



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 EAST LAMAR BLVD
ARLINGTON, TEXAS 76011-4511

February 12, 2013

Mr. Eric W. Olson
Site Vice President, Operations
Entergy Operations, Inc.
River Bend Station
5485 U.S. Highway 61N
St. Francisville, LA 70775

SUBJECT: RIVER BEND STATION - NRC SPECIAL INSPECTION REPORT
05000458/2012013

Dear Mr. Olson:

On February 5, 2013, the U.S. Nuclear Regulatory Commission (NRC) completed a reactive inspection pursuant to Inspection Procedure 93812, "Special Inspection," at your River Bend Station in response to a jacket water leak from a circumferential crack in a threaded connection on top of the Division I Emergency Diesel Generator (EDG) exhaust shroud. The enclosed inspection report documents the inspection results. The preliminary findings were discussed on December 21, 2012, with you and other members of your staff. After additional in-office inspection, a final telephonic exit meeting was conducted on February 5, 2013, with Ms. K. Huffstatler, Senior Licensing Specialist.

The special inspection commenced on December 17, 2012, in accordance with NRC Management Directive 8.3, "NRC Incident Investigation Program," and Inspection Manual Chapter 0309, "Reactive Inspection Decision Basis for Reactors," based on the initial risk and deterministic criteria evaluation made by the NRC on December 10, 2012. The inspector reviewed the circumstances surrounding the jacket water leak from a circumferential crack in a threaded connection on top of the Division I Emergency Diesel Generator (EDG) exhaust shroud, the broken edges of the threaded pipe which indicated that the break had occurred at the location of a pre-existent crack that had extended through approximately 270° of the piping circumference, and the lack of procedures for providing emergency makeup water to the jacket water system during a loss of off-site power. At the time of the pipe failure and jacket water leak, the plant was operating at 100 percent power, with all off-site power supplies available. Also, the Division II EDG was always available if it was needed.

The inspector also examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license.

This issue met the criteria of NRC Management Directive (MD) 8.3, "NRC Incident Investigation Program," for a detailed follow-up inspection, in that this issue not only involved a possible design deficiency with potential generic safety implications, but also may involve repetitive

failures. In addition, the incremental conditional core damage probability associated with this issue is above the MD 8.3 range of "No additional inspection" and in the range of "Special Inspection." The applicability of these deterministic criteria and the subject incremental conditional core damage probability are consistent with the need to perform a special inspection.

Based on the results of this inspection, no violations of NRC requirements were identified. The inspector concluded that: (1) the licensee's initial response to the Division I EDG exhaust shroud jacket water leak was appropriate, (2) the replacement flange and pipe met the original purchase order design specifications, and (3) the repair was completed and appropriate surveillances performed to declare the Division I Emergency Diesel Generator operable.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Document Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

/RA/

David Proulx, Acting Branch Chief
Project Branch C
Division of Reactor Projects

Docket No.: 05000458
License No: NPF-47

Enclosure:

1. Inspection Report 05000458/2012013

w/Attachments:

1. Supplemental Information
2. Special Inspection Charter

Electronic distribution by RIV:

Regional Administrator (Elmo.Collins@nrc.gov)
 Deputy Regional Administrator (Steven.Reynolds@nrc.gov)
 DRP Director (Kriss.Kennedy@nrc.gov)
 Acting DRS Director (Tom.Blount@nrc.gov)
 Acting DRS Deputy Director (Jeff.Clark@nrc.gov)
 Senior Resident Inspector (Grant.Larkin@nrc.gov)
 Resident Inspector (Andy.Barrett@nrc.gov)
 RBS Administrative Assistant (Lisa.Day@nrc.gov)
 Acting Branch Chief, DRP/C (David.Proulx@nrc.gov)
 Project Engineer, DRP/C (Rayomand.Kumana@nrc.gov)
 Public Affairs Officer (Victor.Dricks@nrc.gov)
 Public Affairs Officer (Lara.Uselding@nrc.gov)
 Project Manager (Alan.Wang@nrc.gov)
 Branch Chief, DRS/TSB (Ray.Kellar@nrc.gov)
 RITS Coordinator (Marisa.Herrera@nrc.gov)
 Regional Counsel (Karla.Fuller@nrc.gov)
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U.S. NUCLEAR REGULATORY COMMISSION

REGION IV

Docket: 05000458

License: NPF-47

Report: 05000458/2012013

Licensee: Entergy Operations, Inc.

Facility: River Bend Station

Location: 5485 U.S. Highway 61
St. Francisville, LA 70775

Dates: December 17, 2012 through February 5, 2013

Inspectors: Ronald A. Kopriva, Senior Reactor Inspector, Engineering Branch 1

Approved By: David L. Proulx, Acting Chief, Project Branch C
Division of Reactor Projects

SUMMARY OF FINDINGS

IR 05000458/2012013; 12/17/2012 – 02/05/2013; River Bend Station; Special Inspection.

This report covered a 5-day period (December 17 – December 21, 2012) of onsite inspection, with additional in-office review through February 5, 2013. No finding(s) was (were) identified. The significance of most findings is indicated by their color (Green, White, Yellow, or Red) using Inspection Manual Chapter 0609, "Significance Determination Process." The crosscutting aspects were determined using IMC 0310, "Components within the Cross-Cutting Areas." Findings for which the significance determination process does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

A. NRC-Identified Findings and Self-Revealing Findings

A Special Inspection was conducted on December 17, 2012, through February 5, 2013, to assess the facts and circumstances surrounding the jacket water leak from a circumferential crack in a threaded connection on top of the Division I Emergency Diesel Generator exhaust shroud, the review of the broken edges of the threaded pipe which indicated that the break had occurred at the location of a pre-existent crack that had extended through approximately 270° of the piping circumference, and the lack of procedures for providing emergency makeup water to the jacket water system during a loss of off-site power. The inspection was established in accordance with NRC Management Directive 8.3, "NRC Incident Investigation Program," and implemented using Inspection Procedure 93812, "Special Inspection." The inspection was conducted by an inspector from the NRC's Region IV office.

No finding was identified.

B. Licensee-Identified Violations

None.

REPORT DETAILS

1.0 Basis for Special Inspection

On December 2, 2012, operators started the Division I Emergency Diesel Generator (EDG) for a scheduled test. Approximately six hours later, they secured the EDG due to a jacket water leak from a circumferential crack in a threaded connection on top of the EDG exhaust shroud, at the jacket water connection. During the EDG run, the jacket water coolant leak rate increased to “a steady stream”, where the leakage had lowered the level of water in the jacket water stand pipe by approximately 2 inches over five minutes, which was equivalent to 0.5 gallons per minute. The licensee did not have a procedure for emergency makeup water to the jacket water system during a loss of off-site power. In addition, the licensee had no dedicated equipment for diverting emergency makeup water to the jacket water system.

On December 3, 2012, when maintenance technicians attempted to remove the threaded pipe from the top of the EDG exhaust shroud jacket water cooling outlet coupling, the pipe broke at the threaded end of the pipe, within the coupling. A cursory examination of the broken edges indicated that that the break had occurred at the location of a pre-existent crack that had extended through approximately 270° of the piping circumference.

This issue met the criteria of NRC Management Directive 8.3, “NRC Incident Investigation Program,” for a detailed follow-up inspection, in that this issue not only involved a possible design deficiency with potential generic safety implications, but also may have involved repetitive failures. In addition, the incremental conditional core damage probability associated with this issue is above the Management Directive (MD) 8.3 range of “No additional inspection” and in the range of “Special inspection.” The applicability of these deterministic criteria and the subject incremental conditional core damage probability were consistent with the need to perform a special inspection.

2.0 Event Description

On December 2, 2012, at 21:17, operators started the Division I EDG for a scheduled test. Approximately six hours later, they secured the EDG due to a jacket water leak from a circumferential crack in a threaded connection on top of the EDG exhaust shroud. Initially, the licensee estimated the leak rate to be 150 drops per minute (approximately 3.7 gallons per day). However, during the EDG run, that leak rate increased to “a steady stream”, which resulted in the licensee shutting down the EDG. According to initial reports, the leakage had lowered the level of water in the jacket water stand pipe by approximately 2 inches over five minutes, which is equivalent to 0.5 gallons per minute. The licensee does not have a procedure for emergency makeup water to the jacket water system during a loss of off-site power. In addition, the licensee has no dedicated equipment for diverting emergency makeup water to the jacket water system. However, as directed by a senior reactor operator, operators could have refilled the standpipe by

diverting either firewater or standby service water to a drain line off the jacket water standpipe.

On December 3, 2012, when maintenance technicians attempted to remove the threaded pipe from the top of the EDG exhaust shroud, the pipe broke at the threaded end of the pipe, within the coupling. A cursory examination of the broken edges indicated that the break had occurred at the location of a pre-existent crack that had extended through approximately 270° of the piping circumference.

3.0 Inspection Results

3.1 Sequence of events (Charter Item 1)

a. Inspection Scope

The inspector developed and evaluated a timeline of significant events for the Division I EDG due to a jacket water leak from a circumferential crack in a threaded connection on top of the EDG exhaust shroud. The inspector developed the timeline, in part, through a review of plant condition reports, operating experience reports, work orders, engineering changes, modifications, and discussions with licensee personnel.

b. Findings and Observations

Timeline of Events Identified by the Team

The inspector reviewed the period leading up to the event as well as the day of the event. A brief timeline of post-event actions is provided below. This evaluation was performed to assess the effectiveness of licensee's actions taken in response to the jacket water leak from a circumferential crack in a threaded connection on top of the Division I EDG manifold exhaust shroud. The following timeline was developed:

PRIOR TO THE EVENT

March 25, 2008	The licensee initiated Condition Report CR-RBS-2008-02410 for a Division I EDG jacket water leak on the threaded connection where the jacket water leaves the exhaust manifold on the turbo charger side on top of the EDG.
May 2, 2008	The licensee initiated Condition Report CR-RBS-2008-03083 for the Division I EDG inactive jacket water leak (not leaking when the EDG is not running, but they found a chemical residue near the turbocharger).
April 6, 2009	The licensee initiated Condition Report CR-RBS-2009-01642 for Division I EDG jacket water piping leaking when the EDG was running. The licensee identified this because of dried

jacket water cooling chemicals located on the pipe coming from the top of the jacket water expansion tank where it enters into the top of the Division I EDG. The leak did not appear to be large due to the jacket water level not lowering significantly over the last couple of months.

December 4, 2009 The licensee issued Work Order 144886 to repair the jacket water leak. Under that work order, the licensee cleaned the pipe ends and threads and applied new pipe sealant.

DIVISION I EMERGENCY DIESEL GENERATOR EVENT

December 2, 2012

09:56 Operations declared Division I EDG inoperable for performance of Procedure STP-309-0206 "Division I Diesel Generator 184 Day Operational Test," Revision 21.

12:05 Unexpected Occurrence. Division I EDG failed to start during performance of Procedure STP-309-0206. Building operators and diesel engineer investigating. This was a forward air only start.

14:30 After discussion with work week manager and duty manager who discussed the issue with Plant Manager, plant management made the decision to re-perform Procedure STP-309-0206, Division I EDG with both forward and rear air banks.

14:35 Operations started Division I EDG for Procedure STP-309-0206.

14:47 -16:20 Operations synchronized Division I EDG to the grid per Procedure STP-309-0206. Operations raised the Division I EDG to full load. Division I EDG load was raised to 3130 kW for performance of Procedure STP-309-0206. Operations reduced Division I EDG load to less than full load. Operations opened Division I EDG output breaker per Procedure STP-309-0206. Operations secured Division I EDG for performance of Procedure STP-309-0206. Operations notified Chemistry that the Division I EDG run was completed.

21:17 Operators started Division I EDG per Procedure SOP-0053, "Standby Diesel Generator and Auxiliaries (SYS#309)," Revision 324, for Work Order WO 52331134

21:45 The diesel engineer and a plant operator noted a small amount of water around the jacket water outlet pipe nipple.

22:33 Operations synchronized Division I EDG to the grid per Procedure SOP-0053 and Work Order WO 52331134.

December 3, 2012

01:15 The diesel engineer noted Jacket Water level to be 168" prior to exiting the room.

02:45 The diesel engineer noted Jacket Water level to be 155" upon re-entry into the engine room.

03:00 Operations made the decision to secure Division I EDG.

03:24 Operations opened Division I EDG output breaker per Procedure SOP-0053.

03:26 Operations secured Division I EDG per Procedure SOP-0053 from the EGS-EG1A Pre-Maintenance Inspection and run due to jacket water leak. Chemistry was notified. The licensee issued Condition Report CR-RBS-2012-07400 for the Division I EDG jacket water leak from the threaded connection of the jacket water where it exits the exhaust shroud of the EDG. Work Order WO 334908 was initiated to repair leak. The condition report also included the apparent cause evaluation, past operability evaluation, and probable risk assessment of the condition

04:01 The diesel engineer and a plant operator noted that the jacket water leak rate was increasing to a steady stream of water. The licensee issued Condition Report CR-RBS-2012-07402 due to the jacket water leak rate increasing to a steady stream of water. Condition Report CR-RBS-2012-07402 was then closed to CR-RBS-2012-07400.

09:50 Operations placed Division I EDG in Maintenance per Procedure SOP-0053 due to Division I EDG jacket water leak. Maintenance personnel fabricated pipe nipple and flange per weld data and original purchase order design requirements.

December 4, 2012

02:01 Operations restored Division I EDG to operational status per Procedure SOP-0053

02:57 Operations started Division I EDG per Procedure SOP-0053 for post maintenance run.

03:10 Operations synchronized the Division I EDG to the grid per Procedure SOP-0053.

03:18 Division I EDG at full load.

04:19 Operations reduced the output of the Division I EDG to less than full load.

04:25 Operations opened Division I EDG output breaker per Procedure SOP-0053.

05:38 Operations secured the Division I EDG per Procedure SOP-0053.

15:54 The diesel engineer and plant operator performed a walkdown of the Division II EDG – looking for potential exhaust shroud jacket water return pipe and flange leaks and/or cracks.

December 5, 2012

14:26 Operations placed the Division II EDG in Maintenance per Procedure STP-309-0202, "Division II EDG Operability Test," Revision 321.

15:18 -17:01 Operations synchronized the Division II EDG to the grid per Procedure STP-309-0202. Division II EDG at full load. Walkdown by the System Engineering, and Design Civil Engineering performed while Division II diesel was at 100% load. Operations reduced the Division II EDG to less than full load. Operations opened Division II EDG output breaker per Procedure STP-309-0202. Operations secured the Division II EDG per Procedure STP-309-0202. Operations notified Chemistry that the Division II EDG run was completed.

17:11 Operations placed the Division II EDG in Maintenance per Procedure STP-309-0202.

17:22 Operations restored the Division II EDG to Operational per Procedure STP-309-0202.

EVENT REVIEW AND INSPECTION

- December 17, 2012 The inspector arrived on site and discussed the Division I EDG event with the licensee. The licensee explained the activities that preceded the exhaust shroud jacket water pipe leak, the repair of the pipe and flange, and the subsequent activities reviewing the extent of condition and analysis of the broken pipe.
- December 18, 2012 The inspector toured the Division I and II EDG's reviewing previously identified problems with cracked parts, vibration induced cracks and wear on tubing, and other past failures of parts attached to the EDG's.
- December 19, 2012 The licensee provided site specific data pertaining to the design of of the EDG. The inspector also reviewed EDG trend data and condition reports associated with past EDG concerns.
- December 20, 2012 The inspector was informed that when the Division I EDG exhaust shroud jacket water return pipe failed, the licensee had engaged a third party consultant to provide an analysis of the failure mechanism. During their review of the material, the consultant identified that the piece of pipe supplied from the original EDG vender was different than that specified in the original purchase order design requirements. The purchase order required the pipe to be ASME Schedule 80, and the pipe that had been installed was ASME Schedule 40.

No findings were identified.

3.2 Licensee's response to the jacket water leak, including the licensee's actions to repair the failed pipe (Charter Item 2)

a. Inspection Scope

The inspector interviewed system engineers and operations personnel who were on shift during the event to evaluate the licensee's responses to the leak. Also, the inspector reviewed written operator event log entries. The inspector evaluated procedure use and the appropriateness of Technical Specification entries and any required reporting criteria.

The inspector noted that the licensee had initially noted a small amount of water around the jacket water outlet pipe nipple, and had continued the Division I EDG

surveillance run. During the EDG run, the leak rate increased to an estimated 150 drops per minute (approximately 3.7 gallons per day). The operability limit of the exhaust shroud jacket water cooling system is 7.4 gallons per day. During the run, jacket water leakage increased to a steady stream, and operators shutdown the diesel. Reports quantified the leakage as lowering in the jacket water stand pipe two inches every five minutes, approximately 0.5 gallon per minute, 30 gallons per hour, or 720 gallons per day.

b. Findings and Observations

The inspector observed the following regarding the licensee's response to the event:

- The licensee did not have a procedure for emergency makeup water to the jacket water system during a loss of off-site power.
- The licensee had no dedicated equipment for diverting emergency makeup water to the jacket water system.
- As directed by a senior reactor operator, operators could have refilled the standpipe by diverting either firewater or standby service water to a drain line off the jacket water standpipe.
- The system engineer and a plant operator inspected the running Division I EDG for other leaks or anomalies while the EDG was running and shortly after the engine was shut down, but did not document what was inspected. The licensee has a document identified as 309/405 (Diesel Generator, Diesel Generator Building HVAC) "System Walkdown Inspection Checklist," Attachments 9.2, which would have provided a methodical, documented, review of all the critical components on the EDG that were inspected.
- For the replacement of the broken pipe and flange assembly, the licensee referred to the original Division I and Division II EDG purchase order design specifications for the materials required.

The inspector identified that during and shortly after the event occurred, the licensee did not have a process for documenting activities related to the event, besides those of plant and control room operations. Instead, information about the activities and inspections performed existed only as verbal communications with the involved knowledgeable personnel. Due to the resulting lack of documentation, the inspector was not able to adequately assess the licensee's response to the event. The licensee had previously documented problems associated with the Division I EDG surveillance in several condition reports, including Condition Report CR-RBS-2012-07400, "Division I diesel outage jacket water leak from the threaded connection on the jacket water jumper on top of the exhaust shroud closest to the turbocharger". Event activities, significance, root cause, and material analysis, will be reviewed upon the completion of the licensee's corrective action process.

No findings were identified.

3.3 Licensee's actions to evaluate the extent of condition of the failed pipe (Charter Item 3)

a. Inspection Scope

The inspector interviewed selected personnel in system engineering, operations, design engineering, and maintenance to determine the actions taken by the license to evaluate the potential extent-of-condition of the failed pipe. The inspector also reviewed operations and maintenance logs, along with work orders and condition reports to identify the licensee's efforts in evaluating the extent-of-condition of the failed Division I EDG exhaust shroud jacket water return pipe.

b. Findings and Observations

The inspector made the following observations regarding the licensee's review of the extent-of-condition for the event:

- The licensee inspected all threaded and welded connections in the Division I EDG exhaust shroud jacket water system for leakage or failures.
- The licensee inspected all other welded and threaded pipe and tubing connections (fuel oil, lubrication oil, water, air) associated with the Division I EDG for leakage or failures.
- The licensee similarly inspected all welded and threaded pipe and tubing connections associated with the Division II EDG for leakage or failures.
- The inlet (suction side) of the Division I EDG exhaust shroud jacket water cooling system is of a similar configuration in that it has a threaded connection into a coupling. At the end of this inspection, the licensee was evaluating how they would confirm compliance with the original specifications for the threaded pipe.
- The licensee sent the failed threaded pipe to a vendor for metallurgical analysis. Preliminary analysis of the failed threaded pipe revealed that the pipe did not meet the purchase order design requirements, in that the purchase order had specified that the Division I EDG exhaust shroud jacket water cooling system outlet (discharge) threaded pipe was to be ASME Schedule 80 pipe, but the analysis revealed that Transamerica DeLaval Incorporated had installed an ASME Schedule 40 pipe.
- The vendor performing the metallurgical analysis also performed an initial failure analysis of the pipe using the two different ASME pipe schedules. They developed an analytical model of the 1½-inch jacket-water pipe using vibration data from the Division II EDG (which is similar to the Division I EDG), and used that model to determine that the ASME Schedule 80 pipe was approximately 33 percent stronger than the ASME Schedule 40 pipe. Thus, if the ASME Schedule

80 pipe had been installed, preliminary results indicated that failure of the pipe would not occur until approximately 900,000 hours of operation, approximately 400 times longer than the time to failure of the ASME Schedule 40 pipe.

- The licensee has scheduled a maintenance outage for the Division II EDG to dismantle and replace the discharge (outlet) threaded pipe and flange for the exhaust shroud jacket water cooling system as a precautionary measure to confirm the use of the proper materials to meet the purchase order design requirements. This outage is currently scheduled for January 2013.
- When the Division II EDG exhaust shroud jacket water cooling discharge pipe and flange have been removed, the licensee plans to analyze the materials to verify compliance with the purchase order design requirements.

No findings were identified.

3.4 Licensee's short-term corrective actions (Charter Item 4)

a. Inspection Scope

The inspector reviewed operator logs, condition reports, maintenance work orders, and interviewed personnel in system engineering, design engineering, and maintenance to determine the actions taken by the license to correct the failed Division I EDG exhaust shroud jacket water return pipe and flange, and to restore the Division 1 EDG to operable status.

b. Findings and Observations

The inspector made the following observations regarding the licensee's short-term corrective actions for the event:

- The licensee planned to remain in the Division I EDG Technical Specification Limiting Condition for Operation and initiate work orders to dismantle and replace the leaking exhaust shroud jacket water cooling pipe and flange.
- The licensee procured a flange and pipe from supplies onsite. They used the original purchase order design requirements to select the materials.
- During the removal of the leaking pipe and flange from the Division I EDG exhaust shroud jacket cooling water outlet, the threaded end of the pipe broke within the coupling that was welded to the exhaust shroud. The licensee's initial inspection of the broken pipe revealed that approximately $\frac{3}{4}$ of the pipe's circumference appeared to have cracked previously, based on dark areas where the two parts of the pipe mated, and approximately $\frac{1}{4}$ of the circumference appeared to have recently broken, based on the shine of the separated parts.

- The licensee removed the remaining portion of the threaded end of the pipe from the coupling, and then cleaned the internal portion of the coupling threads.
- The licensee installed the new threaded pipe (ASME Schedule 80, per the purchase order design requirements) and flange on the Division I EDG exhaust shroud jacket water outlet.
- Operators started the Division I EDG and successfully completed the operability surveillance. The licensee declared the Division I EDG operable and exited the Limiting Condition of Operation.
- The licensee reviewed the activities concerning the extent of condition of the failed threaded pipe and flange for both the Division I and Division II EDG's.

No findings were identified.

3.5 Material history for any previous historical leaks (Charter Item 5)

a. Inspection Scope

The inspector reviewed the licensee's corrective action program for historical concerns pertaining to leaks on both the Division I and Division II EDG's. The inspector also interviewed the system engineers, design engineering, maintenance personnel, and the NRC resident inspectors, concerning previous known leaks, and or similar issues associated with the EDG's.

b. Findings and Observations

The inspector identified several corrective action condition reports concerning leaks associated with the EDG's, and had the following observations regarding the licensee's action pertaining to previously identified historical leakage associated with the EDGs:

- March 25, 2008, CR-RBS-200802410 identified a Division I exhaust shroud jacket water leak at the discharge (outlet) of the shroud. The leak was weeping at the threaded connection. The licensee initiated a work order to repair the leak during a suitable Division I EDG work window.
- May 2, 2008, CR-RBS-2008-03083 identified an inactive Division I EDG water leak of the exhaust shroud jacket water cooling outlet. The licensee determined that jacket water cooling was satisfactory, and took no action.
- April 6, 2009, CR-RBS-2009-01642 identified a Division I EDG jacket water leak at the exhaust shroud discharge. The leak did not appear large, based on the jacket water level not lowering much over the previous few months. The licensee closed the condition report to trend.

- August 11, 2009, CR-RBS-2009-03520 was a composite of several conditions identified during a walkdown of the Division I and II EDGs, including accumulated salts. The licensee stated that the accumulated salts were a corrosion inhibitor residue, left by evaporation of leakage over time, and assessed the issue as cosmetic.
- December 4, 2009, the licensee initiated work order 144886 to repair the jacket water leak. In accordance with that work order, they removed the threaded pipe and flange (exhaust shroud jacket water outlet connection), cleaned the pipe threads on the pipe and coupling, applied pipe thread sealant, and reassembled the pipe and flange.
- December 3, 2012, CR-RBS-2012-07400 identified a Division I exhaust shroud jacket water leak at the discharge (outlet) of the shroud at the threaded connection, during a 24 hour surveillance run of the Division I EDG. The leak increased to a point where the licensee became concerned with the functionality of the EDG and shut the EDG down.

No findings were identified.

3.6 Determine if the failure of the jacket water pipe related to previous failures from high vibration (Charter Item 6)

a. Inspection Scope

The Division I and II emergency diesel engines at the River Bend Station are Transamerica DeLaval Incorporated (TDI) Model DSR-48. Concerns with the reliability of TDI diesels first surfaced following the failure of a crankshaft at Shoreham in August 1983. These deficiencies stemmed from inadequacies in design, manufacture, and quality assurance/quality control by TDI. The NRC had concluded in a Safety Evaluation Report dated August 13, 1984 that the TDI Owners Group Program Plan incorporated the essential elements needed to resolve concerns relating to the reliability of the TDI EDGs for nuclear service. As a result, the EDGs at the River Bend Station are derated to 3130 kW continuous power, with no permissible overload, based on a recalculated capacity of the engine crankshaft. The reduction in the EDG rating resulted in increased vibration of the engine due to a naturally occurring harmonic frequency of the engine and generator. This increased vibration has resulted in several vibration-induced problems since the engine was derated. In April 2011, the licensee successfully installed a modification to dampen the vibrations of the Division I and II EDGs.

b. Findings and Observations

The inspector reviewed the licensee's corrective action program for historical concerns pertaining to material concerns from high vibration induced failures for both the Division I and Division II EDG's. The inspector also interviewed not only personnel in system engineering, design engineering, and maintenance, but also the

NRC resident inspectors, concerning previously known vibration-induced equipment failures associated with the EDG's. The inspector made the following observations regarding vibration-induced failures of equipment on the Division I and II EDGs:

- October 9, 2007, CR-RBS-2007-04490 identified that the EGS-PNL1B turbocharger discharge piping was cracked at welded joint to a flange. The crack extended across approximately 1/3 of the pipe's circumference on one side and 1/8 of pipe circumference on the other side.
- April 26, 2008, CR-RBS-2008-02983 identified that during a post-maintenance run on the Division II EDG, an operator noticed an oil leak on the #8 cylinder under the exhaust cooler shroud. A crack was found at the weld root on the pipe side of the number 8 cylinder head exhaust flange. When wiped with a cloth, the "oily exhaust" residue would start to run within approx 10 seconds. When the engine was secured, the area was cleaned and visually inspected. The crack extended across approximately 1/4 of the flange's circumference, then crossed the welds. This was the second occurrence of this crack. The licensee repaired this area in May, 1996 in accordance with work order 50697055.
- May 2, 2008, CR-RBS-2008-03083 identified the following material condition and housekeeping issues:
 - Division II EDG -Conduit cover not secured
 - Division II EDG -Oil Pads under the Machine -no active leak seen, but rags were old.
 - Division II EDG -Oil Pads on the side of the cylinders
 - Division I EDG -Inactive jacket water leak (not leaking with the machine not running) -but had chemical residue near the turbocharger.
- January 21, 2009, CR-RBS-0352 identified that during the monthly surveillance run (STP-309-0202), after about 10 minutes fully loaded, operators discovered an exhaust leak on number 8 cylinder. Of the four associated bolts that should have been in place, one bolt was missing.
- July 9, 2009, CR-RBS-2009-03055 identified inadequate operability evaluations for the Division II EDG that were performed for conditions related to the cylinder number 8 exhaust piping and flange cracking in April 2008, January 2009, and May 2009. The operability evaluations were determined to be inadequate based on the licensee's failure to establish reasonable assurance of operability.
- December 1, 2009, CR-RBS-2009-06132 identified that during the 24 hour Division I EDG run, using surveillance procedure STP-309-0611, operators discovered nine broken bolts on the intercooler, on the side nearest the engine. (This side of the intercooler is held in place by 20 bolts.) The bolts had broken off

and gasket material had been displaced from the air leaking out of the intercooler. The diesel continued to maintain full load and all operating parameters remained within specifications. Operators also identified a jacket water leak approximately four feet from the west end of the exhaust shroud, at a rate of approximately 60 drops per minute.

- February 1, 2009, CR-RBS-2009-06148 identified a tenth bolt on the engine side of the Division I EDG intercooler had its head shear off while the EDG was running in maintenance mode.

The inspector concluded that the Division I and II EDG engines were subjected to increased vibration concerns due to a natural harmonic frequency that had occurred because the EDGs had been derated due to potential crankshaft cracking concerns. In 2011, the licensee successfully installed a modification to reduce the vibration amplitude, thereby reducing vibration-related stresses on EDG structures and components.

The inspector noted that the licensee had received a preliminary stress report from the vendor providing the metallurgical analysis of the failed threaded pipe. The report indicated that the EDG vendor had installed the wrong pipe material, in that the pipe design called for the use of ASME Schedule 80 pipe, but the vendor had installed AMSE Schedule 40 pipe. Preliminary stress analysis results indicated that if the correct material had been used, the pipe would not have cracked.

No findings were identified.

3.7 Potential Generic Issues Related to the Pipe Failure of the Division I EDG Exhaust Shroud Jacket Water Cooling System (Charter Item 7)

a. Inspection Scope

The inspector reviewed the licensee's historical activities in correlation to the vibration concerns pertaining to the Transamerica DeLaval Inc. (TDI) model DSR-48 diesel. The inspector also interviewed personnel in system engineering, design engineering, and maintenance concerning previously known equipment failures associated with the EDG's. The inspector also reviewed known operational experience reports associated with the TDI diesels.

b. Findings and Observations

The inspector made the following observations regarding potential generic issues related to the pipe failure of the EDG exhaust shroud jacket water cooling system:

- River Bend Station is the only nuclear power plant in the United States that uses Transamerica DeLaval Inc. (TDI) model DSR-48 EDG engines for their station emergency diesel generators.

- The licensee had formulated plans to inspect the other threaded pipes in the jacket water cooling systems on both the Division I and II EDGs to determine whether any other incorrect parts had been installed on the EDGs. The licensee will revisit their corrective actions if more incorrect parts are discovered.

No findings were identified.

3.8 Coordinate with the regional Senior Risk Analyst (SRA) to ensure that the NRC response to the event is consistent with the potential safety significance (Charter Items 8 and 9)

a. Inspection Scope

The inspector reviewed the NRC Management Directive 8.3, "NRC Incident Investigation Program," and Inspection Manual Chapter 0309, "Reactive Inspection Decision Basis for Reactors," based on the initial risk and deterministic criteria evaluation made by the NRC on December 10, 2012. The inspector reviewed the circumstances surrounding the jacket water leak from a circumferential crack in a threaded connection on top of the Division I Emergency Diesel Generator (EDG) manifold exhaust shroud.

This issue met the criteria of NRC Management Directive 8.3, "NRC Incident Investigation Program," for a detailed follow-up inspection, in that this issue not only involved a possible design deficiency with potential generic safety implications, but also may involve repetitive failures.

During the inspection, the inspector continued discussing the inspection findings with the Senior Risk Analyst to confirm the risk significance of the inspection findings.

b. Findings and Observations

The inspector made the following observations regarding potential risk-significant issues related to the pipe failure of the EDG exhaust shroud jacket water cooling system:

- The inspector reviewed the licensee's Probabilistic Risk Assessment of the Division I EDG exhaust shroud jacket water cooling system to identify any major discrepancies between the licensee's risk assessment and the NRC's risk assessment.

No findings were identified.

4OA6 Meetings

Exit Meeting Summary

On December 21, 2012, the inspector presented the inspection results to Mr. Eric Olson, Site Vice President, and other members of the licensee staff. The licensee

acknowledged the issues and observations presented. The inspector acknowledged that he had reviewed proprietary materials, that none of the proprietary information would appear in the report, and that all proprietary information had been returned to the licensee. After additional in-office inspection, a final telephonic exit meeting was conducted on February 5, 2013, with Ms. K. Huffstatler, Senior Licensing Specialist, closing section 3.6. "Determine if the failure of the jacket water pipe related to previous failures from high vibration."

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel

R. Barrios, Engineer
G. Bush, Manager, Materials, Purchasing, and Contracts
M. Chase, Manager, Training
J. Clark, Manager, Licensing
C. Coleman, Manager, Programs and Components
R. Conner, Supervisor, Engineering
F. Corley, Manager, Design Engineering
E. Deweese, Supervisor, Engineering
T. Evans, Manager, Operations
C. Forpahl, Manager, System Engineering
A. Fredieu, Manager, Outage
A. Frederickson, System Engineer, Emergency Diesel Generator
R. Gwinn, Sirius
W. Hilliard, Supervisor, Chemistry
K. Huffstatler, Senior Licensing Specialist
K. Klamert, System Engineer, Emergency Diesel Generator
J. Maher, Manager, Projects
W. Mashburn, Director, Engineering
A. Mayfield, Engineer
G. Mermigas, Engineer
E. Olson, Site Vice President
M. Ponzo, Superintendent, Mechanical Maintenance
J. Roberts, Director, Nuclear Safety Assurance
P. Sicard, Engineer, Probable Risk Assessment
D. White, Component Engineer
L. Woods, Manager, Quality Assurance
D. Yoes, Supervisor, Quality Assurance

NRC Personnel

Grant Larkin, Senior Resident Inspector
Andy Barrett, Resident Inspector
B Hagar, Senior Project Engineer, DRP – Branch C

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None.

Closed

None.

LIST OF DOCUMENTS REVIEWED

CONDITION REPORTS

CR-RBS-2001-01510	CR-RBS-2008-03591	CR-RBS-2011-06195
CR-RBS-2007-00279	CR-RBS-2009-01642	CR-RBS-2011-06212
CR-RBS-2007-00291	CR-RBS-2009-06342	CR-RBS-2011-06224
CR-RBS-2007-00294	CR-RBS-2009-03520	CR-RBS-2011-06245
CR-RBS-2007-00304	CR-RBS-2009-03055	CR-RBS-2011-06287
CR-RBS-2007-00308	CR-RBS-2009-06132	CR-RBS-2011-06319
CR-RBS-2007-00318	CR-RBS-2009-06148	CR-RBS-2012-00004
CR-RBS-2007-00331	CR-RBS-2009-01666	CR-RBS-2012-00012
CR-RBS-2007-00346	CR-RBS-2009-01700	CR-RBS-2012-00059
CR-RBS-2007-00468	CR-RBS-2009-01928	CR-RBS-2012-00113
CR-RBS-2007-00521	CR-RBS-2009-01942	CR-RBS-2012-03954
CR-RBS-2007-03311	CR-RBS-2009-02912	CR-RBS-2012-04012
CR-RBS-2007-03461	CR-RBS-2009-03016	CR-RBS-2012-04039
CR-RBS-2007-03558	CR-RBS-2009-03185	CR-RBS-2012-04165
CR-RBS-2007-03766	CR-RBS-2010-01587	CR-RBS-2012-04188
CR-RBS-2007-03791	CR-RBS-2010-01592	CR-RBS-2012-07395
CR-RBS-2007-04490	CR-RBS-2010-01612	CR-RBS-2012-07400
CR-RBS-2007-04914	CR-RBS-2010-01666	CR-RBS-2012-07401
CR-RBS-2007-04935	CR-RBS-2010-01793	CR-RBS-2012-07402

CR-RBS-2007-04967	CR-RBS-2010-05999	CR-RBS-2012-07411
CR-RBS-2008-00116	CR-RBS-2010-06003	CR-RBS-2012-07412
CR-RBS-2008-00283	CR-RBS-2010-06018	CR-RBS-2012-07414
CR-RBS-2008-00991	CR-RBS-2010-06041	CR-RBS-2012-07422
CR-RBS-2008-01125	CR-RBS-2010-06047	CR-RBS-2012-07428
CR-RBS-2008-02410	CR-RBS-2010-06052	CR-RBS-2012-07429
CR-RBS-2008-02566	CR-RBS-2010-06055	CR-RBS-2012-07430
CR-RBS-2008-02713	CR-RBS-2011-00052	CR-RBS-2012-07439
CR-RBS-2008-02869	CR-RBS-2011-06095	CR-RBS-2012-07451
CR-RBS-2008-02878	CR-RBS-2011-06100	CR-RBS-2012-07480
CR-RBS-2008-02983	CR-RBS-2011-06165	CR-RBS-2012-07484
CR-RBS-2008-03083	CR-RBS-2011-06177	CR-RBS-2012-07499
CR-RBS-2008-03206	CR-RBS-2011-06182	CR-RBS-2012-07757

DRAWINGS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
03-435-03	DeLaval Circulating Water Fittings	
03-435-05-01	Cooper Group Parts List for Jacket Water Fittings	
LE-1882101018	Cylinders, Block, Liners and Water Manifold	6

ENGINEERING CHANGES

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
EC-18899	EGS-EG1A Exhaust Shroud Repair	00
EC-24645	Installation of the GERB VISCO type RHY-80/V30/H30 damper.	00

CALCULATIONS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
4244.700-041-033	River Bend Station Standby Diesel Generator Intake System Weak Link Analysis	0

MISCELLANEOUS DOCUMENTS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION/DATE</u>
	ARCHIVE Technical Specifications, Unit 1, LCOTR #: 1-TS -12-DIV I EDG 03DEC12-259	December 3, 2012
	Division I & II Diesel Generator Issues 12/1/12 – 12/12/12	December 20, 2012
	Timeline – Division I and II Diesel Generator Issues 12/01/2012 – 12/12/2012	December 20, 2012
	Control Room Operators Log Entries for Emergency Diesel Generator Entries, 12/02-20, 2012	December 20, 2012

PROCEDURES

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
EN-LI-119	Apparent Cause Evaluation (ACE) Process	16
EN-LI-102	Corrective Action Process	20
EN-LI-102-02	CR Closure Quality	6
EN-LI-118	Root Cause Evaluation Process	18
EN-LI-121	Entergy Trending Process	12
G12.1.15	Division I Diesel Generator 184 Day Operability Test	21
PEP-0026	Diesel generator Operating Logs	14
STP-309-0206	Division I Diesel Generator 184 Day Operability Test -	21

VENDOR MANUALS

<u>NUMBER</u>	<u>TITLE</u>	<u>DATE</u>
VTD-C634-0112	Transamerica DeLaval Instruction Manual for Model DSR048 Diesel Engine/Generator	June 25, 2007
VTD-C634-0247	Assembly Cylinder Block and Liners	May 06, 1996
VTD-C634-0248	Cooper Group Parts List for Water Discharge Manifold	January 22, 2004
C634-0264	Cooper Group Parts List for Exhaust Manifold	April 21 2010

WORK ORDERS

WO-RBS-00144886 WO-RBS-00251286 WO-RBS-00334908 WO-RBS-00217749
WO-RBS-00251287

ATTACHMENT 2

SPECIAL INSPECTION CHARTER

December 14, 2012

MEMORANDUM TO: Ron Kopriva, Senior Reactor Inspector
Engineering Branch 1
Division of Reactor Safety

FROM: Kriss M. Kennedy, Director
Division of Reactor Projects

SUBJECT: SPECIAL INSPECTION CHARTER – REVIEW OF A PIPING FAILURE
ASSOCIATED WITH AN EMERGENCY DIESEL GENERATOR AT
THE RIVER BEND STATION

In response to the failure of jacket water system piping associated with an emergency diesel generator (EDG) at the River Bend Station on December 2, 2012, a Special Inspection is being chartered. You are hereby designated to conduct the Special Inspection.

A. Basis

On December 2, 2012, at 21:17, operators started the Division 1 EDG for a scheduled test. Approximately six hours later, they secured the EDG due to a jacket water leak from a circumferential crack in a threaded connection on top of the EDG manifold exhaust shroud. Initially, the licensee estimated the leak rate to be 150 dpm (≈ 3.7 gallons per day). However, during the run, that leak rate increased to “a steady stream”, so the licensee shut down the EDG. According to initial reports, the leakage had lowered the level of water in the jacket water stand pipe by approximately 2 inches over five minutes, which is equivalent to 0.5 gallons per minute. The licensee does not have a procedure for emergency makeup water to the jacket water system during a loss of off-site power. In addition, the licensee has no dedicated equipment for diverting emergency makeup water to the jacket water system. However, as directed by an SRO, operators could refill the standpipe by diverting either firewater or standby service water to a drain line off the jacket water standpipe.

On December 3, when maintenance technicians attempted to remove the threaded pipe from the top of the EDG manifold exhaust shroud, the pipe broke. A cursory examination of the broken edges indicated that the break had occurred at the location of a pre-existent crack that had extended through approximately 270° of the piping circumference.

This issue meets the criteria of NRC Management Directive (MD) 8.3, “NRC Incident Investigation Program,” for a detailed follow-up inspection, in that this issue not only involved a possible design deficiency with potential generic safety implications, but also may involve repetitive failures. In addition, the incremental conditional core damage probability associated with this issue warranted consideration of a Special Inspection in accordance with MD 8.3. Based on the applicability of these deterministic criteria and the

subject incremental conditional core damage probability, I have determined that the conduct of a special inspection is the appropriate response to this event.

B. Scope

The Special Inspection is to gather data and facts to address the following:

1. Develop a complete sequence of events related to the discovery of the jacket water leak.
2. Inspect the licensee's response to the jacket water leak, including their actions to repair the failed pipe.
3. Inspect the actions taken by the licensee to evaluate the potential extent of the condition of the failed pipe.
4. Inspect the licensee's short-term corrective actions and verify that they address the results of the licensee's preliminary cause evaluation.
5. Review the material history of the Division I and Division II EDGs and determine if the licensee took appropriate corrective actions for any previous leaks identified from this pipe joint.
6. Determine if the failure of the jacket water pipe resulted from the identified causes of previous failures of EDG components related to high vibration. If the failures are related, then assess the adequacy of the licensee's corrective actions for these previous failures as they relate to the jacket water pipe failure.
7. Evaluate the potential for any generic issues related to the discovery of the failed jacket water pipe and promptly communicate any potential generic issues to regional management.
8. Throughout the inspection, coordinate with the regional Senior Risk Analyst (SRA) to ensure that the NRC response to the event is consistent with the potential safety significance.
9. In consultation with the SRA, collect the necessary information to determine the safety significance of any identified issues.

C. Guidance

Inspection Procedure 93812, "Special Inspection," dated July 7, 2003, provides additional guidance for this inspection.

Your duties are described in Inspection Procedure 93812. The inspection is to emphasize fact-finding in the review of the circumstances surrounding the subject piping failure, and you are not responsible for examining the regulatory process.

You will report to the site, conduct an entrance meeting, and begin inspection activities on December 17, 2012. You should complete direct inspection activities by the close of business on December 20, 2012, and schedule a formal exit during the morning of December 21, 2012.

While you are onsite, you will provide daily status briefings to Region IV management, in accordance with your agreement with Bob Hagar.

You will document the inspection results in Special Inspection Report 05000458/2012013. The report will be issued within 45 days of the completion of the inspection.

If you have any questions regarding this charter, contact Bob Hagar at (817) 200-1546.