD.
2) NPPD believes that this report is the type of information normally kept in confidence.
3) The report is being sent to the NRC in confidence.
4) The report is not publicly available.
5) Public disclosure will likely cause commercial harm to NPPD.

Should you have any questions or require additional information, please contact me at 402-825-2774.

Sincerely,

Paul V. Fleming
Licensing Manager
Cooper Nuclear Station

/jrs

Attachment
Enclosure

U.S. Nuclear Regulatory Commission w/attachment and enclosure
Attn: Document Control Desk

COOPER NUCLEAR STATION
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cc-1

Senior Project Manager w/attachment and w/o enclosure
USNRC - NRR Project Directorate IV-1

Kriss Kennedy w/attachment and w/o enclosure
Chief, Branch C
U.S. Nuclear Regulatory Commission
Region IV

Senior Resident Inspector w/attachment and w/o enclosure
USNRC

NPG Distribution w/attachment and w/o enclosure

Records w/attachment and w/o enclosure

Affidavit

I, Paul V. Fleming, state as follows:

(1) I am Manager, Licensing, Cooper Nuclear Station, Nebraska Public Power District (NPPD) and have been delegated the function of reviewing the information described in this letter which is sought to be withheld and have been authorized by NPPD to request that it be withheld.

(2) The information sought to be withheld is contained in the document, "Cooper Nuclear Station, Nebraska Public Power District 28KXL-1 Stage Service Water Pump No Gland Water Pump Run", Report Number 04-0057. NPPD is the sole owner of the report. The report was prepared by a contractor for the exclusive use of NPPD. NPPD considers the entire report to be proprietary (i.e., all information on all pages). Therefore, a redacted copy of the report is not included with this submittal.

(3) In making this application for withholding of proprietary information of which it is the owner, NPPD relies upon exemption from disclosure set forth in the Freedom of Information Act, 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905 and Nuclear Regulatory Commission (NRC) regulations 10 CFR 9.17(a)(4) and 2.390(a)(4) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (i.e., Exemption 4). The provision under which exemption is sought is all "confidential commercial information."

(4) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to the NRC in confidence. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by NPPD, no public disclosure has been made, nor is it anticipated, and the information is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintaining the information in confidence.

(5) Initial classification for proprietary treatment of this document is made by the manager of the relevant equipment, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within NPPD is limited to a "need to know" basis.

(6) Disclosures outside NPPD are limited to regulatory bodies, select employees and their agents, select suppliers and licensees, and others with a legitimate need for the information (based on NPPD's determination), and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(7) The document identified in the letter is classified as proprietary because it contains details of a test performed for NPPD. The testing, development and approval of the supporting methodology was achieved at a significant cost to NPPD. NPPD considers the document to be proprietary for an indefinite period of time. Should NPPD change its position on this matter, the company will inform the NRC, in writing, of its new position.

(8) Public disclosure of the information sought to be withheld is likely to cause substantial harm to NPPD's competitive position and foreclose or reduce the availability of economic benefit due to substantial expense. The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by NPPD. NPPD's competitive advantage will be lost if others are able to use the results of NPPD's experience. Making such information available to others without their having been required to undertake a similar expenditure of resources would deprive NPPD of the opportunity to exercise its competitive advantage to seek an adequate return on its investment in developing and obtaining this valuable test information.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct.

Executed at Brownville, Nebraska, this 7th day of October, 2004.

Paul V. Fleming
Cooper Nuclear Station
Nebraska Public Power District

Correspondence Number: NLS2004126

The following table identifies those actions committed to by Nebraska Public Power District (NPPD) in this document. Any other actions discussed in the submittal represent intended or planned actions by NPPD. They are described for information only and are not regulatory commitments. Please notify the Licensing & Regulatory Affairs Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITTED DATE OR OUTAGE
None	

Report Number: 04-0057

~~PROPRIETARY INFORMATION~~

Revision Number: 0

Cooper Nuclear Station
28KXL-1 Stage Service Water Pump
No Gland Water Pump Run

Prepared for:

Nebraska Public Power District
Brownville, NE

Prepared by:

Rotating Technology Services

Prepared by: Dwight M. Rose Date: 9/20/04
Dwight M. Rose

Reviewed by: James T. Lucas Date: 9/20/04
James T. Lucas

Approved by: Dwight M. Rose Date: 9/20/04
Dwight M. Rose

REVISION CONTROL SHEET

Document Number: _____ PROPRIETARY INFORMATION

Title: 28KXL-1 Stage, No Gland Water Pump Run

Client: Cooper Nuclear Station, Nebraska public Power District

RTS Report Number: 04-0057

Section	Pages	Revision	Date	Comments
Executive Summary		0	9/2004	Initial Issue
Introduction				
Test Plan				
Test Results				
Disassembly and Inspection				
Conclusions				
Attachments				

NPPD – Cooper Nuclear Power Station
Full Scale Service Water Pump Test

~~PROPRIETARY INFORMATION~~

1.0 EXECUTIVE SUMMARY

Rotating Technology Services (RTS) was commissioned on August 25, 2004, to conduct a full scale Service Water Pump test on a 28KXL-1 stage vertical circulating pump.

The purpose of the test run was to confirm that a Service Water Pump could survive a continuous 90 minute run without gland water and then go **immediately and without stopping** into a 48 hour run with gland water restored and continue to meet minimum performance requirements.

Utilizing the A-C Engineered Pump Test Facility (A-C Pump) in Pewaukee, WI, the test was run from September 10th to September 12, 2004. Operating conditions at the test site were adjusted and modified to replicate as-built and as-installed conditions at the Cooper Nuclear Station (CNS).

The pump used in the test was made up of pump components furnished by CNS. The pump was assembled by RTS service personnel and CNS personnel on a new test stand specifically constructed for this test at the A-C Pump Test Facility.

The full scale test was made up of the following four runs:

- A pre-test 4 hour run that served to establish baseline performance criteria and ensure the comparable conditions at the CNS site
- 90 minute no gland water run
- 48 hour run with gland water restored
- Post 48 hour run assessment, which included a pump restart

RTS

Results of the test runs:

- The pre-test 4 hour run was concluded successfully with the pump making performance.
- The 90 minute no gland water run was uneventful until 37 minutes into the run. At that point the pump exhibited a significant rise in vibration and the motor amps spiked from a steady state of 39.2 to 73.6 returning to 39.6 over a period of about 7.5 minutes. During this period, the pump was exposed to the impact of the Cutlass Rubber bearings contacting the shaft without gland flush. As a result of the contact, bearings (#1 thru #5) were damaged and the running clearances opened up. Moreover, the contacts of the bearings against the shaft caused the shaft to heat and expand causing contact between the impeller and bowl liner resulting in some damage. Following this 7.5 minute period the pump returned to its baseline operating conditions and continued to meet performance for the remainder of the 90 minute run with lower discharge pressure.
- The 48 hour run with gland water restored **immediately and without stopping** followed the 90 minute no gland water run. During this run the pump and motor continued to operate near baseline conditions and meet performance requirements. The only visible effect on the pump was increased leakoff coming out of the packing box and a higher discharge pressure for the gland water and a 3% degradation in pump performance.
- Post 48 hour run assessment included a pump restart and inspection of the pump. Inspection of the pump indicated that bearings (#1 thru #5) received significant damage and were destroyed. Inspection of pump components revealed that bearings (#6 thru #10) located near or below the waterline received no apparent damage or significant wear. The pump impeller and bowl liner did exhibit rotating contact. The contact did not inhibit the pump from continuing to operate and make performance. The pump had lost about 3% in performance over the entire 54 hour test run.

Based on the post-test inspection of the pump components, and analysis of the test data, the pump would have operated for several days beyond the 48 hour run and would continue to meet acceptable performance. Additionally, based on the stable operating conditions at the end of the 90 minute run and post-test inspection of the parts, it is apparent that the pump would have continued to perform without gland water for at least an additional 48 hours

E: 28KXL-1, Service Water Pump Gland Water Test
For NPPD – Cooper Nuclear

Date: September 10, 2004

1.0 Purpose

1.1 To conduct a shop performance run to establish and evaluate the effects of pump operation without gland water. Gland water suppression will be conducted for a period of 90 minutes **immediately followed** by a 48 hour pump run.

[redacted]

release

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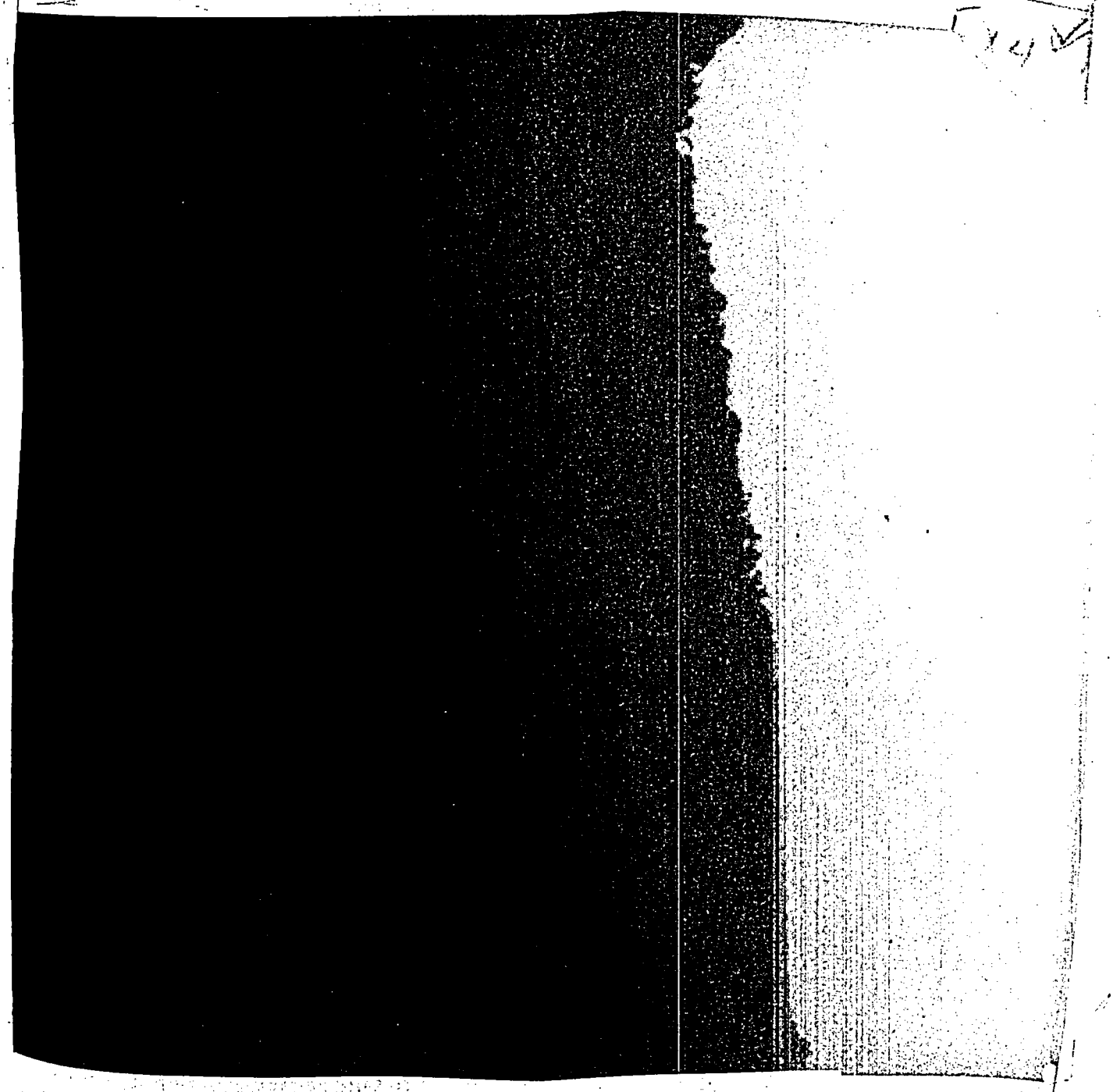
withRold Ex. 4

TITLE: 28KXL-1, Service Water Pump Gland Water Test
For NPPD – Cooper Nuclear

Date: September 10, 2004

1.0 Purpose

1.1 To conduct a shop performance run to establish and evaluate the effects of pump operation without gland water. Gland water suppression will be conducted for a period of 90 minutes **immediately followed** by a 48 hour pump run.



PROPRIETARY INFORMATION

Release ALL

CNS OPERATIONS MANUAL MAINTENANCE PROCEDURE 7.2.15.1 SERVICE WATER PUMP BOWL ASSEMBLY OVERHAUL	USE: REFERENCE ⊕ EFFECTIVE: 9/4/03 APPROVAL: SORC/IQA OWNER: J. A. NICHOLS DEPARTMENT: MNT

REVISION VERIFICATION:
(initial use + every 7 days)

REV.	DATE	CHANGES
9	12/19/02	From Vendor information, corrected Steps 3.4.6 and 7.5.8 by changing torque value from in-lbs to ft-lbs.
10	see above	Changed wording in Step 5.2.3 per CED 6008700.

1. PURPOSE

This procedure provides Maintenance personnel with instructions to overhaul a Service Water pump bowl assembly.

2. PRECAUTIONS AND LIMITATIONS

[ ] 2.1 Observe appropriate safety precautions associated with work on energized equipment.

[ ] 2.2 Prevent foreign materials or dirt from entering the working parts of the pump or driver.

[ ] 2.3 Ensure any steps marked N/A are recorded as discrepancies. Steps within the procedure that clearly indicate they are N/A if specified conditions are met exempt from this requirement.

[ ] 2.4 At least one performer shall have the ability, skill, training, or experience required for the general scope of work in which they are involved.

[ ] 2.5 Certified measuring and mechanical gauging/test equipment shall be calibrated and data recorded on Attachment 3.

[ ] 2.6 QC inspections shall be performed by personnel QC certified for the specific QC function.

[ ] 2.7 Checked By shall be performed by a second Mechanic or personnel QC certified for the specific step function.

3. REQUIREMENTS

[ ] 3.1 Record Work Order Number: _____

[ ] 3.2 Record CIC: _____

[ ] 3.3 Check sections to be performed and discard sections not performed.

[ ] 4, PUMP BOWL DISASSEMBLY

[ ] 5, PUMP BOWL COMPONENT INSPECTION AND MEASUREMENTS

[ ] 6, PUMP BOWL COMPONENT DISASSEMBLY

[ ] 7, PUMP BOWL REASSEMBLY

[ ] 3.4 Ensure the following equipment and materials are available as needed:

[ ] 3.4.1 Calibrated dial indicator and Mag Base.

[ ] 3.4.2 Calibrated outside micrometers 2-3 in, 13-14 in, and 14-15 in.

[ ] 3.4.3 Inside micrometers 2-3 in, 13-14 in, and 14-15 in.

[ ] 3.4.4 Bottom bearing removal tool (available in CNS Tool Crib).

[ ] 3.4.5 Nuclear Grade Nickel Never-Seeze (Q-94-484).

[ ] 3.4.6 Calibrated torque wrench capable of torquing 4.5 ft-lbs, 40 ft-lbs, and 130 ft-lbs.

[ ] 3.4.7 Mobil Special grease.

[ ] 3.4.8 Loctite RC 680 (Q-92-813).

[ ] 3.4.9 Loctite 271 (Q-94-005).

4. PUMP BOWL DISASSEMBLY

[ ] NOTE - Refer to Attachment 2, **Figure 1**, for item numbers in parenthesis.

4.1 Lift pump bowl assembly and place on wooden or I-beam supports in an upright position.

NOTE - Case bearing (12) has left hand threads.

4.2 Unscrew and remove top case bearing (12) from top case (7).

4.3 Remove top case (7) to suction bell (8) nuts and lockwashers.

4.4 Remove top case (7) from suction bell (8) and place on adequate supports.

4.5 Install an eyebolt in top of pump shaft (1).

4.6 Attach rigging to eyebolt and remove pump shaft (1) and impeller (2) as a unit placing on adequate supports.

[ ] NA 4.7 Loosen setscrew and remove sand cap (13).

5. PUMP BOWL COMPONENT INSPECTION AND MEASUREMENTS

5.1 Thoroughly clean disassembled components.

5.2 (QC Hold) Inspect disassembled pump components, recording any discrepancies found:

5.2.1 Top case and suction bell for damage, pitting, and excessive erosion or corrosion.

[ ] SAT; [ ] UNSAT

5.2.2 Impeller liner for damage, erosion, corrosion, or pitting.

[ ] SAT; [ ] UNSAT

5.2.3 Pump shaft for damage, erosion, corrosion, or excessive wear at bearing contact area.

[ ] SAT; [ ] UNSAT

5.2.4 Pump shaft sleeve for damage, corrosion, grooving, or excessive pitting.

[ ] SAT; [ ] UNSAT

5.2.5 Bearings for damage, pitting, or excessive wear. Ensure rubber liner is not separating from metal housing.

[ ] SAT; [ ] UNSAT

5.2.6 Impeller for damage, erosion, corrosion, wear, and damaged, chipped, cracked, or broken vanes.

[ ] SAT; [ ] UNSAT

5.2.7 All remaining components for damage, erosion, corrosion, and wear.

[ ] SAT; [ ] UNSAT

QC Signature/Date: Rahul A McCoy 8-26-04

5.3 (QC Hold) Measure and record on Attachment 1 the following pump component dimensions. Determine diametrical (total) clearance by subtracting shaft OD dimension from bearing ID dimension.

5.3.1 Rubber top case bearing (12) to ~~harden~~ shaft clearance.

5.3.2 Bronze bottom bearing (11) to shaft sleeve (42) clearance.

QC Signature/Date: Rahul A McCoy 8-26-04

5.4 (QC Hold) Measure and record on Attachment 1 impeller (2) and case wear ring (6) dimension in two locations. Determine diametrical running clearance by subtracting impeller dimension from case wear ring dimension.

NOTE - Maximum allowable wear ring clearance is 0.036".

5.4.1 Top case wear ring (6) to impeller (2).

QC Signature/Date: [signature] 8-26-07

NOTE - This component is ASME Section XI, Class 3. If repair or replacement of parts are required, Engineering will be contacted for an evaluation of parts being replaced and/or repaired. A RR-1 Form per Procedure 0.30 may be required for those activities.

5.5 If any discrepancies are recorded, they shall be resolved.

[ ] NOTE - From inspection and measurements taken in Steps 5.2, 5.3, and 5.4, applicable steps in Section 6 should be performed for discrepancies found and steps not performed will be N/A.

6. PUMP BOWL COMPONENT DISASSEMBLY

[ ] N/A 6.1 Remove shaft sleeve (42) from pump shaft (1).

[ ] N/A 6.2 Remove impeller as follows:

N/A [ ] 6.2.1 Remove thrust collar bolts and thrust collar (3).

N/A [ ] 6.2.2 Remove split ring (4).

[ ] **CAUTION** - The impeller must not be heated over 250°F.

N/A [ ] 6.2.3 If impeller requires slight heating for removal, heat impeller to a maximum of 250°F.

N/A [ ] 6.2.4 Remove impeller (2) and impeller key (5) from pump shaft (1).

N/A [ ] 6.3 Remove impeller liner as follows:

N/A [ ] 6.3.1 Remove impeller liner mounting bolts.

N/A [ ] 6.3.2 Remove impeller liner (9) from suction bell (8) by using jacking bolts.

N/A [ ] 6.4 Remove top case wear ring as follows:

N/A [ ] 6.4.1 Grind away metal from setscrew stake and remove setscrews.

N/A [ ] 6.4.2 Remove wear ring (6) from case (7).

N/A [ ] 6.4.3 Check for and remove any burrs from wear ring area.

N/A [ ] 6.5 Remove bottom bearing as follows:

N/A [ ] 6.5.1 Remove bottom bearing setscrew (not shown).

N/A [ ] 6.5.2 Remove pipe plug from bottom of suction bell (8).

N/A [ ] 6.5.3 Using special bearing removal tool, drive bottom bearing (11) out of suction bell (8).

PROPRIETARY INFORMATION

7. PUMP BOWL REASSEMBLY

[ ] NOTE - Refer to Attachment 2, **Figure 1**, for item numbers in parenthesis.

7.1 (QC Hold) Measure and record on Attachment 1 the following pump component dimensions. Determine diametrical (total) clearance by subtracting shaft OD dimension from bearing ID dimension.

7.1.1 Bronze bottom bearing (11) to shaft sleeve (42) clearance.

QC Signature/Date: [signature] 8-26-04

7.2 If removed, install bottom bearing (11) as follows:

NA 7.2.1 (QC Hold) Inspect bottom bearing and bearing seat areas of suction bell (8) and remove any burrs or high spots.

[ ] SAT; [ ] UNSAT

QC Signature/Date: _____

NA 7.2.2 Lubricate outside of bearing and bearing seating areas of suction bell with Nickel Never-Seeze.

NA 7.2.3 Press bottom bearing (11) into suction bell (8).

7.3 If removed, install impeller liner as follows:

NA 7.3.1 Examine impeller liner (9) and suction bell (8) seating areas for cleanliness and remove any burrs or high spots.

Completed By: _____

NA 7.3.2 Lubricate seating areas with Nickel Never-Seeze.

NA 7.3.3 Place impeller liner (9) into place in suction bell (8).

NA 7.3.4 (QC Witness) Draw impeller liner down into its final position by installing and torquing retaining bolts to 40 ft-lbs.

Performed By: _____

QC Signature/Date: _____

NOTE - Maximum allowable total indicated runout (TIR) is 0.002" total with no more than 0.001" in any 1' section.

7.4 (QC Hold) Select a pump shaft (1) for installation and place in V-blocks or between centers, measuring and recording pump shaft TIR on Attachment 1.

QC Signature/Date: _____

7.5 If removed, install shaft sleeve (42) as follows:

7.5.1 Review Steps 7.5.2 through 7.5.9 to ensure familiarity with shaft sleeve installation process prior to continuing.

NOTE - Shaft sleeve to pump shaft allowable clearance is 0.001" to 0.006".

7.5.2 (QC Hold) Measure and record on Attachment 1 replacement shaft sleeve (42) ID dimension and pump shaft (1) OD dimension. Determine diametrical clearance by subtracting replacement pump shaft from shaft sleeve.

QC Signature/Date: _____

7.5.3 Fit replacement shaft sleeve to shaft to ensure proper fit-up.

7.5.4 Install shaft sleeve with setscrews located towards the motor end of the pump shaft to check for proper fit.

7.5.5 Remove after fit has been checked.

NOTE - Loctite installed in Steps 7.5.6 and 7.5.7 should be allowed to cure per manufacturer's recommended cure time before returning pump to service.

7.5.6 Apply a coat of Loctite RC 680 to shaft sleeve and pump shaft as recommended by manufacturer's printed instructions on container and install shaft sleeve with setscrews located towards the motor end of the pump shaft.

NOTE - Steps 7.5.7 and 7.5.8 shall be performed in order and in rapid succession.

7.5.7 Apply Loctite 271 to setscrews.

7.5.8 (QC Witness) Install and torque setscrews to 4.5 ft-lbs (4.0 to 4.5).

Performed By: _____

QC Signature/Date: _____

[ ]. NOTE - Setscrews shall be faced off, if they protrude above shaft sleeve surface.

(H) 7.5.9 (QC Hold) Visually inspect to ensure setscrews are not protruding above the surface of shaft sleeve. Face off top of setscrews, if required.

QC Signature/Date: Robert McKay 8-26-04

(H) 7.5.10 Allow Loctite 271 to cure per manufacturer's recommended cure time before returning pump to service.

NA (H) 7.6 (QC Hold) Select an impeller for installation, measuring, and recording shaft bore dimension in four (4) locations on Attachment 1.

QC Signature/Date: _____

NA (H) 7.7 (QC Hold) Have pump shaft impeller journal area machined to largest diameter recorded in Step 7.6 (+0.000"/-0.002"). Measure and record finished diameter of pump shaft impeller journal on Attachment 1.

QC Signature/Date: _____

(H)

CAUTION - If assembly of impeller onto shaft in Step 7.8 requires impeller to be heated in an oven, do not heat impeller over 250°F.

NA (H) 7.8 Install impeller key (5) and impeller (2) onto pump shaft (1).

NA (H) 7.9 Install split ring (4) into groove in pump shaft.

NA (H) 7.10 (QC Witness) Install thrust collar (3) and torque thrust collar retaining capscrews to 130 ft-lbs.

Performed By: _____

QC Signature/Date: _____

NA (H) 7.11 Install sand cap (13) onto the bottom of shaft.

NA (H) 7.12 Install an eyebolt into top of pump shaft (1).

NA (H) 7.13 Lift pump shaft (1) and install into bottom bearing (11).

NA (H) 7.14 Adjust location of sand cap (13) so that bottom edge is 3/4" from shoulder of bottom bearing (11) and tighten sand cap setscrew.

[ ] **NOTE** - This component is ASME Section XI, Class 3. Replacement of top case and/or case wear ring requires a RR-1 Form per Procedure 0.30 with the work package for wear ring setscrew machining or top case and/or case bolting replacement.

7.15 Verify proper documentation is in the work package prior to proceeding with Step 7.16.

NA 7.16 Install top case wear ring as follows:

NA 7.16.1 Using a soft hammer, install wear ring into place.

NA 7.16.2 Using an F drill bit, drill three new holes to a depth of 3/8" to 1/2" deep ~ 1" away from previously drilled holes.

NA 7.16.3 Tap the three holes using a 5/16" NC tap.

NA 7.16.4 Apply Loctite 271 to setscrews.

NA 7.16.5 Install and tighten setscrews.

NOTE - Diametrical running clearance in Step 7.17 is 0.020" to 0.024" for new case wear ring and impeller and 0.020" to 0.036" for used wear ring and impeller.

7.17 (QC Hold) Measure and record on Attachment 1 top case wear ring dimension and impeller OD dimension. Determine diametrical running clearance by subtracting impeller dimension from top case wear ring dimension.

QC Signature/Date: [signature] 8-26-04

NOTE - Setscrews shall be faced off, if they protrude above shaft sleeve surface.

7.17.1 (QC Hold) Ensure setscrews are below flush.

QC Signature/Date: [signature] 8-26-04

NA 7.17.2 Allow Loctite 271 to cure per manufacturer's recommended cure time before returning pump to service.

NA 7.17.3 Stake the setscrews.

7.18 (QC Hold) Measure and record on Attachment 1 the following pump component dimensions. Determine diametrical (total) clearance by subtracting shaft OD dimension from rubber bearing ID dimension.

7.18.1 Rubber top case bearing (12) to harden shaft clearance.

QC Signature/Date: Richard McKay 8-26-04

7.19 Install top case bearing (12) into top case (7).

7.20 (QC Witness) Install top case (7) onto suction bell (8) and torque retaining bolts to 130 ft-lbs.

Performed By: _____

QC Signature/Date: Richard McKay 8-26-04

NOTE - Step 7.21 is to be performed for pump bowl assembly end play.

7.21 Install an eyebolt into pump shaft (1).

7.21.1 Install dial indicator on pump shaft (1).

7.21.2 (QC Witness) Raise pump shaft (1) and record on Attachment 1 the end play (minimum of 0.100").

Performed By: _____

QC Signature/Date: Richard McKay 8-26-04

7.22 Remove pipe plug from bottom bearing grease hole and install fittings with a grease zerk into grease hole.

7.23 Pump Mobil Special grease into bottom bearing (11) until grease appears around sand cap.

7.24 Remove fittings and zerk and install pipe plug into grease hole.

PROPRIETARY INFORMATION

8. RESTORATION

[ ] 8.1 Rebuilt bowl assembly will be installed or returned to CNS spare parts.

5.3.1 RUBBER TOP CASE BEARING (12) TO HARDEN SHAFT CLEARANCE:

~~USED~~ NEW					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
2.207	2.187	0.020	0.010" to 0.027"		

5.3.2 BRONZE BOTTOM BEARING (11) TO SHAFT SLEEVE (42) CLEARANCE:

~~USED~~ NEW					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
2.950	2.936	0.014	0.012" to 0.0225"		

5.4.1 TOP CASE WEAR RING (6) TO IMPELLER (2):

~~USED~~ NEW					
IMPELLER OD (inches)	CASE W/R ID (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE IMPELLER (Y/N)	REPLACE W/R (Y/N)
13.973	14.005	0.032	0.020" to 0.036"		
		0.	0.020" to 0.036"		

7.1.1 BRONZE BOTTOM BEARING (11) TO SHAFT SLEEVE (42) CLEARANCE:

NEW					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
2.950	2.936	0.014	0.012" to 0.015"		

7.4 TIR: 0. NA inch

7.5.2 NA (Shaft Sleeve ID) - NA (Pump Shaft OD) = 0. NA inch (Clearance)

7.6 1. NA inches 3. NA inches

2. NA inches 4. NA inches

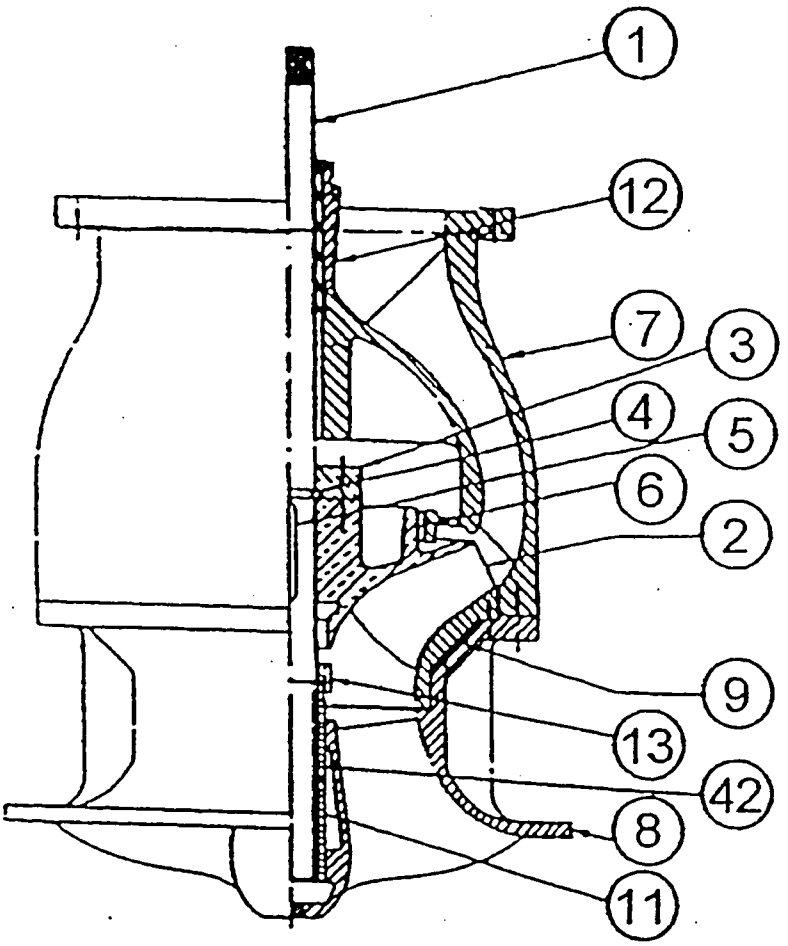
7.7 Finished Diameter: NA inches

7.17 2.950 - 2.936 = 0.014 inch
Case Wear Ring Impeller OD Clearance

7.18 RUBBER TOP CASE BEARING (12) TO HARDEN SHAFT CLEARANCE:

NEW					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
2.207	2.187	0.020	0.010" to 0.018"		

7.21.2 Impeller End Play: 0.300 inch



72-15-1A

Figure 1 - SERVICE WATER PUMP BOWL ASSEMBLY DRAWING AND PARTS LIST

ITEM NUMBER	DESCRIPTION	ITEM NUMBER	DESCRIPTION
1	Pump Shaft	8	Suction Bell
2	Impeller	9	Impeller Liner
3	Thrust Collar	11	Bottom Bearing, Bronze
4	Split Ring	12	Top Case Bearing, Rubber
5	Key - Impeller	13	Sand Cap
6	Case Wear Ring	42	Shaft Sleeve
7	Top Case	N/A	N/A

ATTACHMENT 3 SIGN-OFF AND REVIEW SHEET

STEP NUMBER	IDENTIFICATION NUMBER	DESCRIPTION	CALIBRATION DUE DATE

Initials	Printed Name	Initials	Printed Name
/		/	
/		/	
/		/	
/		/	

Discrepancies Recorded: [ ] YES; [ ] NO If YES, all discrepancies are resolved.

Mechanical Maintenance
Supervision Review: _____ Date: _____

RECORDS

Completed portions of procedure are included with a Work Order for CNS Records (quality record upon TECO).

ATTACHMENT 3 SIGN-OFF AND REVIEW SHEET

Initial/date by each discrepancy or resolution listed.

#	DISCREPANCIES	#	RESOLUTIONS

1. DISCUSSION

1.1 The Service Water pumps are electric driven, single stage, centrifugal pumps, and are located in the Intake Structure.

1.2 The Service Water pumps supply cooling water to Turbine Building Closed Cooling Water System, Reactor Building Closed Cooling Water System, Residual Heat Removal System, and Diesel Generators.

1.3 The one-stage bowl assembly consists of the top case, impeller liner, and pump shaft with attached impeller.

2. REFERENCES

2.1 UPDATED SAFETY ANALYSIS REPORT

2.1.1 Section VIII.

2.2 VENDOR MANUALS

2.2.1 CNS Number 0180, Service Water Pumps.

2.3 PROCEDURES

2.3.1 Administrative Procedure 0.30, ASME Section XI Repair/Replacement and Temporary Non-Code Repair Procedure.

2.4 MISCELLANEOUS

2.4.1 Letter CNS 907024, from L. G. Kuncl to NRC, dated January 29, 1990, Response to Generic Letter 89-13.

2.4.2 © NRC Generic Letter 89-13, Service Water Problems Affecting Safety Related Equipment. Affects Step 5.2.

CNS OPERATIONS MANUAL MAINTENANCE PROCEDURE 7.2.15 SERVICE WATER PUMP COLUMN MAINTENANCE AND BOWL ASSEMBLY REPLACEMENT	USE: REFERENCE EFFECTIVE: 10/15/03 APPROVAL: SORC/IQA OWNER: J. A. NICHOLS DEPARTMENT: MNT

REVISION VERIFICATION:
(initial use + every 7 days)

REV.	DATE	CHANGES
22	10/10/03	Added Step 3.8.7. Revised Steps 6.9, 6.19, 5.4.3, and Attachment 1 data. Added Steps 5.7 and Attachment 1 data. Revised Steps 5.3.4, 5.8, 7.24.1, 8.5, and 8.12.1. Revised NOTES prior to Steps 5.3, 5.4.1, 7.24.3, 8.10, and 8.12.3. Added NOTES prior to Steps 5.7 and 5.3.3. Deleted Step 8.5 and Step 8.5 on Attachment 1. Revised references on Information Sheet.
23	see above	Changed information on lifting SW pumps and motors. Added EE 02-071 and corrected procedure title in References.

1. PURPOSE

This procedure provides Maintenance personnel with instructions to remove, overhaul column components, and install a service water pump (CICs: SW-P-A, SW-P-B, SW-P-C, and SW-P-D).

PROPRIETARY INFORMATION

2. PRECAUTIONS AND LIMITATIONS

[ ] 2.1 Rigging of pumps, motors, and components shall be performed per Procedure 7.1.8, keeping the time the items are suspended over other pumps, motors, and piping to a minimum. When lifting SW pumps or motors with Intake Structure crane for removing a motor or pump from SW Pump Room, motor or pump shall not be lifted over or near other division's unprotected (i.e., equipment hatch plugs removed) pumps or motors.

[ ] 2.2 Observe appropriate safety precautions associated with work on energized equipment.

[ ] 2.3 Prevent foreign materials or dirt from entering the working parts of the pump or driver.

[ ] 2.4 All operation of the Intake Structure overhead crane involving the lifting of SW Pump Room closure plugs or any lift over the open SW Pump Room shall be performed by a crane operator qualified per Procedure 0.17.

[ ] 2.5 At least one performer shall have the ability, skill, training, or experience required for the general scope of work in which they are involved.

[ ] 2.6 Ensure any steps marked N/A are recorded as discrepancies. Steps within the procedure that clearly indicate they are N/A if specified conditions are met are exempt from this requirement.

[ ] 2.7 Certified measuring and mechanical gauging/test equipment shall be calibrated and data recorded on Attachment 4.

[ ] 2.8 QC inspections shall be performed by personnel QC certified for the specific QC function.

[ ] 2.9 Checked By shall be performed by a second Mechanic or personnel QC certified for the specific step function.

[ ] 2.10 All components removed are to be bagged and tagged, as applicable, to control in-process material and traceability.

[ ] 2.11 Any time the pump is unattended, the cover shall be installed on the pump column.

[ ] 2.12 This component is ASME Section XI, Class 3. If repair or replacement of parts are required, contact Engineering for an evaluation of parts being replaced and/or repaired. A RR-1 Form per Procedure 0.30 may be required for those activities.

PROPRIETARY INFORMATION

3. REQUIREMENTS

[ ] 3.1 Record Work Order Number: 4396183

[ ] 3.2 Record CIC: Test Pump

[ ] 3.3 Record sections to be performed.

[ ] 4, DISASSEMBLY

[✓] 5, INSPECTION AND MEASUREMENTS

[✓] 6, REASSEMBLY

[✓] 7, PACKING SLEEVE INSTALLATION

[✓] 8, RESET PUMP LIFT

[ ] 3.4 Station Security Procedures require that special security criteria be met when the Service Water Pump Room ceiling plugs, personnel doors, or under floor hatch are removed or blocked open. Contact Security Shift Supervisor to make security arrangements for working in the Pump Room.

[ ] **NOTE** - Station procedures require that fire protection criteria be met when the Service Water Pump Room ceiling plugs, personnel door, pumps, or under floor hatch are removed or blocked open because of inoperative Halon System and/or fire barriers.

N/A [ ] 3.5 Hot Work Permit, Fire Protection Impairment Permit, and/or Fire Watch established, as required, per Procedure 0.39.

N/A [ ] 3.6 Notify Electric Shop to disconnect main auxiliary electrical leads from pump motor.

N/A [ ] 3.7 Contact Shift Manager prior to removing Service Water Pump Room ceiling hatch plug to have it recorded as an Appendix A fire barrier removal and inoperable Halon System.©

(✓) 3.8 Ensure the following equipment and materials are available as needed:

(✓) 3.8.1 Slings, straps, shackles, and hoisting equipment for removal of hatch plugs and pump parts which have been examined for NUREG 0612 lifts.

(✓) 3.8.2 Temporary lighting.

3.8.3 Two 3' to 4' long I-beams on which to support pump assembly during disassembly.

3.8.4 Cribbing on which to lay pump components on as they are disassembled.

3.8.5 Calibrated dial indicator.

3.8.6 Calibrated outside micrometers.

3.8.7 Calibrated inside micrometers 4" to 5".

3.8.8 Nickel Never-Seeze, thread lubricant (Q-94-484).

3.8.9 Calibrated torque wrenches.

3.8.10 Loctite RC 680 (Q-92-813).

3.8.11 Loctite 271 (Q-94-005).

3.8.12 Loctite 755 (Q-94-490).

3.8.13 Shaft sleeve setscrews.

3.8.14 Versilube (Q-94-547).

4. DISASSEMBLY

[ ] NOTE - Refer to Attachment 2 for item numbers in parenthesis.

[ ] 4.1 Disconnect, tag, remove, as necessary, any piping which would interfere with pump removal and cover pipe openings.

[ ] 4.2 Remove all but two diagonally opposed coupling bolts.

[ ] 4.3 Evenly loosen two remaining coupling bolts until pump shaft stops lowering and remove two coupling bolts.

[ ] 4.4 Using a feeler gauge, determine impeller lift by measuring gap between adjusting plate face and drive half coupling face, and record reading on Attachment 1.

[ ] 4.5 Examine slings, straps, shackles, and hoisting equipment being used for this NUREG 0612 lift for damage and deterioration per Procedure 7.2.76 and/or 7.2.75 prior to rigging pump and motor. Attach inspection sheets to this procedure or to Work Order.

[ ] WARNING - Hatch plug weighs ~ 2,000 lbs.

[ ] NOTE - Hatch plugs shall be reinstalled at the end of each day, if applicable, or if pump is being worked only on one shift.

[ ] 4.6 Remove hatch plug(s) above pump to be worked.

[ ] 4.7 Remove motor hold-down bolts.

[ ] WARNING - Motor weighs ~ 3,500 lbs.

[ ] 4.8 Rig and remove motor and set aside on adequate supports.

[ ] 4.9 Unscrew and remove adjusting plate (41).

[ ] 4.10 Remove pump half coupling (37) and key (38).

[ ] 4.11 Remove packing gland (31) and packing (33).

[ ] 4.12 Unscrew and remove packing tension nut (32).

[ ] 4.13 Remove packing pusher (34) and O-ring (35).

[ ] 4.14 Remove pump discharge flange bolts.

[ ] 4.15 Remove pump head to foundation hold-down bolts.

[ ] **WARNING** - The pump weighs ~ 12,000 lbs.

[ ] 4.16 Attach rigging from pump discharge head (30) to overhead crane.

[ ] 4.17 Lift pump high enough to place I-beams under flange between top column (18) and discharge head (30).

[ ] 4.18 Lower pump until it is supported by I-beams.

[ ] 4.19 Remove discharge head to top column flange bolts.

[ ] **NOTE** - A covering will be installed over pump casing each time a section of column is removed to keep foreign material from entering pump casing.

[ ] 4.20 Lift discharge head and place on adequate supports.

[ ] **NOTE** 1 - Adequately mark tubes, bearings, and shafts while removing so location and orientation of each part can be identified.

[ ] **NOTE** 2 - Head nipple, tubes, and shafts have left-handed threads.

[ ] 4.21 Unscrew and remove head nipple (36).

[ ] 4.22 (QC Witness) Measure and record on Attachment 1 distance from top of the shaft to the top of the shaft sleeve (packing) (14) to help in installation.

Performed By: _____

QC Signature/Date: _____

[ ] **CAUTION** - Shaft sleeve (packing) (14) may have to be cut or ground off. Use caution to prevent damaging the shaft.

[ ] 4.23 Remove shaft sleeve (packing) (14).

[ ] 4.24 Unscrew and remove top tube (22) with top tube bearing (27) as an assembly.

[ ] 4.25 Unscrew and remove top column shaft (24) from shaft coupling (25).

[ ] 4.26 Remove pump sections as follows, initialing for each column removed:

[ ] **NOTE** - In Step 4.26.1 the coupling is normally removed with shaft.

[ ] 4.26.1 If applicable, remove shaft coupling (25).

[ ] 4.26.2 Attach rigging and lift pump assembly high enough to place I-beams under restraint welded to column.

[ ] NOTE - Some of the bolts can be removed between lower and bottom column before resting on beams for ease of removal, leaving four bolts on each side of casing.

[ ] 4.26.3 Lower pump assembly until weight is supported by I-beams.

[ ] 4.26.4 Remove column to column flange bolts.

[ ] 4.26.5 Remove column and place on adequate supports.

[ ] 4.26.6 Unscrew and remove tubes.

[ ] 4.26.7 Unscrew and remove shaft and place on adequate supports.

[ ] NOTE - In Step 4.26.8, the coupling is normally removed with shaft.

[ ] 4.26.8 Unscrew and remove shaft coupling.

[ ] 4.27 Rig to top case (7) and lift remaining pump assembly and place it onto adequate supports in an appropriate lay down area.

PROPRIETARY INFORMATION

5. INSPECTION AND MEASUREMENTS

[ ] 5.1 Discard all used gasket, O-rings, and other elastomers.

[ ] 5.2 Thoroughly clean disassembled components.

[ ] **NOTE** - All QC Validation in Steps 5.3, 5.4, 5.5, 5.6, and 5.7 shall be completed prior to performing Step 5.9.

[ ] 5.3 (QC Validation) Inspect disassembled pump as follows, recording any discrepancies found:©

[ ] 5.3.1 Discharge head and column sections for damage, pitting, and excessive erosion or corrosion.

[ ] SAT; [ ] UNSAT

[ ] 5.3.2 If Pump D, the area near the flanges where filler material was applied to the lower and intermediate columns.

[ ] SAT; [ ] UNSAT

[ ] **NOTE** - If overhaul is to satisfy a Maintenance Plan, Step 5.3.3 is N/A, as all tubes will be replaced with new.©

[ ] 5.3.3 Tubes for damage, pitting, erosion, corrosion, straightness, and tube threads are not damaged, stripped, or galled.

[ ] SAT; [ ] UNSAT

[ ] 5.3.4 Shafts for damage, erosion, corrosion, or excessive wear at bearing contact areas.

[ ] SAT; [ ] UNSAT

[ ] 5.3.5 Bearings for damage or excessive wear. Ensure rubber liner is not separating from metal housing.

[ ] SAT; [ ] UNSAT

[ ] 5.3.6 Fasteners for damage. [ ] SAT; [ ] UNSAT

[ ] 5.3.7 All remaining pump components (excluding pump bowl assembly) for damage, erosion, corrosion, and wear.

[ ] SAT; [ ] UNSAT

QC Signature/Date: 8-28-07

[ ] 5.4 (QC Validation) Measure shaft and bearings as follows:

NOTE - Intermediate column shafts may be rotated end-for-end if either of the bearing contact areas are worn and when rotated maximum allowable diametrical clearances are still met.

5.4.1 Measure and record on Attachment 1 shaft OD dimension and rubber bearing ID dimension. Determine diametrical running clearance between the rubber bearings and their respective hardfaced shaft by subtracting shaft OD from rubber bearing ID to obtain clearance. If column shaft was rotated, indicate it was rotated by marking "R" in REPLACE SHAFT column.

5.4.2 If shaft or bearing was replaced, measure and record on Attachment 1 new bearing dimensions and shafts dimensions. Determine diametrical running clearances for new bearings and shafts by subtracting new shaft dimensions from new bearing dimensions.

NOTE 1 - Maximum acceptable total indicated runout (TIR) for new top shaft is 0.002" and no deviation in straightness may exceed 0.001" over any 1' length.

NOTE 2 - Maximum acceptable TIR for intermediate column shafts is 0.007" and no deviation in straightness may exceed 0.001" over any 1' length.

5.4.3 With shaft in V-blocks or rollers, measure and record on Attachment 1 shaft runout at center of shaft.©

QC Signature/Date: Rachel J McKy 8-27-07

5.5 (QC Validation) Inspect shaft for abnormal nicks, tack weld buildup, gouges, or damage recording any discrepancies found.©

[ ] SAT; [ ] UNSAT

QC Signature/Date: Rachel J McKy 8-27-07

NOTE 1 - Allowable diametrical clearance is 0.001" to 0.006".

NOTE 2 - Replacement shaft sleeve may require machining to obtain proper fit.

5.6 (QC Validation) Measure and record on Attachment 1 replacement shaft sleeve ID dimension and shaft OD dimension. Determine diametrical clearance by subtracting replacement shaft sleeve ID dimension from shaft OD dimension.

QC Signature/Date: Rachel J McKy 8-27-07

~~PROPRIETARY INFORMATION~~

NOTE - Inside diameter (ID) dimension of spider bearing support on a new bottom column and intermediate column is 4.503" to 4.505". If ID is < 4.503" or > 4.505", Engineering is to evaluate.©

5.7 (QC Validation) Measure and record on Attachment 1 bottom and intermediate column spider bearing support ID dimension of the columns being used for pump overhaul.©

QC Signature/Date: [signature] 8-26-04

5.8 Ensure all QC Validation in Steps 5.3, 5.4, 5.5, 5.6, and 5.7 have been performed prior to performing Step 5.9.

5.9 If any discrepancies are recorded, they shall be resolved.

PROPRIETARY INFORMATION

6. REASSEMBLY

[ ] **NOTE** - Bearings may already be installed in tube section and lengths of tube sections may already be screwed together.

[ ] 6.1 Prepare top shaft sleeve (packing) (14) as follows:

[ ] 6.1.1 Fit replacement shaft sleeve (packing) (14) to shaft to ensure proper fit-up.

[ ] 6.1.2 If required, prepare shaft sleeve (packing) (14) for threaded setscrews by boring three holes on each end of shaft sleeve approximately equally spaced around circumference of shaft sleeve (refer to Attachment 2, **Figure 3**, for location and size of holes).

[ ] 6.1.3 (QC Witness) Install shaft sleeve (packing) (14) on shaft at same distance as recorded in Step 4.22 and record distance on Attachment 1.

Performed By: _____

QC Signature/Date: Ruth McKy 8-28-04

[ ] 6.1.4 Mark and counterbore pump shaft. Counter-bore shaft only deep enough to allow for maximum setscrew thread contact with threads in shaft sleeve (packing) (14).

[ ] 6.1.5 Tap six holes bored in shaft sleeve (packing) (14) to accept setscrews (refer to Attachment 2, **Figure 3**, for size and thread pitch of holes).

[ ] 6.1.6 Install shaft sleeve (packing) (14), with setscrews, on pump shaft to check for proper fit; remove after fit has been checked.

[ ] 6.2 Examine slings, straps, shackles, and hoisting equipment being used for this NUREG 0612 lift for damage or deterioration per Procedure 7.2.76 and/or 7.2.75 prior to pump reassembly.

[ ] 6.3 Obtain a replacement bowl assembly and transport it to installation location.

[ ] 6.4 Lower pump into hole and support on I-beams placed under flange.

[ ] 6.5 Using die and tap set, clean coupling and shaft threads.

[ ] 6.6 Apply thread lubricant to threaded portions of each shaft, shaft coupling, bearing, and tube.

[ ] 6.7 Install new O-rings (29) on tee tube bearings (28).

6.8 Install a shaft coupling (25) onto pump shaft (1) and thread the coupling halfway onto shaft.

6.9 Ensuring there is no foreign material on shaft ends or in coupling, install next shaft section and firmly tighten two shafts against each other in center of coupling.

6.10 Install lower tube section.

6.11 Install jump bearing (26).

6.12 Install next tube section.

6.13 Install bottom column section (16) onto top case (7).

6.14 Lubricate case retaining bolts using Nickel Never-Seeze.

6.15 (QC Witness) Install and torque bottom column section to top case retaining bolts to 130 ft-lbs.

Performed By: _____

QC Signature/Date: Rachel McKee 8-28-04

6.16 Lower pump assembly until weight of assembly is supported by I-beams placed under top flange of column section.

6.17 Install a ~~tee~~ Line tube bearing (25) onto top of tube section.

6.18 Install a shaft coupling halfway onto top of shaft.

6.19 Ensuring there is no foreign material on shaft ends or in coupling, install next shaft section and firmly tighten two shafts against each other in center of coupling.

6.20 Install next tube section.

6.21 Install next tube bearing and tube section.

6.22 (QC Witness) Install lower column section and torque retaining column bolting to 165 ft-lbs, then 330 ft-lbs.

Performed By: _____

QC Signature/Date: Rachel McKee 8-29-04

6.23 Repeat Steps 6.14 through 6.20 to install intermediate shaft, tube, and column sections.

6.24 (QC Witness) Install intermediate column section and torque retaining column bolting to 165 ft-lbs, then 330 ft-lbs.

Performed By: _____

QC Signature/Date: [signature] 8-29-04

6.25 Repeat Steps 6.14 through 6.20 to install top shaft, tube, and column sections.

6.26 (QC Witness) Install top column section and torque retaining column bolting to 165 ft-lbs, then 330 ft-lbs.

Performed By: _____

QC Signature/Date: [signature] 8-29-04

PROPRIETARY INFORMATION

7. PACKING SLEEVE INSTALLATION

7.1 Review Steps 7.2 through 7.7.4 to ensure familiarity with shaft sleeve (packing) (14) installation process prior to continuing.

7.2 Lower pump assembly until weight of assembly is supported by I-beams placed under top flange of column section.

7.3 Install a shaft coupling halfway onto top of shaft.

7.4 Install next shaft section and firmly tighten two shafts against each other in center of coupling.

7.5 Install next tube section with bearing.

7.6 Clean pump shaft and shaft sleeve (packing) (14) using Loctite 755 cleaner.

7.7 Apply a coat of Loctite RC 680 to shaft sleeve (packing) (14) and pump shaft as recommended by manufacturer's printed instructions on container and install shaft sleeve (packing) (14) on pump shaft.

NOTE - Steps 7.7.1 and 7.7.2 shall be performed in order and in rapid succession.

7.7.1 Apply Loctite 271 to setscrews.

7.7.2 (QC Witness) Install and torque setscrews to 6 in-lbs.

Performed By: _____

QC Signature/Date: 8-31-04

NOTE - Setscrews shall be faced off, if they protrude above shaft sleeve (packing) (14) surface.

7.7.3 (QC Hold) Verify setscrews are not protruding above the surface of shaft sleeve (packing) (14).

QC Signature/Date: 8-31-04

7.7.4 Allow Loctite 271 to cure per manufacturer's recommended cure time before returning pump to service.

7.8 Install head nipple.

PROPRIETARY INFORMATION

[ ] 7.9 (QC Witness) Install discharge head and torque retaining bolts to 330 ft-lbs.

Performed By: _____

QC Signature/Date: [signature] 8-31-04

[ ] 7.10 Lift pump assembly and remove I-beams.

[ ] 7.11 Lower pump assembly into position on foundation.

[ ] 7.12 Lubricate foundation bolts with Nickel Never-Seeze.

[ ] 7.13 (QC Witness) Install and torque foundation bolts in increments of 53, 105, 158, then 210 ft-lbs.

Performed By: _____

QC Signature/Date: [signature] 8-31-04

[ ] NOTE - Expansion joint is rubber and bolts to discharge head.

[ ] 7.14 Install Garlock expansion joint to pump discharge flange bolts gradually and equally tighten until the edges of the expansion joint bulge slightly.

[ ] 7.15 Lubricate O-ring (35) with Versilube.

[ ] 7.16 Install a new O-ring (35) and packing ring (34) in discharge head (30).

[ ] 7.17 Install tension nut (32) into head nipple (36) and firmly tighten against packing ring (34) to compress O-ring.

[ ] 7.18 Pack pump using 1/4" teflon packing and install packing gland (31).

[ ] 7.19 Install coupling key (38) and pump half coupling (37).

[ ] 7.20 (QC Witness) Check mating faces of coupling and adjusting ring for dirt, burrs, and high spots. Clean or correct as needed to effect proper mating when coupled up.

Performed By: _____

QC Signature/Date: [signature] 9-1-04

[ ] 7.21 Install adjusting ring (41) and thread down against pump half coupling.

[ ] **WARNING** - Motor weighs ~ 3500 lbs.

[ ] 7.22 Rig and install motor onto discharge head with conduit box over pump discharge.

PROPRIETARY INFORMATION

7.23 (QC Witness) Install and torque motor hold-down bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: Rachel J McKay 9-1-04

7.24 Set pump lift as follows:

7.24.1 Using feeler gauges, screw adjusting plate up until there is ~ 0.100" (do not exceed 0.100") gap between adjusting plate and motor half coupling.

7.24.2 Turn adjusting plate down until bolt holes will line up with nearest bolt holes in pump half coupling.

NOTE - Final pump lift shall be as close to 0.100" as possible (without exceeding this value).

7.24.3 (QC Witness) Using a feeler gauge, measure and record on Attachment 1 Final impeller lift by measuring gap between adjusting plate face and driver half coupling face.

Performed By: _____

QC Signature/Date: Rachel J McKay 9-1-04

7.24.4 Rotate driver shaft to align bolt holes of driver half coupling and adjusting plate.

7.24.5 Install two of coupling bolts and tighten until adjusting plate is drawn into contact with motor half coupling.

7.24.6 (QC Witness) Install remaining coupling bolts and torque all bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: Rachel J McKay 9-1-04

7.24.7 (QC Witness) Manually rotate pump to ensure it turns freely.

Performed By: _____

QC Signature/Date: Rachel J McKay 9-1-04

7.25 N/A (QC Hold) Inspect piping removed in Step 4.1 for cleanliness.

QC Signature/Date: _____

PROPRIETARY INFORMATION

7.26 Install and connect piping.

7.27 Notify Electric Shop to reconnect main and auxiliary leads to the motor.

WARNING - Hatch plug weighs ~ 12,000 lbs.

7.28 Install hatch plugs over pump.

7.29 Notify Shift Manager that hatch plugs have been installed.

PROPRIETARY INFORMATION

8. RESET PUMP LIFT

[ ] NOTE - Performance of this section is required when determined by Engineering and/or Operations.

[ ] 8.1 Sign out Clearance Order.

[ ] 8.2 Remove all but two diagonally opposed coupling bolts.

[ ] 8.3 Evenly loosen two remaining coupling bolts until pump shaft stops lowering and remove two coupling bolts.

[ ] 8.4 Using a feeler gauge, determine impeller lift by measuring gap between adjusting plate face and drive half coupling face, and record reading on Attachment 1.

[ ] 8.5 Reset pump lift to dimension as close to 0.100" as possible (without exceeding this value) and record value on Attachment 1.

[ ] 8.6 Rotate driver shaft to align bolt holes of driver half coupling and adjusting plate.

[ ] 8.7 Install two of coupling bolts and tighten until adjusting plate is drawn into contact with motor half coupling.

[ ] 8.8 (QC Witness) Install remaining coupling bolts and torque all bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 8.9 (QC Witness) Manually rotate pump to ensure it turns freely.

Performed By: _____

QC Signature/Date: _____

[ ] NOTE - If lift is ~ 0.100" during performance of Steps 8.1 through 8.9, then Step 8.10 does not apply and Steps 8.12 through 8.12.7 are N/A.

[ ] 8.10 Sign in Clearance Order and have Operations run pump for no more than 16 hours.

[ ] 8.11 Repeat steps necessary to reset lift to Engineering recommendation or perform final lift setting.

[ ] NOTE - Step 8.12 is to be performed for final lift adjustment.

[ ] 8.12 Set pump lift as follows:

[ ] 8.12.1 Using feeler gauges, screw adjusting plate up until there is ~ 0.100" (do not exceed 0.100") gap between adjusting plate and motor half coupling.

[ ] 8.12.2 Turn adjusting plate down until bolt holes will line up with nearest bolt holes in pump half coupling.

[ ] NOTE - Final pump lift shall be as close to 0.100" as possible (without exceeding this value).

[ ] 8.12.3 (QC Witness) Using a feeler gauge, determine Final impeller lift by measuring gap between adjusting plate face and driver half coupling face, and record reading on Attachment 1.

Performed By: _____

QC Signature/Date: _____

[ ] 8.12.4 Rotate driver shaft to align bolt holes of driver half coupling and adjusting plate.

[ ] 8.12.5 Install two of coupling bolts and tighten until adjusting plate is drawn into contact with motor half coupling.

[ ] 8.12.6 (QC Witness) Install remaining coupling bolts and torque all bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 8.12.7 (QC Witness) Manually rotate pump to ensure it turns freely.

Performed By: _____

QC Signature/Date: _____

PROPRIETARY INFORMATION

9. RESTORATION

[ ] 9.1 Sign in Clearance Order and release pump to Operations for post-maintenance testing.

[ ] 9.2 Maintenance to initiate a Notification. This Notification is to have the torque of foundation bolts on this Service Water pump rechecked after 30 days of the initial torque.©

Completed By: _____

4.4 Impeller Lift: 0. N/A inch

4.22 Distance: N/A inch

5.4.1 **NOTE** - Maximum allowable clearance is 0.026".

TUBE BEARING CLEARANCES:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
		0.		
		0.		
		0.		
		0.		
		0.		
		0.		

NOTE - Maximum allowable clearance is 0.026".

TEE TUBE BEARING CLEARANCES:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
		0.		
		0.		

NOTE - Maximum allowable clearance is 0.026".

JUMP TUBE BEARING CLEARANCE:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
		0.		

PRORRIETARY INFORMATION

5.4.2 **NOTE** - Maximum allowable clearance is 0.026".

TUBE BEARING CLEARANCES:

NEW BEARING ID (inches)	NEW SHAFT OD (inches)	CLEARANCE (inches)
2.210/ 2.210	2.187	0.023
2.210/ 2.210	2.186	0.023
2.211/ 2.211	2.186	0.025
2.211/ 2.211	2.187	0.024
2.210/ 2.210	2.187	0.023
2.210	2.186	0.023

NEW TOP Shaft

NOTE - Maximum allowable clearance is 0.026".

TEE TUBE BEARING CLEARANCES:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
2.210	2.187	0.023		
2.209	2.187	0.024		

NOTE - Maximum allowable clearance is 0.026".

JUMP TUBE BEARING CLEARANCE:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
2.211	2.187	0.024		

PROPRIETARY INFORMATION

5.4.3 NOTE - Refer to NOTES 1 and 2 prior to Step 5.4.3 in Section 5.

	REPLACED
Removed Top Shaft Runout: 0. inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0. inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0. inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0. inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0. inch	[ ] YES; [ ] NO

Installed Top Shaft Runout: 0.0005 inch

Installed Intermediate Shaft Runout: 0. 003 inch

Installed Intermediate Shaft Runout: 0. 003 inch

Installed Intermediate Shaft Runout: 0. 002 inch

Installed Intermediate Shaft Runout: 0. 002 inch

5.6 2.184 (Shaft Sleeve ID) - 2.187 (Shaft OD) = 0.004 (Clearance) inch

* bored SLEEVE OUT TO 2.191

5.7 NOTE - Refer to NOTE prior to Step 5.7 in Section 5.

Spider Bearing Support ID Dimension	ACCEPTABLE
Bottom Column: 0. 4.504 inch	[✓] YES; [ ] NO
Intermediate Column: 0. 4504 inch	[✓] YES; [ ] NO

6.1.3 Distance: 8 1/8 inch

7.24.3 Final Pump Lift: 0.090 inch

8.4 Impeller Lift: 0. inch

8.5 Impeller Lift: 0. inch

8.12.3 Final Pump Lift: 0. inch

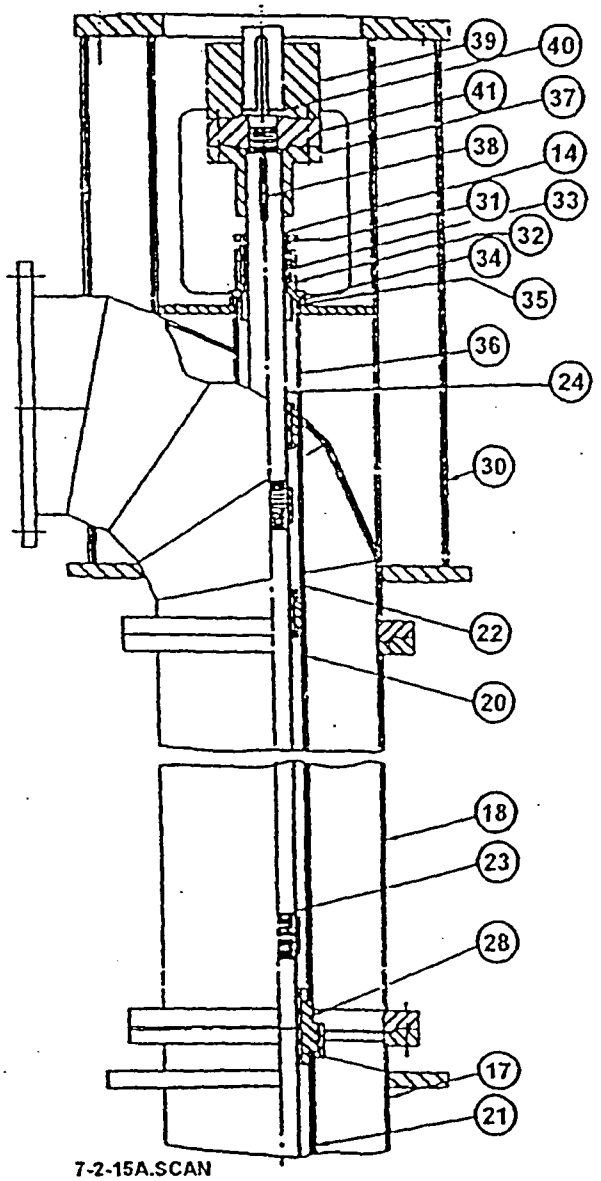


Figure 1 - Upper Service Water Pump Drawing

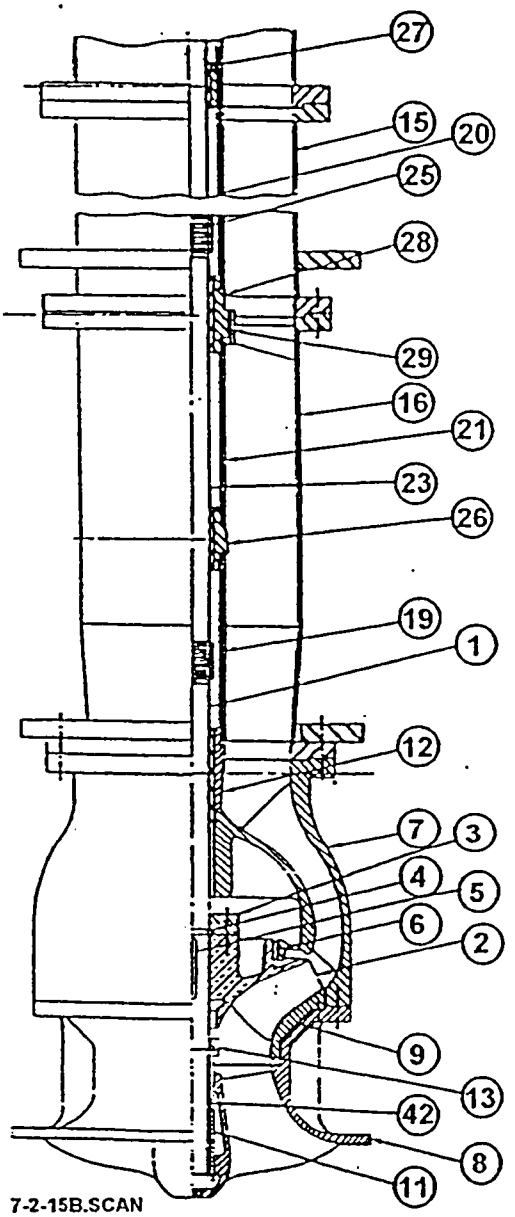


Figure 2 - Lower Service Water Pump Drawing

NOTE 1 - Three setscrews 6-32 x 3/16 to be spaced equally around circumference.

NOTE 2 - C_L of setscrews to be located 3/8" in from end of sleeve.

NOTE 3 - Use cup point setscrew (18-8).

NOTE 4 - Setscrews are loctited into place.

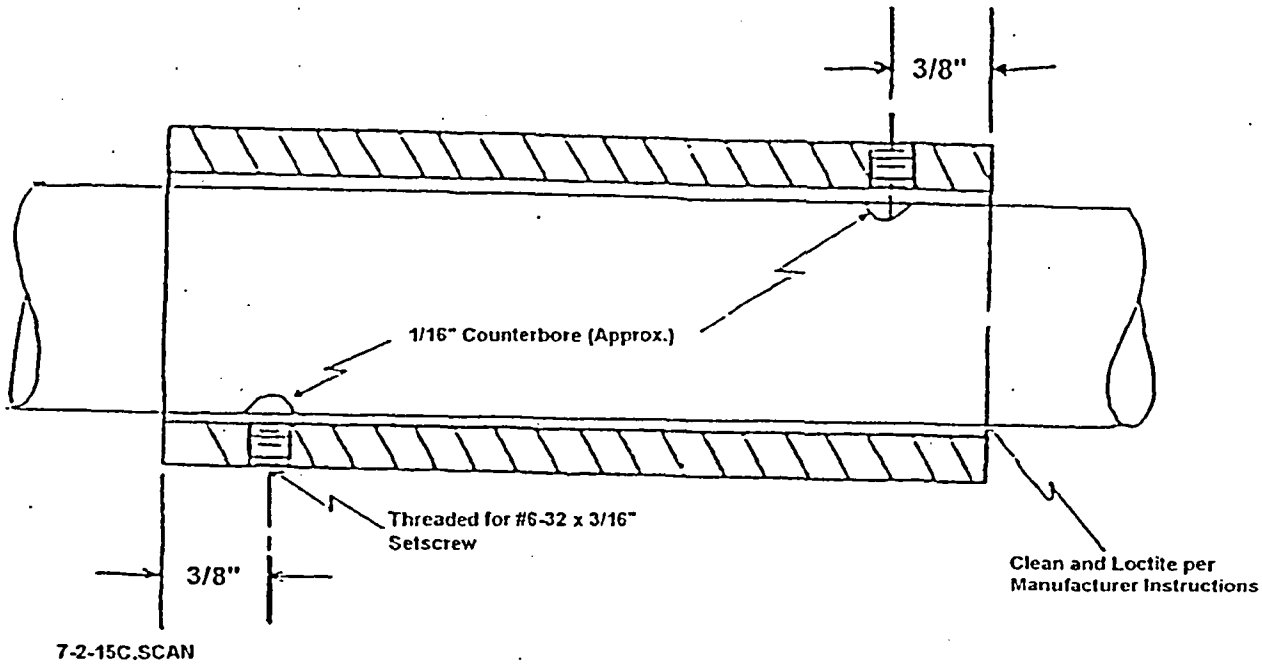


Figure 3 - Service Water Top Shaft Sleeve (Packing) (14) Installation Drawing

ITEM NUMBER	DESCRIPTION OR NAME
1	PUMP SHAFT
2	IMPELLER
3	THRUST COLLAR
4	SPLIT RING
5	KEY - IMPELLER
6	CASE WEAR RING
7	TOP CASE
8	SUCTION BELL
9	IMPELLER LINER
10	SUCTION LINER
11	BOTTOM BEARING
12	TOP CASE BEARING
13	SAND CAP
14	SHAFT SLEEVE (PACKING)
15	LOWER COLUMN
16	BOTTOM COLUMN
17	INTERMEDIATE COLUMN
18	TOP COLUMN
19	BOTTOM TUBE
20	INTERMEDIATE TUBE
21	SPECIAL TUBE
22	TOP TUBE
23	INTERMEDIATE SHAFT
24	TOP SHAFT
25	SHAFT COUPLING
26	JUMP BEARING
27	TUBE BEARING
28	TEE TUBE BEARING
29	O-RING
30	DISCHARGE HEAD
31	SPLIT GLAND
32	PACKING TENSION NUT
33	PACKING
34	PACKING RING

ITEM NUMBER	DESCRIPTION OR NAME
35	O-RING - PACKING RING
36	HEAD NIPPLE
37	PUMP HALF COUPLING
38	KEY
39	DRIVE HALF COUPLING
40	SPLIT RING
41	ADJUSTING PLATE
42	HAFT SLEEVE (BEARING)

ATTACHMENT 3 TORQUE VALUE TABLE

NOTE - All torque values given in table are for lubricated bolting.

STUD SIZE (inch)	TORQUE (ft-lbs)
3/8-16	16
7/16-14	27
1/2-13	40
9/16-12	60
5/8-11	80
3/4-10	130
7/8-9	210
1-8	330
1-1/8-7	520

PROPRIETARY INFORMATION

ATTACHMENT 4 SIGN-OFF AND REVIEW SHEET

STEP NUMBER	IDENTIFICATION NUMBER	DESCRIPTION	CALIBRATION DUE DATE

Initials	Printed Name	Initials	Printed Name
/		/	
/		/	
/		/	
/		/	

Discrepancies Recorded: [ ] YES; [ ] NO If YES, all discrepancies are resolved.

Mechanical Maintenance
Supervision Review: _____ Date: _____

RECORDS

Entire procedure is included with a Work Order for CNS Records (quality record upon TECO).

ATTACHMENT 4 SIGN-OFF AND REVIEW SHEET

Initial/date by each discrepancy or resolution listed.

#	DISCREPANCIES	#	RESOLUTIONS

1. DISCUSSION

1.1 The four Service Water pumps are electric driven, single stage, centrifugal pumps and located in the Intake Structure.

1.2 The service water pumps supply cooling water for Turbine Building Closed Cooling Water System, Reactor Building Closed Cooling Water System, RHR Service Water Booster Pumps, and Diesel Generators.

1.3 The bottom, lower, intermediate, and top column assemblies contain an inner column (or tube), bearings, and column shaft. The inner columns isolate the shafts and their bearings from the pump discharge.

2. REFERENCES

2.1 UPDATED SAFETY ANALYSIS REPORT

2.1.1 Section X-8, Service Water and RHR Service Water Booster System.

2.2 CODES AND STANDARDS

2.2.1 NUREG 0612, Control of Heavy Loads at Nuclear Power Plants.

2.3 DRAWINGS

2.3.1 CNS Drawing CNS-SW-29, Service Water Columns CNS.

2.4 VENDOR MANUALS

2.4.1 CNS Number 0180, Service Water Pumps.

2.5 PROCEDURES

2.5.1 Administrative Procedure 0.17, Selection and Training of Station Personnel.

2.5.2 Administrative Procedure 0.30, ASME Section XI Repair/Replacement and Temporary Non-Code Repair Procedure.

2.5.3 Administrative Procedure 0.39, Fire Watches.

2.5.4 Maintenance Procedure 7.1.8, Rigging and Lifting at CNS.

2.5.5 Maintenance Procedure 7.2.15.1, Service Water Pump, Bowl Assembly Overhaul.

2.5.6 Maintenance Procedure 7.2.75, Chain and Lever Operated Manual Hoist Examination, Maintenance, and Testing.

2.5.7 Maintenance Procedure 7.2.76, Sling Examination, Maintenance, and Testing.

2.6 MISCELLANEOUS

2.6.1 CED 2000-0015.

2.6.2 © CR 94-0895. Affects Step 3.7.

2.6.3 EE 02-071, Evaluation of NUREG 0612 Rigging and Lifting Requirements.

2.6.4 Letter CNSS 907024, from L. G. Kuncl to NRC, dated January 29, 1990, Response to Generic Letter 89-13.

2.6.5 © NRC Generic Letter 89-13, Service Water Problems Affecting Safety Related Equipment. Affects Steps 5.3 and 5.5.

2.6.6 OE 16722, Damage to 0B SX M/U Pump Resulting From Displaced Line-Shaft Bearing.

2.6.7 © RCR 2000-1140. Affects Step 9.2.

2.6.8 © SCR 2003-2655. Affects Steps 5.4.3, 5.7, and NOTE prior to Steps 5.3.3 and 5.7.

~~PROPRIETARY INFORMATION~~

CNS OPERATIONS MANUAL MAINTENANCE PROCEDURE 7.2.15.1 SERVICE WATER PUMP BOWL ASSEMBLY OVERHAUL	USE: REFERENCE ④ EFFECTIVE: 9/4/03 APPROVAL: SORC/IQA OWNER: J. A. NICHOLS DEPARTMENT: MNT

REVISION VERIFICATION:
(initial use + every 7 days)

REV.	DATE	CHANGES
9	12/19/02	From Vendor information, corrected Steps 3.4.6 and 7.5.8 by changing torque value from in-lbs to ft-lbs.
10	see above	Changed wording in Step 5.2.3 per CED 6008700.

1. PURPOSE

This procedure provides Maintenance personnel with instructions to overhaul a Service Water pump bowl assembly.

2. PRECAUTIONS AND LIMITATIONS

[ ] 2.1 Observe appropriate safety precautions associated with work on energized equipment.

[ ] 2.2 Prevent foreign materials or dirt from entering the working parts of the pump or driver.

[ ] 2.3 Ensure any steps marked N/A are recorded as discrepancies. Steps within the procedure that clearly indicate they are N/A if specified conditions are met exempt from this requirement.

[ ] 2.4 At least one performer shall have the ability, skill, training, or experience required for the general scope of work in which they are involved.

[ ] 2.5 Certified measuring and mechanical gauging/test equipment shall be calibrated and data recorded on Attachment 3.

[ ] 2.6 QC inspections shall be performed by personnel QC certified for the specific QC function.

[ ] 2.7 Checked By shall be performed by a second Mechanic or personnel QC certified for the specific step function.

3. REQUIREMENTS

[ ] 3.1 Record Work Order Number: _____

[ ] 3.2 Record CIC: Test Pump

[ ] 3.3 Check sections to be performed and discard sections not performed.

[✓] 4, PUMP BOWL DISASSEMBLY

[ ] 5, PUMP BOWL COMPONENT INSPECTION AND MEASUREMENTS

[ ] 6, PUMP BOWL COMPONENT DISASSEMBLY

[ ] 7, PUMP BOWL REASSEMBLY

[ ] 3.4 Ensure the following equipment and materials are available as needed:

[ ] 3.4.1 Calibrated dial indicator and Mag Base.

[ ] 3.4.2 Calibrated outside micrometers 2-3 in, 13-14 in, and 14-15 in.

[ ] 3.4.3 Inside micrometers 2-3 in, 13-14 in, and 14-15 in.

[ ] 3.4.4 Bottom bearing removal tool (available in CNS Tool Crib).

[ ] 3.4.5 Nuclear Grade Nickel Never-Seeze (Q-94-484).

[ ] 3.4.6 Calibrated torque wrench capable of torquing 4.5 ft-lbs, 40 ft-lbs, and 130 ft-lbs.

[ ] 3.4.7 Mobil Special grease.

[ ] 3.4.8 Loctite RC 680 (Q-92-813).

[ ] 3.4.9 Loctite 271 (Q-94-005).

~~PROPRIETARY INFORMATION~~

4. PUMP BOWL DISASSEMBLY

[ ] **NOTE** - Refer to Attachment 2, **Figure 1**, for item numbers in parenthesis.

[ ] 4.1 Lift pump bowl assembly and place on wooden or I-beam supports in an upright position.

[ ] **NOTE** - Case bearing (12) has left hand threads.

[ ] 4.2 Unscrew and remove top case bearing (12) from top case (7).

[ ] 4.3 Remove top case (7) to suction bell (8) nuts and lockwashers.

[ ] 4.4 Remove top case (7) from suction bell (8) and place on adequate supports.

[ ] 4.5 Install an eyebolt in top of pump shaft (1).

[ ] 4.6 Attach rigging to eyebolt and remove pump shaft (1) and impeller (2) as a unit placing on adequate supports.

[ ] 4.7 Loosen setscrew and remove sand cap (13).

~~PROPRIETARY INFORMATION~~

5. PUMP BOWL COMPONENT INSPECTION AND MEASUREMENTS

[ ] 5.1 Thoroughly clean disassembled components.

[ ] 5.2 (QC Hold) Inspect disassembled pump components, recording any discrepancies found:®

[ ] 5.2.1 Top case and suction bell for damage, pitting, and excessive erosion or corrosion.

[ ] SAT; [ ] UNSAT

[ ] 5.2.2 Impeller liner for damage, erosion, corrosion, or pitting.

[ ] SAT; [ ] UNSAT

[ ] 5.2.3 Pump shaft for damage, erosion, corrosion, or excessive wear at bearing contact area.

[ ] SAT; [ ] UNSAT

[ ] 5.2.4 Pump shaft sleeve for damage, corrosion, grooving, or excessive pitting.

[ ] SAT; [ ] UNSAT

[ ] 5.2.5 Bearings for damage, pitting, or excessive wear. Ensure rubber liner is not separating from metal housing.

[ ] SAT; [ ] UNSAT

[ ] 5.2.6 Impeller for damage, erosion, corrosion, wear, and damaged, chipped, cracked, or broken vanes.

[ ] SAT; [ ] UNSAT

[ ] 5.2.7 All remaining components for damage, erosion, corrosion, and wear.

[ ] SAT; [ ] UNSAT

QC Signature/Date: _____

[ ] 5.3 (QC Hold) Measure and record on Attachment 1 the following pump component dimensions. Determine diametrical (total) clearance by subtracting shaft OD dimension from bearing ID dimension.

[ ] 5.3.1 Rubber top case bearing (12) to ~~harden~~ shaft clearance.

[ ] 5.3.2 Bronze bottom bearing (11) to shaft sleeve (42) clearance.

QC Signature/Date: _____

[ ] 5.4 (QC Hold) Measure and record on Attachment 1 impeller (2) and case wear ring (6) dimension in two locations. Determine diametrical running clearance by subtracting impeller dimension from case wear ring dimension.

NOTE - Maximum allowable wear ring clearance is 0.036".

5.4.1 Top case wear ring (6) to impeller (2).

QC Signature/Date: 9-15-04

[ ] NOTE - This component is ASME Section XI, Class 3. If repair or replacement of parts are required, Engineering will be contacted for an evaluation of parts being replaced and/or repaired. A RR-1 Form per Procedure 0.30 may be required for those activities.

[ ] 5.5 If any discrepancies are recorded, they shall be resolved.

[ ] NOTE - From inspection and measurements taken in Steps 5.2, 5.3, and 5.4, applicable steps in Section 6 should be performed for discrepancies found and steps not performed will be N/A.

6. PUMP BOWL COMPONENT DISASSEMBLY

[ ] 6.1 Remove shaft sleeve (42) from pump shaft (1).

[ ] 6.2 Remove impeller as follows:

[ ] 6.2.1 Remove thrust collar bolts and thrust collar (3).

[ ] 6.2.2 Remove split ring (4).

[ ] CAUTION - The impeller must not be heated over 250°F.

[ ] 6.2.3 If impeller requires slight heating for removal, heat impeller to a maximum of 250°F.

[ ] 6.2.4 Remove impeller (2) and impeller key (5) from pump shaft (1).

[ ] 6.3 Remove impeller liner as follows:

[ ] 6.3.1 Remove impeller liner mounting bolts.

[ ] 6.3.2 Remove impeller liner (9) from suction bell (8) by using jacking bolts.

[ ] 6.4 Remove top case wear ring as follows:

[ ] 6.4.1 Grind away metal from setscrew stake and remove setscrews.

[ ] 6.4.2 Remove wear ring (6) from case (7).

[ ] 6.4.3 Check for and remove any burrs from wear ring area.

[ ] 6.5 Remove bottom bearing as follows:

[ ] 6.5.1 Remove bottom bearing setscrew (not shown).

[ ] 6.5.2 Remove pipe plug from bottom of suction bell (8).

[ ] 6.5.3 Using special bearing removal tool, drive bottom bearing (11) out of suction bell (8).

PROPRIETARY INFORMATION

7. PUMP BOWL REASSEMBLY

[ ] NOTE - Refer to Attachment 2, **Figure 1**, for item numbers in parenthesis.

[ ] 7.1 (QC Hold) Measure and record on Attachment 1 the following pump component dimensions. Determine diametrical (total) clearance by subtracting shaft OD dimension from bearing ID dimension.

[ ] 7.1.1 Bronze bottom bearing (11) to shaft sleeve (42) clearance.

QC Signature/Date: _____

[ ] 7.2 If removed, install bottom bearing (11) as follows:

[ ] 7.2.1 (QC Hold) Inspect bottom bearing and bearing seat areas of suction bell (8) and remove any burrs or high spots.

[ ] SAT; [ ] UNSAT

QC Signature/Date: _____

[ ] 7.2.2 Lubricate outside of bearing and bearing seating areas of suction bell with Nickel Never-Seeze.

[ ] 7.2.3 Press bottom bearing (11) into suction bell (8).

[ ] 7.3 If removed, install impeller liner as follows:

[ ] 7.3.1 Examine impeller liner (9) and suction bell (8) seating areas for cleanliness and remove any burrs or high spots.

Completed By: _____

[ ] 7.3.2 Lubricate seating areas with Nickel Never-Seeze.

[ ] 7.3.3 Place impeller liner (9) into place in suction bell (8).

[ ] 7.3.4 (QC Witness) Draw impeller liner down into its final position by installing and torquing retaining bolts to 40 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] NOTE - Maximum allowable total indicated runout (TIR) is 0.002" total with no more than 0.001" in any 1' section.

[ ] 7.4 (QC Hold) Select a pump shaft (1) for installation and place in V-blocks or between centers, measuring and recording pump shaft TIR on Attachment 1.

QC Signature/Date: _____

[ ] 7.5 If removed, install shaft sleeve (42) as follows:

[ ] 7.5.1 Review Steps 7.5.2 through 7.5.9 to ensure familiarity with shaft sleeve installation process prior to continuing.

[ ] NOTE - Shaft sleeve to pump shaft allowable clearance is 0.001" to 0.006".

[ ] 7.5.2 (QC Hold) Measure and record on Attachment 1 replacement shaft sleeve (42) ID dimension and pump shaft (1) OD dimension. Determine diametrical clearance by subtracting replacement pump shaft from shaft sleeve.

QC Signature/Date: _____

[ ] 7.5.3 Fit replacement shaft sleeve to shaft to ensure proper fit-up.

[ ] 7.5.4 Install shaft sleeve with setscrews located towards the motor end of the pump shaft to check for proper fit.

[ ] 7.5.5 Remove after fit has been checked.

[ ] NOTE - Loctite installed in Steps 7.5.6 and 7.5.7 should be allowed to cure per manufacturer's recommended cure time before returning pump to service.

[ ] 7.5.6 Apply a coat of Loctite RC 680 to shaft sleeve and pump shaft as recommended by manufacturer's printed instructions on container and install shaft sleeve with setscrews located towards the motor end of the pump shaft.

[ ] NOTE - Steps 7.5.7 and 7.5.8 shall be performed in order and in rapid succession.

[ ] 7.5.7 Apply Loctite 271 to setscrews.

[ ] 7.5.8 (QC Witness) Install and torque setscrews to 4.5 ft-lbs (4.0 to 4.5).

Performed By: _____

QC Signature/Date: _____

[ ] NOTE - Setscrews shall be faced off, if they protrude above shaft sleeve surface.

[ ] 7.5.9 (QC Hold) Visually inspect to ensure setscrews are not protruding above the surface of shaft sleeve. Face off top of setscrews, if required.

QC Signature/Date: _____

[ ] 7.5.10 Allow Loctite 271 to cure per manufacturer's recommended cure time before returning pump to service.

[ ] 7.6 (QC Hold) Select an impeller for installation, measuring, and recording shaft bore dimension in four (4) locations on Attachment 1.

QC Signature/Date: _____

[ ] 7.7 (QC Hold) Have pump shaft impeller journal area machined to largest diameter recorded in Step 7.6 (+0.000"/-0.002"). Measure and record finished diameter of pump shaft impeller journal on Attachment 1.

QC Signature/Date: _____

[ ] CAUTION - If assembly of impeller onto shaft in Step 7.8 requires impeller to be heated in an oven, do not heat impeller over 250°F.

[ ] 7.8 Install impeller key (5) and impeller (2) onto pump shaft (1).

[ ] 7.9 Install split ring (4) into groove in pump shaft.

[ ] 7.10 (QC Witness) Install thrust collar (3) and torque thrust collar retaining capscrews to 130 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 7.11 Install sand cap (13) onto the bottom of shaft.

[ ] 7.12 Install an eyebolt into top of pump shaft (1).

[ ] 7.13 Lift pump shaft (1) and install into bottom bearing (11).

[ ] 7.14 Adjust location of sand cap (13) so that bottom edge is 3/4" from shoulder of bottom bearing (11) and tighten sand cap setscrew.

[ ] NOTE - This component is ASME Section XI, Class 3. Replacement of top case and/or case wear ring requires a RR-1 Form per Procedure 0.30 with the work package for wear ring setscrew machining or top case and/or case bolting replacement.

[ ] 7.15 Verify proper documentation is in the work package prior to proceeding with Step 7.16.

[ ] 7.16 Install top case wear ring as follows:

[ ] 7.16.1 Using a soft hammer, install wear ring into place.

[ ] 7.16.2 Using an F drill bit, drill three new holes to a depth of 3/8" to 1/2" deep – 1" away from previously drilled holes.

[ ] 7.16.3 Tap the three holes using a 5/16" NC tap.

[ ] 7.16.4 Apply Loctite 271 to setscrews.

[ ] 7.16.5 Install and tighten setscrews.

[ ] NOTE - Diametrical running clearance in Step 7.17 is 0.020" to 0.024" for new case wear ring and impeller and 0.020" to 0.036" for used wear ring and impeller.

[ ] 7.17 (QC Hold) Measure and record on Attachment 1 top case wear ring dimension and impeller OD dimension. Determine diametrical running clearance by subtracting impeller dimension from top case wear ring dimension.

QC Signature/Date: _____

[ ] NOTE - Setscrews shall be faced off, if they protrude above shaft sleeve surface.

[ ] 7.17.1 (QC Hold) Ensure setscrews are below flush.

QC Signature/Date: _____

[ ] 7.17.2 Allow Loctite 271 to cure per manufacturer's recommended cure time before returning pump to service.

[ ] 7.17.3 Stake the setscrews.

[ ] 7.18 (QC Hold) Measure and record on Attachment 1 the following pump component dimensions. Determine diametrical (total) clearance by subtracting shaft OD dimension from rubber bearing ID dimension.

[ ] 7.18.1 Rubber top case bearing (12) to harden shaft clearance.

QC Signature/Date: _____

[ ] 7.19 Install top case bearing (12) into top case (7).

[ ] 7.20 (QC Witness) Install top case (7) onto suction bell (8) and torque retaining bolts to 130 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] NOTE - Step 7.21 is to be performed for pump bowl assembly end play.

[ ] 7.21 Install an eyebolt into pump shaft (1).

[ ] 7.21.1 Install dial indicator on pump shaft (1).

[ ] 7.21.2 (QC Witness) Raise pump shaft (1) and record on Attachment 1 the end play (minimum of 0.100").

Performed By: _____

QC Signature/Date: _____

[ ] 7.22 Remove pipe plug from bottom bearing grease hole and install fittings with a grease zerk into grease hole.

[ ] 7.23 Pump Mobil Special grease into bottom bearing (11) until grease appears around sand cap.

[ ] 7.24 Remove fittings and zerk and install pipe plug into grease hole.

PROPRIETARY INFORMATION

8. RESTORATION

[ ] 8.1 Rebuilt bowl assembly will be installed or returned to CNS spare parts.

5.3.1 RUBBER TOP CASE BEARING (12) TO HARDEN SHAFT CLEARANCE:

USED					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
2.202	2.187	0.015	0.010" to 0.027"		

5.3.2 BRONZE BOTTOM BEARING (11) TO SHAFT SLEEVE (42) CLEARANCE:

USED					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
2.950	2.938	0.012	0.012" to 0.0225"		

5.4.1 TOP CASE WEAR RING (6) TO IMPELLER (2):

USED					
IMPELLER OD (inches)	CASE W/R ID (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE IMPELLER (Y/N)	REPLACE W/R (Y/N)
13.973	14.005	0.032	0.020" to 0.036"		
13.973	14.005	0.032	0.020" to 0.036"		

7.1.1 BRONZE BOTTOM BEARING (11) TO SHAFT SLEEVE (42) CLEARANCE:

NEW					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
		0.	0.012" to 0.015"		

7.4 TIR: 0. inch

7.5.2 _____ - _____ = 0. inch
Shaft Sleeve ID Pump Shaft OD Clearance

PROPRIETARY INFORMATION

7.6 1. _____ inches 3. _____ inches

2. _____ inches 4. _____ inches

7.7 Finished Diameter: _____ inches

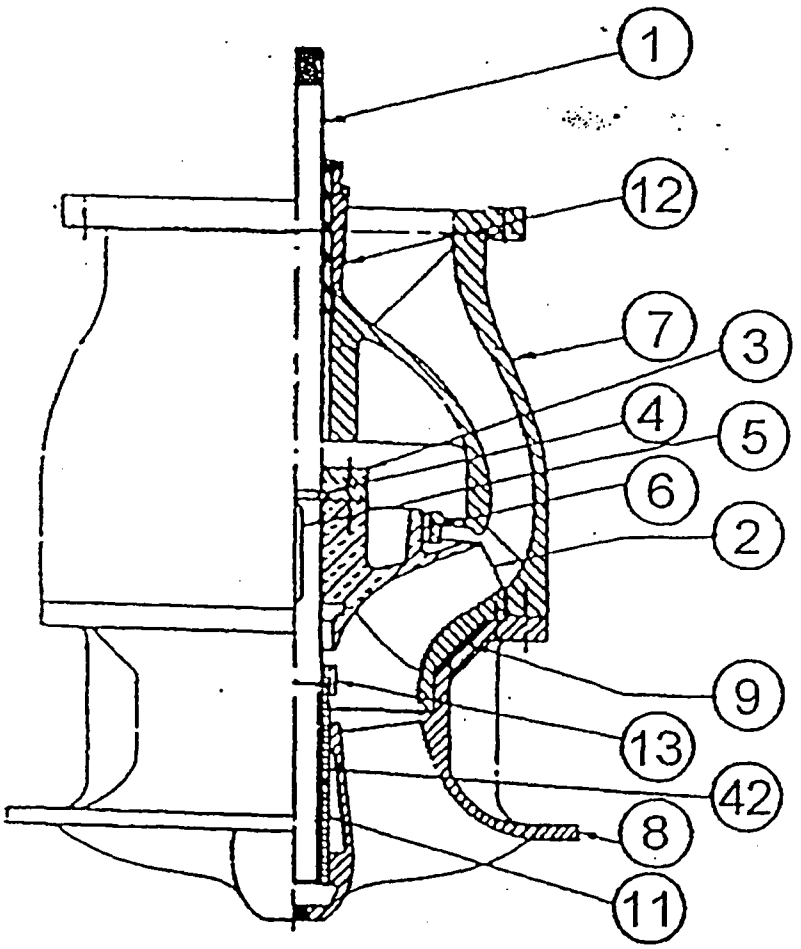
7.17 _____ - _____ = 0._____ inch
Case Wear Ring Impeller OD Clearance

7.18 RUBBER TOP CASE BEARING (12) TO HARDEN SHAFT CLEARANCE:

NEW					
BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	MAXIMUM TOLERANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N)
		0.	0.010" to 0.018"		

7.21.2 Impeller End Play: 0._____ inch

PROPRIETARY INFORMATION



72-15-1A

Figure 1 - SERVICE WATER PUMP BOWL ASSEMBLY DRAWING AND PARTS LIST

ITEM NUMBER	DESCRIPTION	ITEM NUMBER	DESCRIPTION
1	Pump Shaft	8	Suction Bell
2	Impeller	9	Impeller Liner
3	Thrust Collar	11	Bottom Bearing, Bronze
4	Split Ring	12	Top Case Bearing, Rubber
5	Key - Impeller	13	Sand Cap
6	Case Wear Ring	42	Shaft Sleeve
7	Top Case	N/A	N/A

~~PROPRIETARY INFORMATION~~

ATTACHMENT 3 SIGN-OFF AND REVIEW SHEET

STEP NUMBER	IDENTIFICATION NUMBER	DESCRIPTION	CALIBRATION DUE DATE

Initials	Printed Name	Initials	Printed Name
/		/	
/		/	
/		/	
/		/	

Discrepancies Recorded: [ ] YES; [ ] NO If YES, all discrepancies are resolved.

Mechanical Maintenance
Supervision Review: _____ Date: _____

RECORDS

Completed portions of procedure are included with a Work Order for CNS Records (quality record upon TECO).

Initial/date by each discrepancy or resolution listed.

#	DISCREPANCIES	#	RESOLUTIONS

1. DISCUSSION

1.1 The Service Water pumps are electric driven, single stage, centrifugal pumps, and are located in the Intake Structure.

1.2 The Service Water pumps supply cooling water to Turbine Building Closed Cooling Water System, Reactor Building Closed Cooling Water System, Residual Heat Removal System, and Diesel Generators.

1.3 The one-stage bowl assembly consists of the top case, impeller liner, and pump shaft with attached impeller.

2. REFERENCES

2.1 UPDATED SAFETY ANALYSIS REPORT

2.1.1 Section VIII.

2.2 VENDOR MANUALS

2.2.1 CNS Number 0180, Service Water Pumps.

2.3 PROCEDURES

2.3.1 Administrative Procedure 0.30, ASME Section XI Repair/Replacement and Temporary Non-Code Repair Procedure.

2.4 MISCELLANEOUS

2.4.1 Letter CNS 907024, from L. G. Kuncl to NRC, dated January 29, 1990, Response to Generic Letter 89-13.

2.4.2 © NRC Generic Letter 89-13, Service Water Problems Affecting Safety Related Equipment. Affects Step 5.2.

~~PROPRIETARY INFORMATION~~

CNS OPERATIONS MANUAL MAINTENANCE PROCEDURE 7.2.15 SERVICE WATER PUMP COLUMN MAINTENANCE AND BOWL ASSEMBLY REPLACEMENT	USE: REFERENCE ④ EFFECTIVE: 10/15/03 APPROVAL: SORC/IQA OWNER: J. A. NICHOLS DEPARTMENT: MNT

REVISION VERIFICATION:
(initial use + every 7 days)

REV.	DATE	CHANGES
22	10/10/03	Added Step 3.8.7. Revised Steps 6.9, 6.19, 5.4.3, and Attachment 1 data. Added Steps 5.7 and Attachment 1 data. Revised Steps 5.3.4, 5.8, 7.24.1, 8.5, and 8.12.1. Revised NOTES prior to Steps 5.3, 5.4.1, 7.24.3, 8.10, and 8.12.3. Added NOTES prior to Steps 5.7 and 5.3.3. Deleted Step 8.5 and Step 8.5 on Attachment 1. Revised references on Information Sheet.
23	see above	Changed information on lifting SW pumps and motors. Added EE 02-071 and corrected procedure title in References.

1. PURPOSE

This procedure provides Maintenance personnel with instructions to remove, overhaul column components, and install a service water pump (CICs: SW-P-A, SW-P-B, SW-P-C, and SW-P-D).

PROPRIETARY INFORMATION

2. PRECAUTIONS AND LIMITATIONS

[ ] 2.1 Rigging of pumps, motors, and components shall be performed per Procedure 7.1.8, keeping the time the items are suspended over other pumps, motors, and piping to a minimum. When lifting SW pumps or motors with Intake Structure crane for removing a motor or pump from SW Pump Room, motor or pump shall not be lifted over or near other division's unprotected (i.e., equipment hatch plugs removed) pumps or motors.

[ ] 2.2 Observe appropriate safety precautions associated with work on energized equipment.

[ ] 2.3 Prevent foreign materials or dirt from entering the working parts of the pump or driver.

[ ] 2.4 All operation of the Intake Structure overhead crane involving the lifting of SW Pump Room closure plugs or any lift over the open SW Pump Room shall be performed by a crane operator qualified per Procedure 0.17.

[ ] 2.5 At least one performer shall have the ability, skill, training, or experience required for the general scope of work in which they are involved.

[ ] 2.6 Ensure any steps marked N/A are recorded as discrepancies. Steps within the procedure that clearly indicate they are N/A if specified conditions are met are exempt from this requirement.

[ ] 2.7 Certified measuring and mechanical gauging/test equipment shall be calibrated and data recorded on Attachment 4.

[ ] 2.8 QC inspections shall be performed by personnel QC certified for the specific QC function.

[ ] 2.9 Checked By shall be performed by a second Mechanic or personnel QC certified for the specific step function.

[ ] 2.10 All components removed are to be bagged and tagged, as applicable, to control in-process material and traceability.

[ ] 2.11 Any time the pump is unattended, the cover shall be installed on the pump column.

[ ] 2.12 This component is ASME Section XI, Class 3. If repair or replacement of parts are required, contact Engineering for an evaluation of parts being replaced and/or repaired. A RR-1 Form per Procedure 0.30 may be required for those activities.

PROPRIETARY INFORMATION

3. REQUIREMENTS

[ ] 3.1 Record Work Order Number: _____

[ ] 3.2 Record CIC: TEST PUMP

[ ] 3.3 Record sections to be performed.

[ ] 4, DISASSEMBLY

[ ] 5, INSPECTION AND MEASUREMENTS

[ ] 6, REASSEMBLY

[ ] 7, PACKING SLEEVE INSTALLATION

[ ] 8, RESET PUMP LIFT

[ ] 3.4 Station Security Procedures require that special security criteria be met when the Service Water Pump Room ceiling plugs, personnel doors, or under floor hatch are removed or blocked open. Contact Security Shift Supervisor to make security arrangements for working in the Pump Room.

[ ] NOTE - Station procedures require that fire protection criteria be met when the Service Water Pump Room ceiling plugs, personnel door, pumps, or under floor hatch are removed or blocked open because of inoperative Halon System and/or fire barriers.

[ ] 3.5 Hot Work Permit, Fire Protection Impairment Permit, and/or Fire Watch established, as-required, per Procedure 0.39.

[ ] 3.6 Notify Electric Shop to disconnect main auxiliary electrical leads from pump motor.

[ ] 3.7 Contact Shift Manager prior to removing Service Water Pump Room ceiling hatch plug to have it recorded as an Appendix A fire barrier removal and inoperable Halon System.©

[ ] 3.8 Ensure the following equipment and materials are available as needed:

[ ] 3.8.1 Slings, straps, shackles, and hoisting equipment for removal of hatch plugs and pump parts which have been examined for NUREG 0612 lifts.

[ ] 3.8.2 Temporary lighting.

3.8.3 Two 3' to 4' long I-beams on which to support pump assembly during disassembly.

3.8.4 Cribbing on which to lay pump components on as they are disassembled.

3.8.5 Calibrated dial indicator.

3.8.6 Calibrated outside micrometers.

3.8.7 Calibrated inside micrometers 4" to 5".

3.8.8 Nickel Never-Seeze, thread lubricant (Q-94-484).

3.8.9 Calibrated torque wrenches.

3.8.10 Loctite RC 680 (Q-92-813).

3.8.11 Loctite 271 (Q-94-005).

3.8.12 Loctite 755 (Q-94-490).

3.8.13 Shaft sleeve setscrews.

3.8.14 Versilube (Q-94-547).

PROPRIETARY INFORMATION

4. DISASSEMBLY

NOTE - Refer to Attachment 2 for item numbers in parenthesis.

4.1 Disconnect, tag, remove, as necessary, any piping which would interfere with pump removal and cover pipe openings.

4.2 Remove all but two diagonally opposed coupling bolts.

4.3 Evenly loosen two remaining coupling bolts until pump shaft stops lowering and remove two coupling bolts.

4.4 Using a feeler gauge, determine impeller lift by measuring gap between adjusting plate face and drive half coupling face, and record reading on Attachment 1.

4.5 Examine slings, straps, shackles, and hoisting equipment being used for this NUREG 0612 lift for damage and deterioration per Procedure 7.2.76 and/or 7.2.75 prior to rigging pump and motor. Attach inspection sheets to this procedure or to Work Order.

[ ] WARNING - Hatch plug weighs ~ 12,000 lbs.

NOTE - Hatch plugs shall be reinstalled at the end of each day, if applicable, or if pump is being worked only on one shift.

4.6 Remove hatch plug(s) above pump to be worked.

4.7 Remove motor hold-down bolts.

[ ] WARNING - Motor weighs ~ 3,500 lbs.

4.8 Rig and remove motor and set aside on adequate supports.

4.9 Unscrew and remove adjusting plate (41).

4.10 Remove pump half coupling (37) and key (38).

4.11 Remove packing gland (31) and packing (33).

4.12 Unscrew and remove packing tension nut (32).

4.13 Remove packing pusher (34) and O-ring (35).

4.14 Remove pump discharge flange bolts.

PROPRIETARY INFORMATION

[ ] 4.15 Remove pump head to foundation hold-down bolts.

[ ] WARNING - The pump weighs ~ 12,000 lbs.

[ ] 4.16 Attach rigging from pump discharge head (30) to overhead crane.

[ ] 4.17 Lift pump high enough to place I-beams under flange between top column (18) and discharge head (30).

[ ] 4.18 Lower pump until it is supported by I-beams.

[ ] 4.19 Remove discharge head to top column flange bolts.

[ ] NOTE - A covering will be installed over pump casing each time a section of column is removed to keep foreign material from entering pump casing.

[ ] 4.20 Lift discharge head and place on adequate supports.

[ ] NOTE 1 - Adequately mark tubes, bearings, and shafts while removing so location and orientation of each part can be identified.

[ ] NOTE 2 - Head nipple, tubes, and shafts have left-handed threads.

[ ] 4.21 Unscrew and remove head nipple (36).

[ ] 4.22 (QC Witness) Measure and record on Attachment 1 distance from top of the shaft to the top of the shaft sleeve (packing) (14) to help in installation.

Performed By: _____

QC Signature/Date: Rachel McKay 9-13-04

[ ] CAUTION - Shaft sleeve (packing) (14) may have to be cut or ground off. Use caution to prevent damaging the shaft.

[ ] 4.23 Remove shaft sleeve (packing) (14).

[ ] 4.24 Unscrew and remove top tube (22) with top tube bearing (27) as an assembly.

[ ] 4.25 Unscrew and remove top column shaft (24) from shaft coupling (25).

[ ] 4.26 Remove pump sections as follows, initialing for each column removed:

[ ] NOTE - In Step 4.26.1 the coupling is normally removed with shaft.

[ ] 4.26.1 If applicable, remove shaft coupling (25).

4.26.2 Attach rigging and lift pump assembly high enough to place I-beams under restraint welded to column.

NOTE - Some of the bolts can be removed between lower and bottom column before resting on beams for ease of removal, leaving four bolts on each side of casing.

4.26.3 Lower pump assembly until weight is supported by I-beams.

4.26.4 Remove column to column flange bolts.

4.26.5 Remove column and place on adequate supports.

4.26.6 Unscrew and remove tubes.

4.26.7 Unscrew and remove shaft and place on adequate supports.

NOTE - In Step 4.26.8, the coupling is normally removed with shaft.

4.26.8 Unscrew and remove shaft coupling.

4.27 Rig to top case (7) and lift remaining pump assembly and place it onto adequate supports in an appropriate lay down area.

PROPRIETARY INFORMATION

5. INSPECTION AND MEASUREMENTS

[ ] 5.1 Discard all used gasket, O-rings, and other elastomers.

[ ] 5.2 Thoroughly clean disassembled components.

[ ] NOTE - All QC Validation in Steps 5.3, 5.4, 5.5, 5.6, and 5.7 shall be completed prior to performing Step 5.9.

[ ] 5.3 (QC Validation) Inspect disassembled pump as follows, recording any discrepancies found:©

[ ] 5.3.1 Discharge head and column sections for damage, pitting, and excessive erosion or corrosion.

[ ] SAT; [ ] UNSAT

[ ] 5.3.2 If Pump D, the area near the flanges where filler material was applied to the lower and intermediate columns.

[ ] SAT; [ ] UNSAT

[ ] NOTE - If overhaul is to satisfy a Maintenance Plan, Step 5.3.3 is N/A, as all tubes will be replaced with new.©

[ ] 5.3.3 Tubes for damage, pitting, erosion, corrosion, straightness, and tube threads are not damaged, stripped, or galled.

[ ] SAT; [ ] UNSAT

[ ] 5.3.4 Shafts for damage, erosion, corrosion, or excessive wear at bearing contact areas.

[ ] SAT; [ ] UNSAT

[ ] 5.3.5 Bearings for damage or excessive wear. Ensure rubber liner is not separating from metal housing.

[ ] SAT; [ ] UNSAT

[ ] 5.3.6 Fasteners for damage. [ ] SAT; [ ] UNSAT

[ ] 5.3.7 All remaining pump components (excluding pump bowl assembly) for damage, erosion, corrosion, and wear.

[ ] SAT; [ ] UNSAT

QC Signature/Date: Rachel L McK 9-15-09

[ ] 5.4 (QC Validation) Measure shaft and bearings as follows:

NOTE - Intermediate column shafts may be rotated end-for-end if either of the bearing contact areas are worn and when rotated maximum allowable diametrical clearances are still met.

5.4.1 Measure and record on Attachment 1 shaft OD dimension and rubber bearing ID dimension. Determine diametrical running clearance between the rubber bearings and their respective hardfaced shaft by subtracting shaft OD from rubber bearing ID to obtain clearance. If column shaft was rotated, indicate it was rotated by marking "R" in REPLACE SHAFT column.

5.4.2 If shaft or bearing was replaced, measure and record on Attachment 1 new bearing dimensions and shafts dimensions. Determine diametrical running clearances for new bearings and shafts by subtracting new shaft dimensions from new bearing dimensions.

NOTE 1 - Maximum acceptable total indicated runout (TIR) for new top shaft is 0.002" and no deviation in straightness may exceed 0.001" over any 1' length.

NOTE 2 - Maximum acceptable TIR for intermediate column shafts is 0.007" and no deviation in straightness may exceed 0.001" over any 1' length.

5.4.3 With shaft in V-blocks or rollers, measure and record on Attachment 1 shaft runout at center of shaft.©

QC Signature/Date: Robert J McK 9-14-04

repeat step 5.3.4 [ ] 5.5 (QC Validation) Inspect shaft for abnormal nicks, tack weld buildup, gouges, or damage recording any discrepancies found.©

[ ] SAT; [ ] UNSAT

QC Signature/Date: Robert J McK 9-14-04

NOTE 1 - Allowable diametrical clearance is 0.001" to 0.006".

[ ] NOTE 2 - Replacement shaft sleeve may require machining to obtain proper fit.

5.6 NA (QC Validation) Measure and record on Attachment 1 replacement shaft sleeve ID dimension and shaft OD dimension. Determine diametrical clearance by subtracting replacement shaft sleeve ID dimension from shaft OD dimension.

QC Signature/Date: NA

[ ] NOTE - Inside diameter (ID) dimension of spider bearing support on a new bottom column and intermediate column is 4.503" to 4.505". If ID is < 4.503" or > 4.505", Engineering is to evaluate.©

[ ] (QC Validation) Measure and record on Attachment 1 bottom and intermediate column spider bearing support ID dimension of the columns being used for pump overhaul.©

QC Signature/Date: _____

[ ] 5.8 Ensure all QC Validation in Steps 5.3, 5.4, 5.5, 5.6, and 5.7 have been performed prior to performing Step 5.9.

[ ] 5.9 If any discrepancies are recorded, they shall be resolved.

PROPRIETARY INFORMATION

6. REASSEMBLY

[ ] NOTE - Bearings may already be installed in tube section and lengths of tube sections may already be screwed together.

[ ] 6.1 Prepare top shaft sleeve (packing) (14) as follows:

[ ] 6.1.1 Fit replacement shaft sleeve (packing) (14) to shaft to ensure proper fit-up.

[ ] 6.1.2 If required, prepare shaft sleeve (packing) (14) for threaded setscrews by boring three holes on each end of shaft sleeve approximately equally spaced around circumference of shaft sleeve (refer to Attachment 2, **Figure 3**, for location and size of holes).

[ ] 6.1.3 (QC Witness) Install shaft sleeve (packing) (14) on shaft at same distance as recorded in Step 4.22 and record distance on Attachment 1.

Performed By: _____

QC Signature/Date: _____

[ ] 6.1.4 Mark and counterbore pump shaft. Counter-bore shaft only deep enough to allow for maximum setscrew thread contact with threads in shaft sleeve (packing) (14).

[ ] 6.1.5 Tap six holes bored in shaft sleeve (packing) (14) to accept setscrews (refer to Attachment 2, **Figure 3**, for size and thread pitch of holes).

[ ] 6.1.6 Install shaft sleeve (packing) (14), with setscrews, on pump shaft to check for proper fit; remove after fit has been checked.

[ ] 6.2 Examine slings, straps, shackles, and hoisting equipment being used for this NUREG 0612 lift for damage or deterioration per Procedure 7.2.76 and/or 7.2.75 prior to pump reassembly.

[ ] 6.3 Obtain a replacement bowl assembly and transport it to installation location.

[ ] 6.4 Lower pump into hole and support on I-beams placed under flange.

[ ] 6.5 Using die and tap set, clean coupling and shaft threads.

[ ] 6.6 Apply thread lubricant to threaded portions of each shaft, shaft coupling, bearing, and tube.

[ ] 6.7 Install new O-rings (29) on tee tube bearings (28).

[ ] 6.8 Install a shaft coupling (25) onto pump shaft (1) and thread the coupling halfway onto shaft.

[ ] 6.9 Ensuring there is no foreign material on shaft ends or in coupling, install next shaft section and firmly tighten two shafts against each other in center of coupling.

[ ] 6.10 Install lower tube section.

[ ] 6.11 Install jump bearing (26).

[ ] 6.12 Install next tube section.

[ ] 6.13 Install bottom column section (16) onto top case (7).

[ ] 6.14 Lubricate case retaining bolts using Nickel Never-Seeze.

[ ] 6.15 (QC Witness) Install and torque bottom column section to top case retaining bolts to 130 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 6.16 Lower pump assembly until weight of assembly is supported by I-beams placed under top flange of column section.

[ ] 6.17 Install a tee tube bearing (25) onto top of tube section.

[ ] 6.18 Install a shaft coupling halfway onto top of shaft.

[ ] 6.19 Ensuring there is no foreign material on shaft ends or in coupling, install next shaft section and firmly tighten two shafts against each other in center of coupling.

[ ] 6.20 Install next tube section.

[ ] 6.21 Install next tube bearing and tube section.

[ ] 6.22 (QC Witness) Install lower column section and torque retaining column bolting to 165 ft-lbs, then 330 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 6.23 Repeat Steps 6.14 through 6.20 to install intermediate shaft, tube, and column sections.

[ ] 6.24 (QC Witness) Install intermediate column section and torque retaining column bolting to 165 ft-lbs, then 330 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 6.25 Repeat Steps 6.14 through 6.20 to install top shaft, tube, and column sections.

[ ] 6.26 (QC Witness) Install top column section and torque retaining column bolting to 165 ft-lbs, then 330 ft-lbs.

Performed By: _____

QC Signature/Date: _____

7. PACKING SLEEVE INSTALLATION

PROPRIETARY INFORMATION

[ ] 7.1 Review Steps 7.2 through 7.7.4 to ensure familiarity with shaft sleeve (packing) (14) installation process prior to continuing.

[ ] 7.2 Lower pump assembly until weight of assembly is supported by I-beams placed under top flange of column section.

[ ] 7.3 Install a shaft coupling halfway onto top of shaft.

[ ] 7.4 Install next shaft section and firmly tighten two shafts against each other in center of coupling.

[ ] 7.5 Install next tube section with bearing.

[ ] 7.6 Clean pump shaft and shaft sleeve (packing) (14) using Loctite 755 cleaner.

[ ] 7.7 Apply a coat of Loctite RC 680 to shaft sleeve (packing) (14) and pump shaft as recommended by manufacturer's printed instructions on container and install shaft sleeve (packing) (14) on pump shaft.

[ ] NOTE - Steps 7.7.1 and 7.7.2 shall be performed in order and in rapid succession.

[ ] 7.7.1 Apply Loctite 271 to setscrews.

[ ] 7.7.2 (QC Witness) Install and torque setscrews to 6 in-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] NOTE - Setscrews shall be faced off, if they protrude above shaft sleeve (packing) (14) surface.

[ ] 7.7.3 (QC Hold) Verify setscrews are not protruding above the surface of shaft sleeve (packing) (14).

QC Signature/Date: _____

[ ] 7.7.4 Allow Loctite 271 to cure per manufacturer's recommended cure time before returning pump to service.

[ ] 7.8 Install head nipple.

[ ] 7.9 (QC Witness) Install discharge head and torque retaining bolts to 330 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 7.10 Lift pump assembly and remove I-beams.

[ ] 7.11 Lower pump assembly into position on foundation.

[ ] 7.12 Lubricate foundation bolts with Nickel Never-Seeze.

[ ] 7.13 (QC Witness) Install and torque foundation bolts in increments of 53, 105, 158, then 210 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] NOTE - Expansion joint is rubber and bolts to discharge head.

[ ] 7.14 Install Garlock expansion joint to pump discharge flange bolts gradually and equally tighten until the edges of the expansion joint bulge slightly.

[ ] 7.15 Lubricate O-ring (35) with Versilube.

[ ] 7.16 Install a new O-ring (35) and packing ring (34) in discharge head (30).

[ ] 7.17 Install tension nut (32) into head nipple (36) and firmly tighten against packing ring (34) to compress O-ring.

[ ] 7.18 Pack pump using 1/4" teflon packing and install packing gland (31).

[ ] 7.19 Install coupling key (38) and pump half coupling (37).

[ ] 7.20 (QC Witness) Check mating faces of coupling and adjusting ring for dirt, burrs, and high spots. Clean or correct as needed to effect proper mating when coupled up.

Performed By: _____

QC Signature/Date: _____

[ ] 7.21 Install adjusting ring (41) and thread down against pump half coupling.

[ ] WARNING - Motor weighs ~ 3500 lbs..

[ ] 7.22 Rig and install motor onto discharge head with conduit box over pump discharge.

[ ] 7.23 (QC Witness) Install and torque motor hold-down bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 7.24 Set pump lift as follows:

[ ] 7.24.1 Using feeler gauges, screw adjusting plate up until there is ~ 0.100" (do not exceed 0.100") gap between adjusting plate and motor half coupling.

[ ] 7.24.2 Turn adjusting plate down until bolt holes will line up with nearest bolt holes in pump half coupling.

[ ] NOTE - Final pump lift shall be as close to 0.100" as possible (without exceeding this value).

[ ] 7.24.3 (QC Witness) Using a feeler gauge, measure and record on Attachment 1 Final impeller lift by measuring gap between adjusting plate face and driver half coupling face.

Performed By: _____

QC Signature/Date: _____

[ ] 7.24.4 Rotate driver shaft to align bolt holes of driver half coupling and adjusting plate.

[ ] 7.24.5 Install two of coupling bolts and tighten until adjusting plate is drawn into contact with motor half coupling.

[ ] 7.24.6 (QC Witness) Install remaining coupling bolts and torque all bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 7.24.7 (QC Witness) Manually rotate pump to ensure it turns freely.

Performed By: _____

QC Signature/Date: _____

[ ] 7.25 (QC Hold) Inspect piping removed in Step 4.1 for cleanliness.

QC Signature/Date: _____

PROPRIETARY INFORMATION

[ ] 7.26 Install and connect piping.

[ ] 7.27 Notify Electric Shop to reconnect main and auxiliary leads to the motor.

[ ] WARNING - Hatch plug weighs ~ 12,000 lbs.

[ ] 7.28 Install hatch plugs over pump.

[ ] 7.29 Notify Shift Manager that hatch plugs have been installed.

8. RESET PUMP LIFT

[ ] NOTE - Performance of this section is required when determined by Engineering and/or Operations.

[ ] 8.1 Sign out Clearance Order.

[ ] 8.2 Remove all but two diagonally opposed coupling bolts.

[ ] 8.3 Evenly loosen two remaining coupling bolts until pump shaft stops lowering and remove two coupling bolts.

[ ] 8.4 Using a feeler gauge, determine impeller lift by measuring gap between adjusting plate face and drive half coupling face, and record reading on Attachment 1.

[ ] 8.5 Reset pump lift to dimension as close to 0.100" as possible (without exceeding this value) and record value on Attachment 1.

[ ] 8.6 Rotate driver shaft to align bolt holes of driver half coupling and adjusting plate.

[ ] 8.7 Install two of coupling bolts and tighten until adjusting plate is drawn into contact with motor half coupling.

[ ] 8.8 (QC Witness) Install remaining coupling bolts and torque all bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 8.9 (QC Witness) Manually rotate pump to ensure it turns freely.

Performed By: _____

QC Signature/Date: _____

[ ] NOTE - If lift is ~ 0.100" during performance of Steps 8.1 through 8.9, then Step 8.10 does not apply and Steps 8.12 through 8.12.7 are N/A.

[ ] 8.10 Sign in Clearance Order and have Operations run pump for no more than 16 hours.

[ ] 8.11 Repeat steps necessary to reset lift to Engineering recommendation or perform final lift setting.

[ ] NOTE - Step 8.12 is to be performed for final lift adjustment.

[ ] 8.12 Set pump lift as follows:

[ ] 8.12.1 Using feeler gauges, screw adjusting plate up until there is ~ 0.100" (do not exceed 0.100") gap between adjusting plate and motor half coupling.

[ ] 8.12.2 Turn adjusting plate down until bolt holes will line up with nearest bolt holes in pump half coupling.

[ ] NOTE - Final pump lift shall be as close to 0.100" as possible (without exceeding this value).

[ ] 8.12.3 (QC Witness) Using a feeler gauge, determine Final impeller lift by measuring gap between adjusting plate face and driver half coupling face, and record reading on Attachment 1.

Performed By: _____

QC Signature/Date: _____

[ ] 8.12.4 Rotate driver shaft to align bolt holes of driver half coupling and adjusting plate.

[ ] 8.12.5 Install two of coupling bolts and tighten until adjusting plate is drawn into contact with motor half coupling.

[ ] 8.12.6 (QC Witness) Install remaining coupling bolts and torque all bolts to 80 ft-lbs.

Performed By: _____

QC Signature/Date: _____

[ ] 8.12.7 (QC Witness) Manually rotate pump to ensure it turns freely.

Performed By: _____

QC Signature/Date: _____

PROPRIETARY INFORMATION

9. RESTORATION

[ ] 9.1 Sign in Clearance Order and release pump to Operations for post-maintenance testing.

[ ] 9.2 Maintenance to initiate a Notification. This Notification is to have the torque of foundation bolts on this Service Water pump rechecked after 30 days of the initial torque.©

Completed By: _____

~~PROPRIETARY INFORMATION~~

ATTACHMENT 1 RECORDED DATA SHEET

4.4 Impeller Lift: 0.118 inch

4.22 Distance: 8 5/8 inch

5.4.1 **NOTE** - Maximum allowable clearance is 0.026".

TUBE BEARING CLEARANCES:

BEARING ID (inches)		SHAFT OD (inches)		CLEARANCE (inches)		REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
Top Shaft. N.1 2.409		2.187		0.218			
(1) 2.420	(2) 2.371	(2) 2.187	(3) 2.187	(2) 0.233	(3) 0.184		
(4) 2.372	(5) 2.401	(4) 2.187	(5) 2.188	(4) 0.185	(5) 0.213		
(6) 2.208	(7) 2.204	(6) 2.187	(7) 2.187	(6) 0.021	(7) 0.017		
(8) 2.196	(9) 2.200	(8) 2.187	(9) 2.187	(8) 0.009	(9) 0.013		
				0.			

NOTE - Maximum allowable clearance is 0.026".

TEE TUBE BEARING CLEARANCES:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
N.4 Bearing 2.372	2.187	0.185		
N. 8 Bearing 2.196	2.187	0.009		

NOTE - Maximum allowable clearance is 0.026".

JUMP TUBE BEARING CLEARANCE:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
N. 9 Bearing 2.200	2.187	0.013		

5.4.2 NOTE - Maximum allowable clearance is 0.026".

TUBE BEARING CLEARANCES:

NEW BEARING ID (inches)	NEW SHAFT OD (inches)	CLEARANCE (inches)
		0.
		0.
		0.
		0.
		0.
		0.

NOTE - Maximum allowable clearance is 0.026".

TEE TUBE BEARING CLEARANCES:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
		0.		
		0.		

NOTE - Maximum allowable clearance is 0.026".

JUMP TUBE BEARING CLEARANCE:

BEARING ID (inches)	SHAFT OD (inches)	CLEARANCE (inches)	REPLACE BEARING (Y/N)	REPLACE SHAFT (Y/N/R)
		0.		

ATTACHMENT 1 RECORDED DATA SHEET

5.4.3 NOTE - Refer to NOTES 1 and 2 prior to Step 5.4.3 in Section 5.

	REPLACED
Removed Top Shaft Runout: 0.001 inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0.001 inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0.001 inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0.002 inch	[ ] YES; [ ] NO
Removed Intermediate Shaft Runout: 0.002 inch	[ ] YES; [ ] NO

Installed Top Shaft Runout: 0._____ inch

Installed Intermediate Shaft Runout: 0._____ inch

Installed Intermediate Shaft Runout: 0._____ inch

Installed Intermediate Shaft Runout: 0._____ inch

Installed Intermediate Shaft Runout: 0._____ inch

5.6 _____ - _____ = 0._____ inch
Shaft Sleeve ID Shaft OD Clearance

5.7 NOTE - Refer to NOTE prior to Step 5.7 in Section 5.

Spider Bearing Support ID Dimension	ACCEPTABLE
Bottom Column: 0._____ inch	[ ] YES; [ ] NO
Intermediate Column: 0._____ inch	[ ] YES; [ ] NO

6.1.3 Distance: _____ inch

7.24.3 Final Pump Lift: 0._____ inch

8.4 Impeller Lift: 0._____ inch

8.5 Impeller Lift: 0._____ inch

8.12.3 Final Pump Lift: 0._____ inch

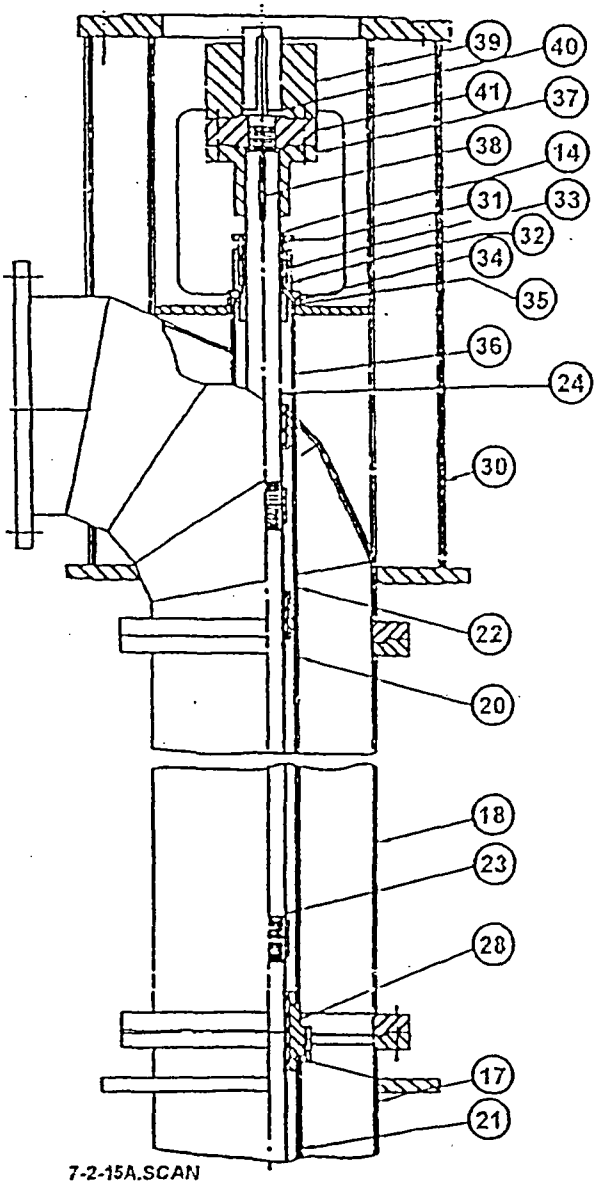


Figure 1 - Upper Service Water Pump Drawing

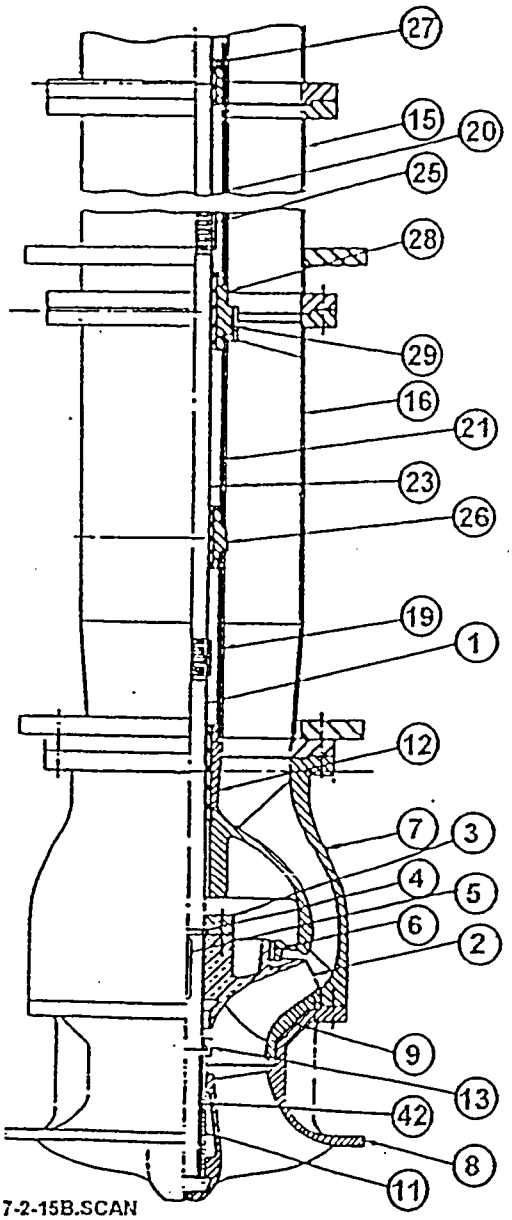


Figure 2 - Lower Service Water Pump Drawing

NOTE 1 - Three setscrews 6-32 x 3/16 to be spaced equally around circumference.

NOTE 2 - C_L of setscrews to be located 3/8" in from end of sleeve.

NOTE 3 - Use cup point setscrew {18-8}.

NOTE 4 - Setscrews are loctited into place.

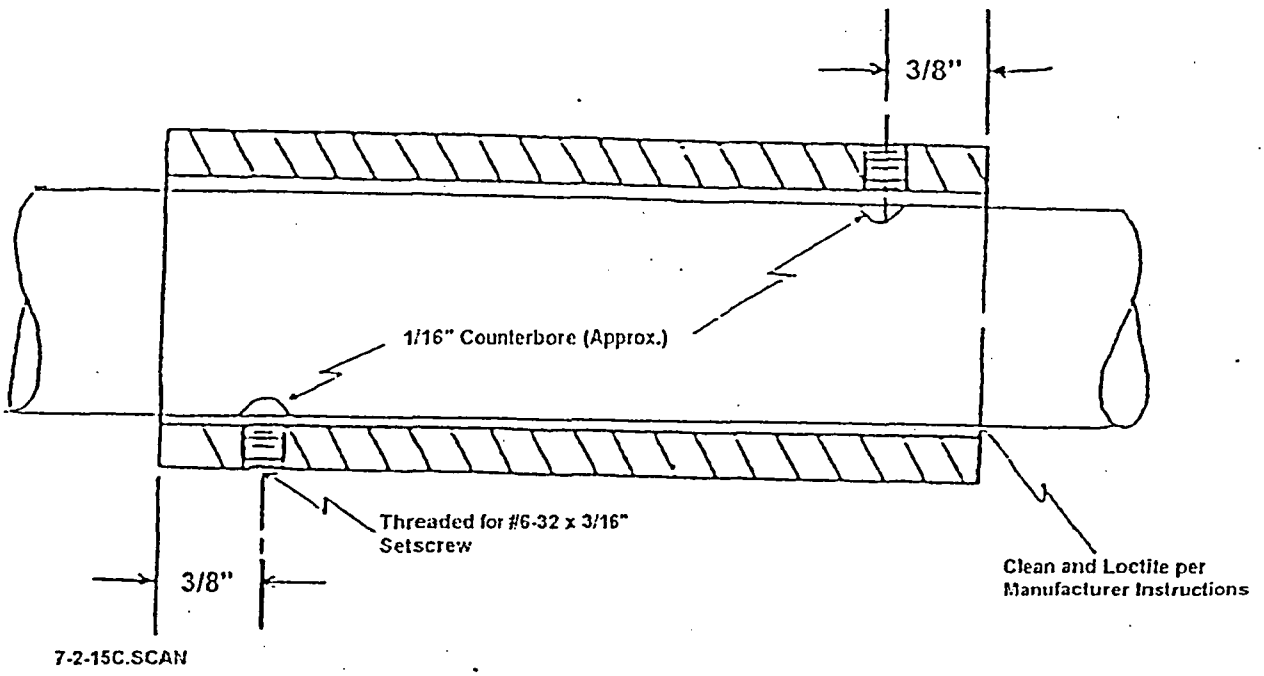


Figure 3 - Service Water Top Shaft Sleeve (Packing) (14) Installation Drawing

ITEM NUMBER	DESCRIPTION OR NAME
1	PUMP SHAFT
2	IMPELLER
3	THRUST COLLAR
4	SPLIT RING
5	KEY - IMPELLER
6	CASE WEAR RING
7	TOP CASE
8	SUCTION BELL
9	IMPELLER LINER
10	SUCTION LINER
11	BOTTOM BEARING
12	TOP CASE BEARING
13	SAND CAP
14	SHAFT SLEEVE (PACKING)
15	LOWER COLUMN
16	BOTTOM COLUMN
17	INTERMEDIATE COLUMN
18	TOP COLUMN
19	BOTTOM TUBE
20	INTERMEDIATE TUBE
21	SPECIAL TUBE
22	TOP TUBE
23	INTERMEDIATE SHAFT
24	TOP SHAFT
25	SHAFT COUPLING
26	JUMP BEARING
27	TUBE BEARING
28	TEE TUBE BEARING
29	O-RING
30	DISCHARGE HEAD
31	SPLIT GLAND
32	PACKING TENSION NUT
33	PACKING
34	PACKING RING

ITEM NUMBER	DESCRIPTION OR NAME
35	O-RING - PACKING RING
36	HEAD NIPPLE
37	PUMP HALF COUPLING
38	KEY
39	DRIVE HALF COUPLING
40	SPLIT RING
41	ADJUSTING PLATE
42	HAFT SLEEVE (BEARING)

ATTACHMENT 3 TORQUE VALUE TABLE

NOTE - All torque values given in table are for lubricated bolting.

STUD SIZE (inch)	TORQUE (ft-lbs)
3/8-16	16
7/16-14	27
1/2-13	40
9/16-12	60
5/8-11	80
3/4-10	130
7/8-9	210
1-8	330
1-1/8-7	520

PROPRIETARY INFORMATION

ATTACHMENT 4 SIGN-OFF AND REVIEW SHEET

STEP NUMBER	IDENTIFICATION NUMBER	DESCRIPTION	CALIBRATION DUE DATE

Initials	Printed Name	Initials	Printed Name
/		/	
/		/	
/		/	
/		/	

Discrepancies Recorded: [ ] YES; [ ] NO If YES, all discrepancies are resolved.

Mechanical Maintenance
Supervision Review: _____ Date: _____

RECORDS

Entire procedure is included with a Work Order for CNS Records (quality record upon TECO).

ATTACHMENT 4 SIGN-OFF AND REVIEW SHEET

Initial/date by each discrepancy or resolution listed.

#	DISCREPANCIES	#	RESOLUTIONS

1. DISCUSSION

1.1 The four Service Water pumps are electric driven, single stage, centrifugal pumps and located in the Intake Structure.

1.2 The service water pumps supply cooling water for Turbine Building Closed Cooling Water System, Reactor Building Closed Cooling Water System, RHR Service Water Booster Pumps, and Diesel Generators.

1.3 The bottom, lower, intermediate, and top column assemblies contain an inner column (or tube), bearings, and column shaft. The inner columns isolate the shafts and their bearings from the pump discharge.

2. REFERENCES

2.1 UPDATED SAFETY ANALYSIS REPORT

2.1.1 Section X-8, Service Water and RHR Service Water Booster System.

2.2 CODES AND STANDARDS

2.2.1 NUREG 0612, Control of Heavy Loads at Nuclear Power Plants.

2.3 DRAWINGS

2.3.1 CNS Drawing CNS-SW-29, Service Water Columns CNS.

2.4 VENDOR MANUALS

2.4.1 CNS Number 0180, Service Water Pumps.

2.5 PROCEDURES

2.5.1 Administrative Procedure 0.17, Selection and Training of Station Personnel.

2.5.2 Administrative Procedure 0.30, ASME Section XI Repair/Replacement and Temporary Non-Code Repair Procedure.

2.5.3 Administrative Procedure 0.39, Fire Watches.

2.5.4 Maintenance Procedure 7.1.8, Rigging and Lifting at CNS.

PROPRIETARY INFORMATION

Report No.: SIR-04-122
Revision No.: 0
Project No.: COOP-18
File No.: COOP-18-401
September 2004

Cooper Nuclear Station
Service Water Pump Test
Dynamic Assessment

Prepared for:

Nebraska Public Power District
Brownville, NE
Contract:

Prepared by:

Structural Integrity Associates, Inc.
Centennial, Colorado

Prepared by: _____ Date: 9-21-04
Kevin J. O'Hara

Reviewed by: _____ Date: 9 21-04
Karen K. Fujikawa, P.E.

Approved by: _____ Date: 9-21-04
Kevin J. O'Hara

PROPRIETARY INFORMATION

REVISION CONTROL SHEET

Document Number: SIR-04-122

Title: Cooper Nuclear Station - Service Water Pump Test Dynamic Assessment

Client: Nebraska Public Power District

SI Project Number: COOP-18

Section	Pages	Revision	Date	Comments
1.0	1-1	0	9/21/04	Initial Issue
2.0	2-1 – 2-7			
3.0	3-1 – 3-10			
4.0	4-1 – 4-3			
5.0	5-1 – 5-4			
6.0	6-1 – 6-3			
7.0	7-1			
Appendix A	A-1 – A-8			
Appendix B	B-1 – B-8			
Appendix C	C-1 – C-8			
Appendix D	D-1 – D-8			

PROPRIETARY INFORMATION

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PROPRIETARY INFORMATION

1.0 INTRODUCTION

A pump test was performed at the ITT A-C Pump Test Facility, Pewaukee, Wisconsin to confirm that service water (SW) pumps at Cooper Nuclear Station (CNS) can operate without coolant water for 90 minutes and continue to operate for another 48 hours after water is restored.

Background Information

CNS has four SW pumps at their facility. The SW pumps are vertical, mixed flow, single stage, irrigation pumps. They are individually driven by a 300 hp direct-drive, electric motor that operates at ~1180 rpm. The motor drives a shaft that is approximately 48' long that is connected to the pump. River water is pumped up the column, through a discharge strainer to the plant. A small amount of strained water (6-10 gpm) is used to both cool and lubricate the shaft rubber bearings.

The purpose of this report was to:

1. assess the test versus plant configuration geometric differences
2. ensure that the test structure was safe
3. perform a dynamic comparison of test versus plant configurations and
4. evaluate and summarize the pump test results

6.0 TEST RESULTS AND CONCLUSIONS

The test pump configuration was evaluated for its few geometric differences and verified by the modal analysis. This test pump configuration was found to be representative of the plant configuration, especially with respect to its dynamic behavior of the motor/pump sub-systems. The key issue was to ensure that the test pump configuration, especially the column, shaft and rubber bearing geometries, had the same dynamic behavior as the plant pump, then the test pump configuration would be valid. The modal analysis indicated that the principal frequencies and mode shapes were the same for the plant and test pump configurations. The rubber bearing and the shaft dynamics were identical. Therefore, the test configuration set-up was valid.

Four Hour Test

The four hour test provided a vibration baseline for the test pump system. Dynamic data observed in both the spectra plots (Appendix A) and the RMS/peak vibration trends (Figures 5-1 and 5-2) show low vibration levels at all accelerometer locations. Additionally, the test motor vibration levels were found to be very comparable to the plant motor vibration levels ($\pm$0.25-$\pm$0.50 g's). This establishes an excellent vibration baseline for the test pump configuration.

Ninety Minute Test

During the 90 minute test (coolant water was turned off), the baseline vibration levels were maintained for 38 minutes. At ~ 38 minutes into the test, a high vibration event occurred that lasted ~4 minutes (Figures 5-1 and 5-2). The vibration levels increased steadily from $\pm$0.72 g's (0-peak) to a maximum vibration of $\pm$7.02 g's (0-peak) – channel 6 on the top column. After ~4 minutes, the high vibration event subsided and the pump system vibration levels returned to normal ($\pm$0.5 g on average). The test pump continued to operate at this vibration level for remainder of the test segment. No other vibration events were observed. Given no new failure mechanisms, this pump system could have operated for several hours without coolant water.

48 Hour Test

During this test period, the test pump continued to operate at $\pm$0.5 g's (0-peak) on average. Figures 5-3 and 5-4 confirm the vibration trend. No vibration anomalies were observed. Based the stable vibration readings, this pump could have operated for an extended period of time.

Post-test Inspection of the Hardware

Post-test inspection results found five rubber bearings melted. They were the #1 (near the stuffing box) through #5 bearing (inside the top column). Each bearing, except the #2 bearing, had deposited some of their rubber on the shaft during contact. This damage was a result of the dry bearing/shaft contact. The #4 and #5 bearings were located in the top column near accels 6 and 7, which saw the highest vibration and the #5 bearing had the most significant damage.

Additionally, the pump impeller liner had significant wear (~0.040") resulting from impeller contact. This wear would have resulted in the low screeching/grinding sounds similar to the sounds heard just prior to and during the high vibration event. The impeller rubbing was caused by line shaft elongation that resulted from the excess heat generated from the bearing/shaft contact.

Conclusions

Review of the modal analysis results indicated that the test pump configuration was dynamically representative of the plant pump configuration. All column, shaft and enveloping tube mode shapes compared very well (within 1 Hz accuracy). Additionally, the motor responses, based on the motor modal tests and the running speed vibration levels behaved dynamically similar to the plant motor vibration levels [5]. Both the modal analyses and the dynamic test data confirmed that test and plant pump configurations were very similar, especially with regard to the shaft and rubber bearing dynamics, which makes this test valid.

The high vibration (greater than ± 1 g) event lasted ~4 minutes and then returned to the baseline vibration levels. These vibration levels were a direct result of the shaft elongation that caused the impeller to wear on the impeller liner. This impeller wear created the grinding noise and the high vibrations. Once the shaft elongation was accommodated, the impeller wear stopped and the vibration levels subsided. It should be noted that the high vibration levels start after the high motor amperage was observed and ended before the high motor amperage record. The reason for this was the impeller started to drag on the impeller liner before the high vibrations were detected and continued to drag on the liner after the high vibration had subsided (the majority of the

impeller liner wear had occurred). The impeller liner grinding created the high vibration event. No other high vibration events were observed after this single event (Figures 5-2 and 5-4).

After the high vibration event and during the entire 48 hours test, the pump system vibration levels were stable (Figures 5-2 and 5-4). Additionally, both the pump impeller liner wear and the rubber bearing damage were complete, therefore, the system vibration levels returned to normal. Based on this data, it is apparent that the pump could have continued to operate without incident.

This high vibration event slightly exceeded 7 g's (0-peak) and the impeller grinding sound was very audible (coming from the open test pit). Additionally, the A-C Pump test structure and test floor began to aggressively vibrate. If these vibration levels had occurred at the plant, they would have been felt, however, due to the 18" thick concrete floor and 6" support pad, it can be concluded that both the sound and vibration levels would have been reduced (muffled). The plant floor is quite massive and would have attenuated the sound and vibration levels. Based on expert opinion, an operator would have felt ~3-5 g's of vibration level, but may not have heard the muffled grinding sounds against the motor background noise.

7.0 REFERENCES

1. CNS Service Water Pump – Design Data, SI File No. Coop-18-202.
2. MATLAB, Version 6.5.1, Release 13, Math Works, August 2003.
3. CRC Standard Mathematical Tables, 26th Edition, William H. Beyer Editor, CRC Press, Inc., 1982.
4. ANSYS/Mechanical, Revision 5.7, ANSYS, Inc., December 2000.
5. CNS Service Water Pump – Vibration Data, SI File No. Coop-18-201

~~PROPRIETARY INFORMATION~~

For this information please see our website:

rotechservices.com/report

for user name & password contact

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