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FEB 0 2 2005

PSEG Nuclear LLC

LR-N05-0085

Mr. Samuel Collins, Regional Administrator
United States Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

CHANGES TO VIBRATION MONITORING PROGRAM FOR THE 'B' REACTOR RECIRCULATION PUMP
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NO. NPF-57
DOCKET NO. 50-354

References: PSEG letter LR-N05-0077 from C. Perino to S. Collins, February 1, 2005

Dear Mr. Collins:

Due to an administrative oversight the Enclosure to PSEG letter LR-N05-0077, dated February 1, 2005, was not included in the mailing.

A copy of procedure HC.ER-AP.BB-0001(Z), "Hope Creek Reactor Recirculation Pumps/Motors Vibration Monitoring," Revision 1, is provided herein. We regret any inconvenience this may have caused.

Should you have any further questions please contact Brian Thomas at 856-339-2022.

Sincerely,

for Christina L. Perino
Regulatory Assurance Director

Enclosure

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HOPE CREEK
REACTOR RECIRCULATION PUMPS/MOTORS
VIBRATION MONITORING

HC.ER-AP.BB-0001(Z) REV. 1

PROCEDURE SPONSOR: Engineering Programs

REVISION SUMMARY Biennial Review Required: Yes __ No X

1. This is an Editorial Revision in accordance with Attachment 3 of NC.DM-AP.ZZ-0001(Q), Procedure Administrative Processes.
2. This revision adds an annotation for an NRC Commitment (Letter from A. C. Bakken to S. Collins, LR-N05-0017, January 9, 2005). This commitment states "PSEG will notify the NRC prior to implementing any change to the vibration monitoring and operating procedures... This notification will provide sufficient time for the NRC to complete a review of the proposed changes." **[80077525]**
3. This revision also adds clarification with respect to establishing vibration baseline data acceptance criteria at reduced speed in §5.5.2, adjusts the time for installing setpoints to two days in §5.5.8, and separates the action to write a notification for revising the procedure (if necessary) into a separate step. Successive steps are renumbered.
4. This revision specifies speed ranges for obtaining data on Attachment 1 for all pump data collection intervals and does not change the intent of data collection.

IMPLEMENTATION REQUIREMENTS Effective date: February 1, 2005

Approved: (KEN KNAIDE) 1/31/05

Engineering Programs Manager — Date

HOPE CREEK
REACTOR RECIRCULATION PUMPS/MOTORS
VIBRATION MONITORING

TABLE OF CONTENTS

1.0 PURPOSE

Monitor the vibration information available for 'A' & 'B' Reactor Recirculation pumps and motors for the following purposes:

- Trend the general condition of the reactor recirculation pumps and motors.
- Provide an early warning of possible reactor recirculation pump shaft cracking.
- Provide guidelines for gathering vibration data on reactor recirculation pumps, evaluating the data, and determining any required actions to address the condition.
- Adjust acceptance criteria as pump baselines change.
- Support emergent evaluation for shaft cracking initiated by overhead alarm C1-E4, REACTOR RECIRC PUMP VIB HI.

2.0 SCOPE

2.1 This procedure is limited to the Hope Creek Reactor Recirculation Pumps and Motors. It will be used to monitor the overall condition of the reactor recirculation pumps and motors, and specifically for early detection of pump shaft cracks.

2.2 The usage of this procedure will be controlled by the station's Preventative Maintenance program, and by the operations alarm response procedure HC.OP-AR.ZZ-0008(Q).

3.0 RESPONSIBILITIES

3.1 Manager Engineering Programs

Oversee the Reactor Recirculation pump/motor vibration data collection and analysis. Ensure it is being routinely collected and analyzed by knowledgeable personnel.

3.2 Component Engineering Supervisor

Ensure knowledgeable engineering resources are available to review the vibration data in a timely manner after it is collected.

3.3 Responsible Engineer

- Review the collected vibration data provided against the acceptance criteria, provided in this procedure, and general component and vibration experience.
- Initiate the actions specified in this procedure
- Document the results in a retrievable format.
- Obtain a peer review for any data collection or determinations performed under this procedure.

4.0 BACKGROUND/PROCESS DESCRIPTION

4.1 Reactor Recirculation Pump Description:

The Hope Creek Reactor Recirculation pumps are Byron-Jackson (now Flowserve) Type DVSS Size 28x28x35, vertical, single stage pumps. Vibration data is collected by two orthogonal proximity probes located on the pump coupling assembly.

4.2 Pump Shaft Vibration Instrumentation Description:

Two proximity probes (X & Y directions), FLOC's: H1BB–1BBVE-7910A(B)1/2, are mounted on the pump coupling assembly to detect shaft radial vibration. The vibration signal is alarmed in the control room via overhead alarm C1-E4, REACTOR RECIRC PUMP VIB HI and digital points D5351/D5352. The vibration signal is also indicated and alarmed in the plant computer via analog points A2601/A2603.

4.3 Reactor Recirculation Motor Description:

The Hope Creek Reactor Recirculation pump motors are General Electric (GE) variable speed, 7500 HP motors. Vibration data is collected by a velocity meter and in the case of 'B' Reactor Recirculation pump motor also by five accelerometers.

4.4 Motor Radial Vibration Description:

One Velocity meter is installed on the upper edge of the motor upper bearing bracket to detect motor radial vibration, FLOC: H1BB–1BBVE-7910A(B)4. The vibration signal is alarmed in the control room via overhead C1-E4, "REACTOR RECIRC PUMP VIB HI" and digital points D5351/D5352. The vibration signal also is indicated and alarmed in the plant computer via analog points A2602/A2604.

In addition, 'B' Reactor Recirculation pump motor contains three accelerometers (Horizontal, Vertical, and Axial directions) at the upper edge of the upper motor bearing bracket, and two accelerometers (Horizontal, Vertical directions) on the lower motor bearing bracket. This data is recorded in a data acquisition cabinet located in the reactor building, 102' elevation.

4.5 **Continuous Pump Vibration Spectrum Monitoring System:**

Hope Creek Station installed upgraded reactor recirculation pump vibration processing and alarm equipment per Design Change Package (CP) 80077512.

CP 80077512 replaced existing Hope Creek Recirculation Pumps/Motors vibration monitoring probes, proximeters, extension cables, and electronic equipment with new probes, proximeters, extension cables and state-of-the-art Bently Nevada (BN) 3500 Monitoring System. The new system improves the reliability, and resolves the replacement parts and service related problems. The new system also provides additional digital outputs to enhance the diagnostics capability of the vibration monitoring system. These pump and motor vibration sensors allow continuous monitoring and provide alarms in the Control Room for necessary operator action. The new 3500 Monitoring System is installed in Rack C of cabinet 1BC374. Existing system equipment located in Rack B of cabinet 1BC374 has been removed.

The new system permits the control room operators to have continuous 1X and 2X vibration peak and associated phase angle monitoring with audible alarms.

4.6 **Process:**

See Figure 1 for Flowchart.

5.0 PROCESS

NOTE

PSEG shall notify the NRC prior to implementing any change to this vibration monitoring procedure. This notification will provide sufficient time for the NRC to complete a review of the proposed changes prior to implementation. **[80077525]**

5.1 General Instructions

5.1.1 The evaluation of potential shaft cracks is time critical. The Detailed Vibration Review of step 5.3.2.B, and recommendation to the control room must be completed within 4 hours.

5.1.2 If this procedure is used to support the control room response to overhead C1-E4 REACTOR RECIRC PUMP VIB HI, go directly to step 5.3.2.B, Detailed Vibration Data Review. The applicable recirculation pump will be at reduced speed in accordance with HC.OP-AB.RPV-0003(Q), Recirculation System.

5.1.3 The reactor recirculation pumps have resonance frequencies at specific operating speeds. Data collected at these speeds is erroneously high and is of no trending value. Avoid collecting data at the following pump speeds:

'A' Reactor Recirculation Pump	720-800 RPM
	1040-1090 RPM
'B' Reactor Recirculation Pump	700-760 RPM
	1150-1200 RPM
	1444-1484 RPM

5.1.4 Continuous monitoring of the pump and motor overall vibration levels are indicated and alarmed in the control room. The operators have an approved procedure in place (HC.OP-AR.ZZ-0008(Q), Overhead Annunciator Window Box C1) with the necessary guidance in the event of elevated vibration levels. The purpose of the data collected in this procedure is to provide guidance to engineering to evaluate the vibration data. The vibration analysis includes the evaluation of vibration peaks and phase angle shifts.

5.1.5 The following information is provided to assist engineering in evaluating the reactor recirculation pump and motor vibration data. The engineer performing the evaluation remains responsible to review the overall operating condition of the pump, and if necessary collect data outside this procedure, to determine the condition of the component.

5.1.6 Notify the Engineering Programs Manager within one hour of receiving a valid reactor recirculation pump alarm.

5.1.7 Reactor recirculation pump and motor conditions can change from cycle to cycle based on maintenance performed during outage periods; therefore, all vibration baseline levels will be re-evaluated after each plant startup and the baseline levels and acceptance bands revised accordingly.

5.1.8 If a single X or Y proximity probe on the B reactor recirculation pump is out of service, restore probe to service within 14 days. If both X and Y proximity probes are out of service on the B reactor recirculation pump, restore a probe to service within 72 hours. Notify the NRC Senior Resident Inspector if proximity probe(s) are out of service. If equipment cannot be restored to service within required time frame, notify Control Room to secure the applicable reactor recirculation pump. Ensure SAP notification is written to document the condition.

5.1.9 If a single X or Y proximity probe on the A reactor recirculation pump is out of service, restore probe to service within 30 days. If both X and Y proximity probes are out of service on the A reactor recirculation pump, restore a probe to service within 7 days. Notify the NRC Senior Resident Inspector if proximity probe(s) are out of service. If equipment cannot be restored to service within required time frame, contact Component Engineering to evaluate the condition. Ensure SAP notification is written to document the condition.

5.2 Startup Vibration Monitoring

5.2.1 Data Collection

- Prior to reactor recirculation pump start; ensure the 1X and 2X amplitude and phase angle setpoints have been raised to maximum per Section 5.5.
- Review the maintenance performed on the reactor recirculation pump since the previous pump start, and record on Attachment 1.
- Obtain a copy of Attachment 1 of this procedure from the previous start of the reactor coolant pump.
- Vibration data is collected from the Turbine Supervisory Instrument Cabinet (H1AC –10-C-366) located in the Auxiliary Panel Room #3449 on 124' elevation in the Auxiliary Building, or from the Bently Nevada System 1 computer system.
- After pump start and during its ascension to 100% pump speed, record the data specified in Attachment 1 at each of the specified pump speed intervals.
- Review the data as it is available for each pump speed interval. Do not wait until the pump has reached 100% pump speed.
- Complete data evaluation as outlined in section 5.2.2.
- Notify the control room with the results of this data collection when the pump reaches full pump speed.

5.2.2 **Engineering Evaluation Criteria**

Complete the initial review of the vibration data collected in Attachment 1.

A. During the first performance of this procedure, no historical vibration data is available to establish acceptance criteria.

B. During the first performance of this procedure data is collected to establish baseline data and acceptance criteria.

5.2.3 **Data Documentation**

A. Forward a copy of the completed Attachment 1 to Component Engineering.

B. Submit the completed copy of the procedure with the associated work order for permanent records retention.

5.3 **Periodic Pump Vibration Monitoring**

5.3.1 **Data Collection**

- For consistency, data is to be collected with the reactor recirculation pumps at a steady speed during the time of data collection, and record on Attachment 2.
- The setpoints provided in Attachment 4 were established using 100% pump speed conditions. If the station is operating at <95% pump speed for greater than one day establish new acceptance criteria using section 5.5.
- Vibration data is collected from the Turbine Supervisory Instrument Cabinet (H1AC –10-C-366) located in the Auxiliary Panel Room #3449 on 124' elevation in the Auxiliary Building, or from the Bently Nevada System 1 computer system.
- Review the Reactor Recirculation Pump vibration trends in System 1 or the results of previous performances of this procedure for the most recent vibration data trends.
- Complete data evaluation as outlined in section 5.3.2.
- Notify the control room with the results of this data collection.

5.3.2 **Engineering Evaluation Criteria**

A. Initial Vibration Data Review - Complete the initial review of the vibration data collected in Attachment 2.

1. Review the data collected in Attachment 2 against the associated criteria specified in Attachment 4.
2. If any of the following abnormal vibration indications are met perform a Detailed Vibration Data Review, step 5.3.2.B:
   a. Any parameter is found outside of its acceptance criteria.

5.3.2.A.2 **Engineering Evaluation Criteria (Continued)**

b. Operations receives overhead alarm C1-E4 "REACTOR RECIRC PUMP VIB HI", and elevated vibrations are noted on analog points A2601 or A2603. In the event an overhead alarm is received, Operations will have taken action to reduce pump speed per HC.OP-AB.RPV-0003(Q), Recirculation System, or removed the pump from service per HC.OP-SO.BB-0002(Q), Reactor Recirculation System Operation.

3. Obtain a peer review of the initial vibration data review.
4. Initiate a Notification in SAP if an abnormal vibration indication identified in step 5.3.2.A.2.

B. Detailed Vibration Data Review - Complete the detailed vibration evaluation of the vibration data.

> **NOTE**
> The evaluation of potential shaft cracks is **TIME CRITICAL**, and the detailed evaluation and recommendation to the Control Room must be completed **WITHIN FOUR (4) HOURS**.

1. False Indication Determination - Determine if the indication identified in step 5.3.2.A.2 is a false indication. If it is a false indication annotate Attachment 2 accordingly, and complete the data documentation section. A false indication could be determined by:
   a. There is no indication of a trend in the vibration data plot which is in Alarm.
   b. The data indicates there is an instrument problem.
   c. The pump was in a start or stop transient after which the vibration levels returned to normal.
   d. The other pump was in a start or stop transient after which the vibration levels returned to normal.
   e. The vibration data was collected with the pump in a critical frequency band.
2. Acceptance Band - Determine if pump parameters are within the acceptance band established from startup baseline data, utilizing section 5.5 and recorded values in Attachment 4 at reduced pump speed.

   IF within the acceptance band, **THEN** go to step 5.3.2.B.3.

   IF outside the acceptance band, notify the Control Room Supervisor to secure the applicable reactor recirculation pump in accordance with HC.OP-SO.BB-0002(Q).
3. Shaft Crack Determination – A shaft crack is indicated by any one of the following five scenarios: ***USE WITH FIGURE 1***

a. **IF ANY** of the following five scenarios are true IMMEDIATELY perform step 5.3.2.B.3.c.

b. **IF NONE** of the following five scenarios are true go to step 5.3.2.C.

Scenario 1

Overall Vibration was in Alarm **AND**

EITHER:

2X Amplitude was in Alarm

OR

1X or 2X Phase Angle was in Alarm

Scenario 2

2X Amplitude was in Alarm

AND

1X or 2X Phase Angle was in Alarm.

Scenario 3

2X Amplitude was in Alarm **AND**

EITHER:

1X or 2X Phase Angle has trended outside the 25% baseline range in Attachment 4.

OR

Overall Vibration level has trended above the 25% baseline limit in Attachment 4.

Scenario 4

1X or 2X Phase Angle was in Alarm **AND**

EITHER:

2X Amplitude has trended above the 25% baseline limit in Attachment 4.

OR

Overall Vibration level has trended above the 25% baseline limit in Attachment 4.

Scenario 5

Overall Vibration level was in Alarm **AND**

EITHER:

1X or 2X Phase Angle has trended outside the 25% baseline range in Attachment 4.

OR

2X Amplitude level has trended above the 25% baseline limit in Attachment 4.

5.3.2.B.3 **Engineering Evaluation Criteria (Continued)**

c. **NOTIFY** the Control Room Supervisor to secure the applicable reactor recirculation pump in accordance with HC.OP-SO.BB-0002(Q) **AND** then go to step 5.3.3.

C. Enhanced Vibration Monitoring -

1. Install an oscilloscope to continuously monitor orbital information, and evaluate the orbital information once per 12-hour shift.
2. Review the 1X orbital plots for any indication of shaft cracking. Shaft cracks are indicated by a figure eight pattern to the orbital plot. **IF** a figure eight pattern is detected, notify the Control Room Supervisor to secure the applicable reactor recirculation pump in accordance with HC.OP-SO.BB-0002(Q) **THEN** go to step 5.3.3.
3. Increase the periodic vibration data collection and evaluation to once per 12 hour shift.
4. Initiate a Reactor Recirculation pump vibration log utilizing Form-1 of this procedure.
5. Evaluate for other possible causes of the abnormal vibration indication:
   a. Review plant conditions for any contribution to the change. (i.e. plant temperature or pressure changes, pump speed changes etc.)
   b. Review filtered and unfiltered orbitals and compare to the most recent baseline.
   c. Review history trend of each vibration peak.
   d. If possible verify the proximity probe gap voltage.
   e. Compare data to similar data from similar pumps.
   f. If available, check the loose parts system for any events.

5.3.3 **Data Documentation**

A. Forward a copy of the completed Attachment 2 to Component Engineering.
B. Submit the completed copy of the procedure with the associated work order for permanent records retention.

5.4 Periodic Motor Vibration Monitoring

5.4.1 Data Collection

A. Download the vibration data in the Data Acquisition System data onto a CD or similar storage media.

B. Record the motor accelerometer data specified on Attachment 3

C. Record the motor velocity meter data specified on Attachment 3 from the Turbine Supervisory Instrument Cabinet (H1AC –10-C-366) located in the Auxiliary Panel Room #3449 on 124' elevation in the Auxiliary Building, or from the Bently Nevada System 1 computer system.

D. Complete data evaluation as outlined in section 5.4.2.

5.4.2 Engineering Evaluation Criteria

A. Initial Vibration Data Review - Complete the initial review of the vibration data collected in Attachment 3.

1. Review data to ensure that all data is within the associated criteria specified in Attachment 5.
2. Review data against the data in the spreadsheet located at entdata08(M):Shared/HC Reactor Recirc Vibrations/Motors to determine if there are any unexpected trends. An unexpected trend is three successive data points progressing either higher or lower.
3. Do not begin the detailed vibration evaluation steps until the initial vibration data review is complete and reviewed.
4. If any of the following abnormal vibration indications are met, a detailed vibration evaluation is required:
   a. Any parameter is found outside of its acceptance criteria.
   b. Any unexpected trend is identified. An unexpected trend is three successive data points progressing either higher or lower with no readily known reason.
   c. Operations receives overhead alarm C1-E4 "REACTOR RECIRC PUMP VIB HI", and elevated vibrations are noted on analog points A2602 or A2604.
   d. The judgment of the reviewing or approving engineer indicates that a detailed vibration evaluation is warranted.
5. Obtain a peer review of the initial vibration data review.
6. Initiate a notification to report the indication identified in step 5.4.2.A.4.
7. If a detailed vibration evaluation is required, complete section 5.4.2.B to determine the cause of the indication identified in step 5.4.2.A.4.

B. Detailed Vibration Data Review - Complete the detailed evaluation of the vibration data.

1. Review the full vibration spectrum and the history of each vibration peak.

5.4.2 **Engineering Evaluation Criteria (Continued)**

a. Elevated vibration peaks at 0.4-0.48X is an indication of oil whirl in the motor bearing.
b. Elevated vibration peaks 1/2X, 1/3X, or 1/4X is an indication of a rotor rub.
c. Elevated 1X vibration peaks indicate an imbalance in the motor.
d. Elevated 2X vibration peaks indicate misalignment in the motor.

2. Review motor bearing temperature trends. Motor bearings will continue to operate satisfactorily provided bearing temperatures remain stable.

Parameter	'A'	'B'
Thrust bearing upper face	A2991	A3001
Thrust bearing lower face	A2992	A3002
Upper guide bearing	A2993	A3003
Lower guide bearing	A2994	A3004

3. Review motor stator temperature trends.

Parameter	'A'	'B'
Motor winding A	A2995	A3005
Motor winding B	A2996	A3006
Motor winding C	A2997	A3007

4. Each of the possible motor vibration concerns are motor reliability concerns, and continued motor operation is satisfactory provided the overall vibration levels remain below the 13 mils Danger Level.

C. Data Reporting

1. Update the Reactor Recirculation motor vibration spreadsheet located at entdata08(M):/Shared/HC Reactor Recirc Vibrations/Motors with the data collected.
2. Forward a copy of the completed Attachment 3 to Component Engineering.
3. Submit the completed copy of the procedure with the associated work order for permanent records retention.

5.5 **Establishing Acceptance Criteria**

5.5.1 Prior to the start of a reactor recirculation pump, the pump 1X and 2X amplitude and phase angle alarm setpoints should be raised to their maximum value. The setpoints should be re-established after reaching steady state full power operation."

5.5.2 When establishing new acceptance criteria due to a reactor recirculation pump speed reduction, utilize the baseline data for the new pump speed collected during the plant start-up if available. If startup vibration data was not collected at the new pump speed utilize the closest baseline data available until 12 hours of data is available at the new pump speed.

5.5.3 Acceptance criteria is established using historical data. The following historical data is acceptable to use for calculating acceptance criteria.

A. The data has been reviewed and is representative of a steady-state condition.

B. The data does not contain a large phase angle or amplitude change related to previous maintenance activities.

C. The preferred amount of historical data is 20 days. If 20 days of historical data is not available the setpoint can be established with 12 hours of continuous data. When less than 20 days of data is used, the setpoint should be re-evaluated after 20 days.

5.5.4 Review the historical data and select the maximum and minimum values. When evaluating phase angles, **IF** the data scatter is on both sides of 360° **THEN** ensure 360° is added to low phase angles (i.e. 005°, 014°) to ensure proper comparison with the large phase angles (345°, 357°).

5.5.5 Determine the upper and the lower acceptance criteria using the following formula:

$$Acceptable\ Band = \left(\frac{\max + \min}{2}\right) \pm 1.5 \bullet (\max - \min)$$

A. Phase angle minimum limits should be rounded down to the nearest 15°, and Phase angle maximum limits should be rounded up to the nearest 15°.

B. Amplitude minimum limits should be rounded down to the nearest 0.1 mil, and Amplitude maximum limits should be rounded up to the nearest 0.1 mil.

5.5.6 Determine the upper and the lower 25% Baseline limits using the following formulae:

$$Upper\ 25\%\ Baseline\ Limit = Upper\ Accept\ Criteria - \left(\frac{Upper\ Criteria - Lower\ Criteria}{4}\right)$$

$$Lower\ 25\%\ Baseline\ Limit = Lower\ Accept\ Criteria + \left(\frac{Upper\ Criteria - Lower\ Criteria}{4}\right)$$

A. Phase angle 25% Baseline limits should be rounded to the nearest whole degree.

B. Amplitude 25% Baseline limits should be rounded to the nearest hundredth of a mil.

5.5.7 Obtain a peer review of the new acceptance criteria and 25% Baseline limits.

5.5.8 Install the new setpoints within 48 hours. On-site engineering personnel should provide enhanced vibration monitoring via the Bently Nevada System 1 or equivalent until the new setpoints are installed.

5.5.9 Initiate a notification in SAP to have this procedure revised, if necessary.

6.0 RECORDS

6.1 Any documentation developed will be retained IAW NC.NA-AP.ZZ-0011(Q), Records Management Program.

6.2 Data generated from this monitoring program will be trended on EXCEL spreadsheet located in entdata08:Shared/HC Reactor Recirc Vibrations/Pumps and Motors.

7.0 DEFINITIONS

None

8.0 REFERENCES

8.1 Engineering Evaluation H-1-BB-MEE-1878, Hope Creek 'B' Reactor Recirculation Pump Vibration Analysis

8.2 NUCR 70043649

8.3 P&ID M-43-1

8.4 GE SIL 459

8.5 GE SIL 459S1

8.6 GE SIL 459S2

8.7 BP 980129115

8.8 ICD cards for instruments:

H1BB–1BBVSH7910A(B)1, H1BB–1BBVSH7910A(B)4

8.9 Cross References

8.9.1 HC.OP-AB.RPV-0003(Q), Recirculation System

8.9.2 HC.OP-SO.BB-0002(Q), Reactor Recirculation System Operation

8.9.3 HC.OP-AR.ZZ-0008(Q), Overhead Annunciator Window Box C1

8.10 Commitments

8.10.1 Letter from A. C. Bakken (PSEG) to S. Collins (NRC) LR-N05-0017, January 9, 2005 **[80077525]**

ATTACHMENT 1
STARTUP REACTOR RECIRCULATION PUMP
VIBRATION MONITORING TABLE

Reactor Recirculation Pump Maintenance since last time in service:

'A' Reactor Recirculation Pump 20% - 30% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X Amplitude	mils	X		
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

'B' Reactor Recirculation Pump 20% - 30% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X Peak	mils	X		
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

Data Collected By: _____ Date _____

Data Reviewed By: _____ Date _____

ATTACHMENT 1
STARTUP REACTOR RECIRCULATION PUMP
VIBRATION MONITORING TABLE
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'A' Reactor Recirculation Pump 30% - 50% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

'B' Reactor Recirculation Pump 30% - 50% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

Data Collected By: _____ Date _____

Data Reviewed By: _____ Date _____

ATTACHMENT 1
STARTUP REACTOR RECIRCULATION PUMP
VIBRATION MONITORING TABLE
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'A' Reactor Recirculation Pump 50% - 70% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

'B' Reactor Recirculation Pump 50% - 70% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

Data Collected By: _____ Date _____

Data Reviewed By: _____ Date _____

ATTACHMENT 1
STARTUP REACTOR RECIRCULATION PUMP
VIBRATION MONITORING TABLE
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'A' Reactor Recirculation Pump 70% - 90% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

'B' Reactor Recirculation Pump 70% - 90% Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

Data Collected By: _____ Date _____

Data Reviewed By: _____ Date _____

ATTACHMENT 1
STARTUP REACTOR RECIRCULATION PUMP
VIBRATION MONITORING TABLE
Page 5 of 6

'A' Reactor Recirculation Pump Full Power Pump Speed Vibration Data Pump Speed ____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

'B' Reactor Recirculation Pump Full Power Pump Speed Vibration Data Pump Speed ____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

Data Collected By: _____ Date _____

Data Reviewed By: _____ Date _____

ATTACHMENT 1
STARTUP REACTOR RECIRCULATION PUMP
VIBRATION MONITORING TABLE
Page 6 or 6

'A' Reactor Recirculation Pump Full Power Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

'B' Reactor Recirculation Pump Full Power Pump Speed Vibration Data Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

Data Collected By: _____ Date _____

Data Reviewed By: _____ Date _____

ATTACHMENT 2
PERIODIC REACTOR RECIRCULATION PUMP VIBRATION MONITORING TABLE

'A' Reactor Recirculation Pump Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

'B' Reactor Recirculation Pump Pump Speed _____				
Frequency	Amplitude	Direction	Phase Angle	Comments
1/2X	mils	X		
Peak	mils	Y		
1X	mils	X		
Peak	mils	Y		
2X	mils	X		
Peak	mils	Y		
5X	mils	X		
Peak	mils	Y		

Data Collected By: _____ Date _____

Data Reviewed By: _____ Date _____

ATTACHMENT 3
PERIODIC REACTOR RECIRCULATION MOTOR
VIBRATION MONITORING TABLE
Page 1 of 2

Date: _____

'A' Reactor Recirculation Motor Vibration Data			
Frequency	**Amplitude Criteria**	**Direction**	**Comments**
1X Peak	**mils**	**Velocity Meter**	To be developed after RF12
	mils	Upper Horizontal	Restart
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
2X Peak	**mils**	**Velocity Meter**	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
3X Peak	**mils**	**Velocity Meter**	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	

Note: 'A" Reactor Recirculation Motor does not have accelerators installed at this time.

ATTACHMENT 3
PERIODIC REACTOR RECIRCULATION MOTOR
VIBRATION MONITORING TABLE
Page 2 of 2

'B' Reactor Recirculation Motor Vibration Data			
Frequency	**Amplitude Criteria**	**Direction**	**Comments**
1X Peak	mils	Velocity Meter	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
2X Peak	mils	Velocity Meter	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
3X Peak	mils	Velocity Meter	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	

Data Collected By: _____ Date _____

Reviewed By: _____ Date _____

ATTACHMENT 4
PUMP ACCEPTANCE CRITERIA/SETPOINTS
Page 1 of 7

Vibration Level	Parameter	Channel/Point#
7 mils	Reactor Recirculation motor vibration alarm.	VSH7910A4 VSH7910B4 A2602 A2604 D5351 D5352
13 mils	Reactor Recirculation motor danger limit.	VSH7910A4 VSH7910B4 A2602 A2604
11 mils	Reactor Recirculation pump vibration alarm.	VSH7910A1 VSH7910B1 A2601 A2603 D5351 D5352
16 mils	Reactor Recirculation pump danger limit.	VSH7910A1 VSH7910B1 A2601 A2603
25 mils	Reactor Recirculation pump vendor limit	TechNote 9309-08-022

'A' Reactor Recirculation Pump 20% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

'B' Reactor Recirculation Pump 20% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

ATTACHMENT 4
PUMP ACCEPTANCE CRITERIA/SETPOINTS
Page 2 of 7

'A' Reactor Recirculation Pump 40% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

'B' Reactor Recirculation Pump 40% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

ATTACHMENT 4
PUMP ACCEPTANCE CRITERIA/SETPOINTS
Page 3 of 7

'A' Reactor Recirculation Pump 60% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

'B' Reactor Recirculation Pump 60% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

ATTACHMENT 4
PUMP ACCEPTANCE CRITERIA/SETPOINTS
Page 4 of 7

'A' Reactor Recirculation Pump 80% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

'B' Reactor Recirculation Pump 80% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

ATTACHMENT 4
PUMP ACCEPTANCE CRITERIA/SETPOINTS
Page 5 of 7

'A' Reactor Recirculation Pump 90% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

'B' Reactor Recirculation Pump 90% Pump Speed Vibration Criteria				
Frequency	**Amplitude Criteria**	**Direction**	**Phase Angle Criteria**	**Comments**
1/2X Peak	mils	X		To be developed after RF12 restart
	mils	Y		
1X Peak	mils	X		
	mils	Y		
2X Peak	mils	X		
	mils	Y		
5X Peak	mils	X		
	mils	Y		

ATTACHMENT 4
PUMP ACCEPTANCE CRITERIA/SETPOINTS
Page 6 of 7

'A' Reactor Recirculation Pump						
Frequency	**Direction**	**Amplitude Criteria (mils)**	**Amplitude 25% Baseline (mils)**	**Phase Angle Criteria (degrees)**	**Phase Angle 25% Baseline (degrees)**	**Comments**
1/2X Peak	X					To be developed after RF12 restart
	Y					
1X Peak	X	2.8-3.5	3.32	120-150	128-142	Setpoints are based on Cycle 12 data and may change based on Cycle 13 baseline data.
	Y	0.8-3.9	3.12	195-225	202-218	
2X Peak	X	0.0-0.3	0.22	285-225	000-150	
	Y	0.0-0.3	0.22	225-135	292-068	
5X Peak	X	0.1-1.7	1.30	180-240	195-225	
	Y	0.8-2.4	2.00	300-345	311-334	
Overall	X	3.8-6.1	5.55	none	none	
	Y	1.0-9.0	7.00	none	none	

ATTACHMENT 4
PUMP ACCEPTANCE CRITERIA/SETPOINTS
Page 7 of 7

'B' Reactor Recirculation Pump						
Frequency	**Direction**	**Amplitude Criteria (mils)**	**Amplitude 25% Baseline (mils)**	**Phase Angle Criteria (degrees)**	**Phase Angle 25% Baseline (degrees)**	**Comments**
1/2X Peak	X					To be developed after RF12 restart
	Y					
1X Peak	X	7.0-8.2	7.90	285-300	289-296	Setpoints are based on Cycle 12 data and may change based on Cycle 13 baseline data.
	Y	7.0-8.2	7.90	000-030	008-022	
2X Peak	X	0.5-1.1	0.95	255-285	262-278	
	Y	0.2-0.5	0.42	060-150	082-128	
5X Peak	X	0.4-1.0	0.85	225-285	240-270	
	Y	1.1-1.6	1.48	315-015	330-360	
Overall	X	8.3-11.0	10.32	none	none	
	Y	9.0-11.0	11.00	none	None	

ATTACHMENT 5
MOTOR ACCEPTANCE CRITERIA/SETPOINTS
Page 1 of 2

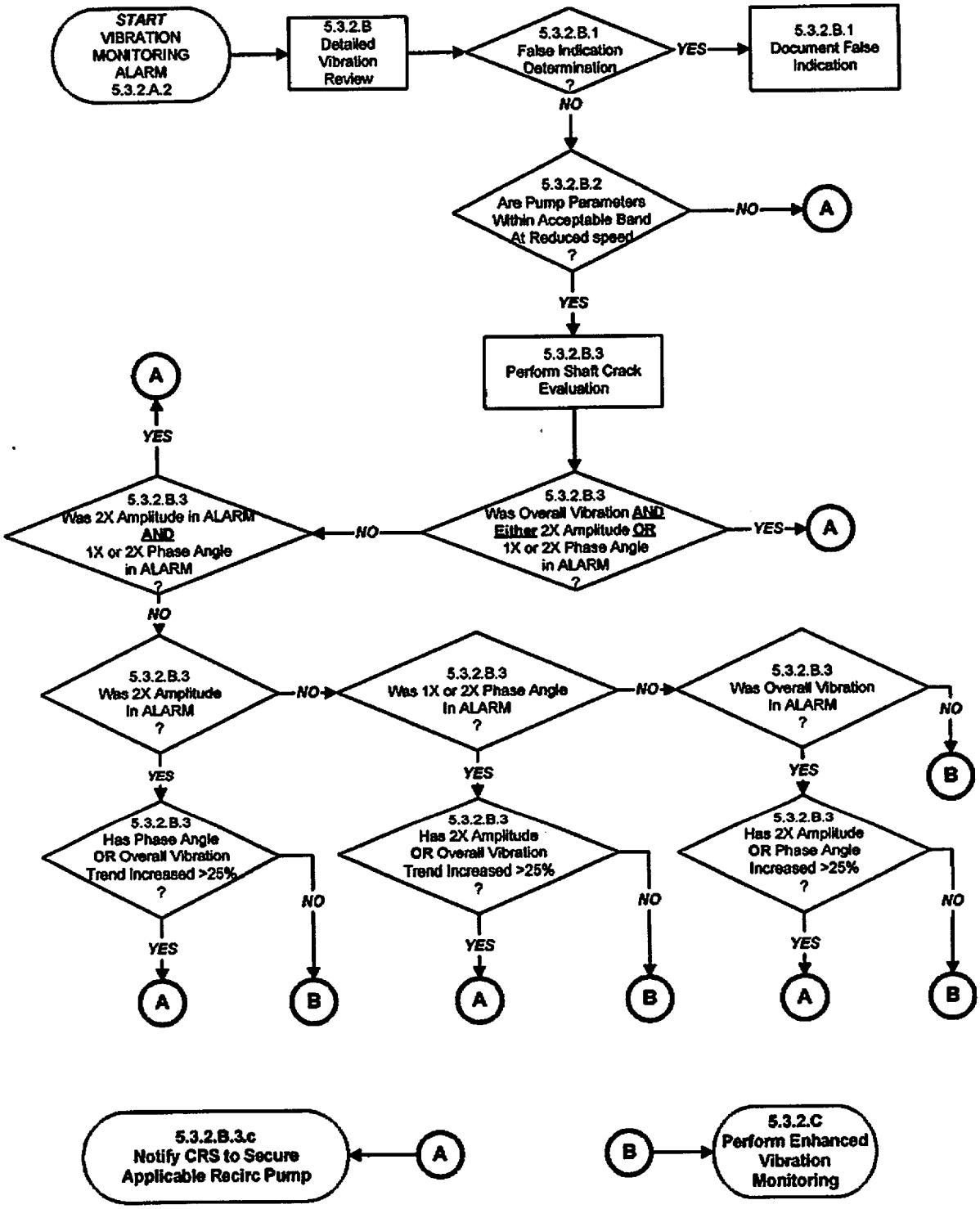
'A' Reactor Recirculation Motor Vibration Criteria			
Frequency	**Amplitude Criteria**	**Direction**	**Comments**
1X Peak	**mils**	**Velocity Meter**	**To be developed after RF12**
	mils	Upper Horizontal	**Restart**
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
2X Peak	**mils**	**Velocity Meter**	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
3X Peak	**mils**	**Velocity Meter**	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	

Note: 'A" Reactor Recirculation Motor does not have accelerators installed at this time.

ATTACHMENT 5
MOTOR ACCEPTANCE CRITERIA/SETPOINTS
Page 2 of 2

'B' Reactor Recirculation Motor Vibration Criteria			
Frequency	**Amplitude Criteria**	**Direction**	**Comments**
1X Peak	mils	Velocity Meter	To be developed after RF12 restart
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
2X Peak	mils	Velocity Meter	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	
3X Peak	mils	Velocity Meter	
	mils	Upper Horizontal	
	mils	Upper Vertical	
	mils	Upper Axial	
	mils	Lower Horizontal	
	mils	Lower Vertical	

FIGURE 1
PROCESS FLOWCHART



FORM-1
REACTOR RECIRCULATION PUMP VIBRATION MONITORING LOG

Administrative Notes:

1. *Complete a minimum of one log page per 12-hour shift.*
2. *Maintain the log pages in a binder in a known location.*
3. *Continue the log until the pump is secured or until the indication is determined to not be a shaft cracking concern.*

Date: _____ Shift: _____

Current Condition of _____ Reactor Recirculation pump:

Current Vibration levels:

Next Administrative action level:

Current projected date to reach vibration levels 11 mils and 16 mils:

Information provided to operations during shift:

Any new observations associated with the reactor recirculation pump:

Completed By: _____