UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

October 17, 2012

Mr. Anthony Vitale
Vice-President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT - NRC SPECIAL INSPECTION TEAM (SIT) REPORT 05000255/2012012

Dear Mr. Vitale:

On September 5, 2012, the United States Nuclear Regulatory Commission (NRC) completed a special inspection at your Palisades Nuclear Plant. The inspection was conducted in response to the circumstances surrounding the steam leak on the Control Rod Drive Mechanism (CRDM) 24 housing. Based on the risk and deterministic criteria specified in Management Directive 8.3, "NRC Incident Investigation Program," a special inspection was initiated in accordance with Inspection Procedure 93812, "Special Inspection." The special inspection charter (Attachment 2 of the enclosure) provides the basis and focus areas for the inspection.

The enclosed inspection report documents the inspection results, which were discussed with you and other members of your staff at the exit meeting on September 5, 2012. The determination that the special inspection would be conducted was made on August 15, 2012, and the on-site inspection commenced the same day.

The inspection examined activities conducted under your license as they relate to safety, compliance with the Commission's rules and regulations, and with the conditions of your license. The inspectors reviewed selected procedures and records, conducted field walkdowns, and interviewed personnel.

Based on the results of this inspection, no findings of significance were identified.

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 and from the Publicly Available Records (PARS) component of NRC's document system, Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Website at http://www.nrc.qov/readinq-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA by Gary L. Shear for/

Steven West, Director
Division of Reactor Projects

Docket No. 50-255
License No. DPR-20

Enclosure: Inspection Report 05000255/2012012;
w/Attachments:
1. Supplemental Information
2. Memo to Phillips
3. Palisades Timeline
4. Palisades Rack and Pinion CRDM
5. Results of Dye Penetrant Test

cc w/encl: Distribution via ListServ

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No.:	50-255
License No.:	DPR-20
Report No.:	05000255/2012012
Licensee:	Entergy Nuclear Operations, Inc.
Facility:	Palisades Nuclear Plant
Location:	Covert, MI
Dates:	August 15, 2012 - September 5, 2012
Inspectors:	C. Phillips, Senior Resident Inspector Dresden Station (Lead) A. Shaikh, Reactor Inspector E. Sanchez-Santiago, Reactor Inspector
Approved by:	John B. Giessner, Chief Branch 4 Division of Reactor Projects

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SUMMARY OF FINDINGS

Inspection Report (IR) 05000255/2010012; 08/15/2012-09/05/2012; Palisades Nuclear Plant; Inspection Procedure 93812, Special Inspection.

This report covers a 15-day period (August 15 – September 5, 2012) of on-site inspection and in-office review. A team, comprised of three regional inspectors, conducted this special inspection. 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 and Self-Revealing Findings

No findings were identified.

B. Licensee-Identified Violations

No findings were identified.

REPORT DETAILS

Summary of the Degraded Condition

August 11, 2012

At 11:07 p.m., the licensee commenced a planned shutdown due to a management decision based on steadily increasing unidentified primary coolant system (PCS) leakage. The plant entered Mode 3 at 3:01 a.m. on August 12, 2012. During a containment inspection, the licensee identified pressure boundary leakage on Control Rod Drive Mechanism (CRDM) housing 24 at 4:18 a.m. on August 12, 2012.

The unidentified PCS leak rate had been gradually increasing since the site started up from a forced outage on July 10, 2012. Per the NRC Inspection Manual Chapter (IMC) 2515, the inspectors are expected to calculate a mean unidentified leak rate and take specific actions if the measured unidentified leak rate should exceed the mean by 1, 2, or 3 standard deviations (sigma). The unidentified PCS leak rate exceeded the IMC 2515 three sigma value on July 16, 2012. The licensee conducted a number of containment entries to identify the source of the leak, but was unable to locate the leak. The licensee determined an administrative limit that a shutdown would commence within 2 hours if the leak rate and the confirmatory leak rate measurements exceeded 0.5 gallons per minute (gpm). The Technical Specification (TS) limit is 1.0 gpm for unidentified PCS leakage. On August 9, 2012, the licensee notified the NRC that they intended to shutdown the plant to investigate the source of elevated PCS unidentified leakage. At the point of the shutdown, unidentified leakage was approximately 0.3 gpm.

With the reactor shut down, a containment entry was performed on Sunday, August 12, 2012, to conduct a visual inspection of PCS areas inaccessible during power operation. An NRC inspector was present during this containment entry. A CRDM housing assembly was identified as the source of the leak. The steam leak was coming from an area on CRDM-24, about 1 foot above the rod drive to reactor vessel head flange, with no bolted connections, making it a pressure boundary leak. There was some boric acid on the head insulation, some small amount was rust colored.

The leak was present in the lower witness band of the Type 316L stainless steel pipe section of the upper housing of CRDM-24 located above Weld No.3 (see attachment 4). Weld No.3 was a butt weld (structural weld) that joined the pipe section and the lower flange assembly of the upper housing assembly. The through-wall leak location was at the upper radius of the witness band opposite the lower taper of the internal weld build up area (non-structural weld No.5) and was axially oriented (see attachment 5). A witness band is a precisely machined area on the exterior of the pipe section used during the fabrication process as a reference for critical dimensions. A laboratory evaluation determined that the cracking in the housing of CRDM-24 was transgranular stress corrosion cracking (TGSCC) initiating from a flaw location on the inner wall, propagating outward to the outer wall. Three concurrent conditions are necessary for TGSCC to occur – namely an accumulation of tensile stresses greater than some minimum, a material that is susceptible to the cracking phenomenon, and an environment that supports cracking. An NRC inspector observed the testing done at this laboratory. In the laboratory, using a dye penetrant test, nine axial cracks were found including the crack that went through-wall. Testing done on eight additional housings (installed on the vessel head), in the same location as the cracks found on CRDM-24, found no cracks.

2001 CRDM Leak

On June 21, 2001, a pressure boundary leak was identified in the upper housing assembly for CRDM-21. The cracking was limited to Weld No. 3. Indications from Non-destructive examination (NDE) of the remaining 44 CRDMs showed similar flaws in the vicinity of Weld No.3. In CRDM-21, the NDE indicated three additional flaws in the CRDM-21 upper housing; however, only one of the flaws in CRDM-21 was found to be through-wall. The 2001 root cause and destructive examination concluded that the cracks in CRDM-21 were caused by TGSCC which occurred in areas of heavy grinding or machining tool marks. The leak in the upper housing was the result of an inner diameter initiated, axially oriented, transgranular crack in the austenitic stainless steel housing material. The licensee replaced all 45 CRDM housings with modified housings when subsequent testing indicated additional cracks in the same location in other CRDM housings. The inspectors reviewed the circumstances surrounding the 2001 crack on the housing of CRDM-21 to determine if the licensee's actions in response to that event were related to the cause of the 2012 crack on the housing of CRDM-24. (See NRC Inspection Report 05000-255/2001-15 for more detail.)

Inspection Scope

Based on the deterministic and conditional risk criteria specified in Management Directive 8.3, "NRC Incident Investigation Program," a special inspection was initiated in accordance with NRC Inspection Procedure 93812, "Special Inspection Team." The special inspection charter, dated August 15, 2012, is included as Attachment 2. The team reviewed technical and design documents, procedures, maintenance records, and corrective action documents; interviewed station personnel and consultants; and performed plant walkdowns of plant equipment. A list of specific documents reviewed is provided in Attachment 1.

4. OTHER ACTIVITIES

4OA5 Other Activities – Special Inspection (93812)

In accordance with the Charter for this inspection (Attachment 2), the following items were reviewed.

.1 Establish a historical sequence of events related to leak recognition, leakage trend/rate and subsequent plant shutdown. Review related licensee actions with respect to monitoring of plant conditions and decision making.

a. Inspection Scope

The inspectors reviewed corrective action documents, operating experience reports, operation history, operating and emergency procedures, and interviewed plant personnel for information related to the use of abnormal operating procedures.

A detailed historical timeline of activities and information involving use and experience is contained in Attachment 3.

b. Findings and Observations

Based on the information the inspectors reviewed, the following unresolved item was identified.

Unresolved Item: Technical Specification for Primary Coolant System Pressure Boundary Leakage

Introduction: An unresolved item regarding TS 3.4.13, "PCS Operational Leakage," was self-identified associated with pressure boundary leakage through a cracked CRDM housing.

Description: On August 9, 2012, licensee management decided a plant shutdown was necessary to investigate the source of elevated PCS unidentified leakage. At the point of the shutdown on August 12, 2012, unidentified leakage was approximately 0.3 gpm and had been gradually increasing. The plant was required to be shut down per TSs when the unidentified leak rate exceeded 1.0 gpm. The NRC had been monitoring the increased trend in unidentified leakage since July 2012, when the plant was restarted from a forced outage, to ensure that the plant was taking action as the leakage increased. The operators completed a controlled reactor shutdown on August 12, 2012. Following containment entry, the cause of the rise in leakage was determined to be from a steam leak originating on CRDM-24 housing. The licensee reported that the leakage was PCS pressure boundary leakage. The TS for PCS pressure boundary leakage was 0 gpm.

The licensee concluded that they operated the plant in a condition prohibited by TS 3.4.13, "PCS Operational Leakage," and reported this condition to the NRC in accordance with 10 CFR 50.72. The NRC had previously granted enforcement discretion for situations where the licensee met all associated NRC regulations with regard to CRDM nozzle inspections and the violation was the result of equipment failure that could not have been reasonably avoided or detected (Enforcement discretion was granted under EA-02-011 in 2002 for the 2001 Palisades pressure boundary leak). Whether or not the licensee appropriately implemented their quality control program during the manufacture and installation of the CRDM-24 housing in 2001 or whether this failure was the result of an unavoidable equipment failure, is an unresolved item pending the review of the licensee's root cause evaluation. It is not known, at this time, what caused the flaw which eventually propagated. (Unresolved Item (**URI) 05000255/2012012-01,** "TS for PCS Pressure Boundary Leakage")

c. Observation

In review of the information in Attachment 3, the inspectors determined the failure to enter the off-normal procedures (ONP) for leakage was a performance deficiency. This was screened as minor since the licensee was taking appropriate action, consistent with the ONP, to address the issue.

.2 Evaluate if the licensee missed prior opportunities to have identified this leak at an earlier point in time (e.g. American Society of Mechanical Engineers Code pressure test post refueling VT-2 examination or during the more recent forced outage).

a. Inspection Scope

There are various requirements in place that involve inspection of the CRDM housings. These include ultrasonic testing on a specified sample of pressure retaining welds on a 10-year frequency and a visual examination once every refueling outage. The inspectors reviewed the documentation related to the required examinations to ensure

they were completed and no items of interest were identified that could have led to the detection of the cracking in the CRDM-24 housing. The inspectors also reviewed various procedures and commitments made to the NRC to verify if any additional inspection requirements existed.

Findings and Observations

No findings were identified.

Based on the items reviewed by the inspection team and the information provided, the inspectors did not identify any prior opportunities to identify this condition which may have been missed by the licensee. Weld No. 5 is not a pressure retaining weld and would not have, and has not been, subjected to testing in accordance with existing requirements.

.3 Review the licensee's reportability requirements to confirm necessary notifications were made per 10 CFR 50.72 and possible Emergency Action Levels.

a. Inspection Scope

The inspectors reviewed the licensee's operating logs, Emergency Action Level documents, and NRC Event Report No.48182.

b. Findings and Observations

No findings were identified

Based on the items reviewed by the inspection team and the information provided, the inspectors did not identify any issues with the licensee making the required notifications or the timeliness of those notifications. The inspectors also concluded that no entry into the Emergency Action Level procedures was required.

.4 Review the licensee's extent of condition evaluation and related activities including underlying non-destructive examinations, initial/apparent cause determination, analytical calculations and rationale, and relevant plant specific and industry operating experience, to determine if the repair scope is adequate.

a. Inspection Scope

The inspectors reviewed the licensee's final extent of condition evaluation as documented in their technical justification for start-up and the supporting calculations justifying operation through the remainder of the current operating cycle. The inspectors also observed and reviewed the non-destructive examinations performed on the failed housing of CRDM-24 and the eight CRDM housings included in the extent of condition evaluation. In addition, the inspectors reviewed the licensee's initial/apparent cause determination to verify that the licensee had deduced a broad enough initial/apparent cause so as to appropriately consider and identify all actual root cause(s) in their ongoing root cause evaluation. Relevant plant specific and industry operating experience was also reviewed by the inspectors to determine whether the licensee had appropriately considered the root cause(s) from the plant's 2001 CRDM housing leak event and similar CRDM housing leaks/cracking at other plants in the industry.

b. Findings and Observations

Based on the information the inspectors reviewed, the following unresolved item was identified.

Unresolved Item: Potential Inadequate Degradation Evaluation of Control Rod Drive Mechanism Housings

Introduction: The inspectors identified an unresolved item concerning the potentially inadequate degradation evaluation following identification of leakage from the housing of CRDM-24.

Description: On August 12, 2012, the licensee shutdown the plant to investigate the source of elevated PCS unidentified leakage. During a containment walk down post shutdown it was discovered the source of the leakage was from the housing of CRDM-24. The leak was classified as pressure boundary leakage. The licensee performed NDE as well as destructive testing on the housing of CRDM-24 at a laboratory contracted by the licensee.

The preliminary results from this laboratory testing concluded that cracking in the housing of CRDM-24 was attributed to TGSCC. This form of cracking is prevalent when susceptible material such as the housing of CRDM-24 (austenitic stainless steel) is subjected to a corrosive environment (some level of oxygen and a small amount of chlorides) under applied stresses. The corrosive environment in this case is the primary coolant and the applied stresses include thermal and structural stress.

The licensee also examined the fracture surface of the housing of CRDM-24 at the location of the through-wall crack and identified six concentric rings (beach marks) propagating in a radial direction from the inside diameter out towards the outside diameter of the housing. The licensee considered the width of each of these beach marks as indicative of consistent periods/intervals corresponding to crack growth during operation (corrosive environment and stresses present). The relatively narrow band between successive concentric rings was interpreted by the licensee to represent periods of crack arrest during refueling outages (housing not in contact with corrosive environment and stresses are relaxed). However, more oxygenated water is introduced when the coolant system is refilled after refueling, starting the crack propagation process again when stress is applied.

Based on the above interpretations of the fracture surface of the housing of CRDM-24, the licensee extrapolated the crack growth rate for the through-wall crack that caused leakage in the housing. The licensee applied this calculated crack growth rate to consider TGSCC in the remainder of the 44 CRDM housings based on the maximum size crack that could avoid detection. This licensee assessment revealed a time frame of over four years for the crack to propagate through-wall. The results of this crack growth rate as applied to the remainder of the 44 CRDM housings was documented in the licensee's technical justification for startup. The inspectors have outstanding questions and concerns with regards to the methodology used by the licensee to extrapolate a crack growth rate due to TGSCC from the fracture surface of the housing of CRDM-24. The NRC Office of Nuclear Reactor Regulation (NRR) has been involved with detailed technical discussions with the licensee regarding these questions and concerns over the calculated crack growth rates. It is also possible that the concentric

rings represent different periods where the temperature and pressure stresses were removed during heatup and cooldown cycles, irrespective of reintroducing oxygen into the system. In this case, the timeframe would be around 2 years for crack propagation. The NRC concluded that it was still acceptable for startup, but future detailed inspections may be needed sooner than the licensee's assessment. The resolution of this URI is pending further discussions and potential independent examination of the fractured housing of CRDM-24 by NRC staff. **(URI 05000255/2012012-02,** "Potential Inadequate Degradation Evaluation of CRDM Housings").

Observations:

The licensee performed non-destructive exams of the CRDM-24 mechanism using an ultrasonic testing (UT) method while still installed on the head and then destructive tests at the contracted laboratory after it was removed from the site. The licensee's extent of condition document was a living document which used inspection results to inform future extent of condition inspections. At the laboratory, using a dye penetrant test, nine axial cracks were found including the crack that went through-wall. All the cracks were partially in the weld build-up area of Weld No.5. In addition, UTs were performed, as part of the extent of condition, on a sample of another eight CRDMs installed on the reactor vessel head. These eight were picked based on their location on the periphery (ability to access) and source of previous leaks. The UTs were performed near the weld buildup area of Weld No. 5 and the witness mark. On initial UT, no cracks were detected on the eight extent-of-condition housings. However, the UT on CRDM-24 found less than the nine cracks which were found in the laboratory from the penetrant test, due to the placement of the transducers used to perform the test. The NRC was concerned about the coverage of the testing in the areas of interest. The NRC concluded that the initial testing of the other eight housings did not include adequate coverage of the potentially affected area. In response to NRC questions, these housings were retested with extended transducer coverage of the affected areas to ensure the plant was safe to start up. The NRC's questions to the licensee are available in the document titled "Summary of the August 24 and August 28, 2012, Meetings regarding Palisades Nuclear Plant Control Rod Drive Mechanism (CRDM) 24," (NRC ADAMS Accession Number ML12243A519). The NRC concluded that no violation of NRC requirements occurred because it is possible the site's onsite review committee, which had not yet met, may have concluded the testing was needed.

.5 Review the repair activities including human performance, repair method, and post-maintenance/modification testing plan to ensure that applicable plant procedures, plant instructions, Code, and other requirements are followed.

a. Inspection Scope

The inspectors reviewed the procedures and work packages related to the 2012 CRDM housing replacement. The inspectors also reviewed the design change evaluation and the required testing performed on the replacement housing to ensure the housing was installed in accordance with the required codes and standards. The inspectors verified the changes made to the CRDM housing used to replace CRDM-24 did not negate the actions taken in 2001 to prevent recurrence of leakage. Some of the specific activities observed were installation of the replacement CRDM housing and non-destructive examinations performed post installation. The inspectors also interviewed various staff members involved in the repair plan and design changes. The purpose of this review

was to ensure the replacement was performed in accordance with established code and site requirements and all safety standards were met prior to putting the component into service.

b. Findings and Observations

No findings were identified.

Based on this review the inspectors did not identify any issues or concerns associated with the replacement activities.

.6 Review licensee's evaluation that assessed for potential degradation/wastage on the reactor vessel head from the leak to verify adequacy of corrective actions.

a. Inspection Scope

The inspectors observed the licensee perform the bare metal visual (BMV) examination of the reactor head to identify any degradation of the reactor head and surrounding components due to boric acid leakage from the leaking housing of CRDM-24. After removing the vessel head insulation, it was determined approximately two cups of dried boric acid was on the head itself. This boric acid was removed. In addition, the inspectors reviewed the final BMV examination report and all corresponding boric acid evaluations of components that were in contact with boric acid from the leak on the housing of CRDM-24 to determine the accuracy of the report and adequacy of the evaluations.

b. Findings and Observations

No findings were identified.

Based on this review the inspectors did not identify any issues or concerns associated with the inspection and evaluation of the reactor head.

.7 Review repair activities and causal analysis completed for similar event in 2001 to verify that designated corrective actions were completed as prescribed and the causal analysis was adequate.

a. Inspection Scope

Following the 2001 CRDM housing leakage, the licensee performed various analyses and evaluations of the components and the environment these components were exposed to, to determine the causes of the cracking and determine the appropriate corrective actions. The inspectors reviewed the reports containing the results of these evaluations including the root cause report and the engineering change evaluation. The inspectors also reviewed the metallurgical reports and the destructive and nondestructive testing reports performed on the CRDM housings removed in 2001. The root cause of the 2001 event was determined to be TGSCC as a result of susceptible material, fabrication flaws and inherent stresses. The purpose of this review was to verify the licensee completed all the proposed corrective actions. The 2001 incident was characterized as a significant condition adverse to quality which, in accordance with 10 CFR Appendix B Criterion XVI, the licensee is required to implement corrective actions to prevent recurrence. Therefore, the inspectors reviewed the

completed corrective actions to verify they were appropriate and effective in preventing the recurrence of leakage caused by TGSCC as described in the 2001 root cause report.

Findings and Observations

Based on the information the inspectors reviewed, the following unresolved item was identified.

Unresolved Item: Potential Failure to Prevent Recurrence of a Significant Condition Adverse to Quality

Introduction: The inspectors identified an unresolved item regarding the failure to prevent recurrence of a significant condition adverse to quality as required by 10 CFR 50, Appendix B, Criterion XVI.

Description: On August 12, 2012, the licensee shutdown the reactor to investigate the source of elevated PCS unidentified leakage. During a containment walk down post shutdown it was discovered the source of the leakage was the housing on CRDM-24. The leak was classified as pressure boundary leakage. An event similar to this occurred in 2001 when the licensee discovered a steam leak in the housing of CRDM-21 which was also classified as pressure boundary leakage. Title 10 of the Code of Federal Regulations, Part 50, Appendix B, Criterion XVI, states, "In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition." This 2001 pressure boundary leakage event was classified by the licensee as a significant condition adverse to quality. Therefore, as part of the developed corrective action, the need to prevent recurrence was specified. The root cause of the 2001 event was determined to be TGSCC due to susceptible material, fabrication flaws and inherent stresses in the weld due to the design of the component. The corrective actions to prevent recurrence established by the licensee included making changes to the design, fabrication, and material of this component. Specific attention was paid to the pressure retaining welds. The location of the current leak was not in proximity to the pressure retaining welds; therefore, susceptibility in this area was not considered. The root cause evaluation for the current failure was ongoing at the end of the inspection; therefore, it cannot be definitively concluded that the failure mechanism for the current leak is the same as the cause identified in 2001 and the corrective actions to prevent recurrence were inadequate. Although the method of crack propagation was the same, TGSCC, the initiation mechanism for the crack is not yet known. There is no current safety issue as the housing was replaced and the current crack propagation assessments and extent of condition reviews performed provide reasonable assurance a through-wall crack will not occur. (**URI 05000255/2012012-03,** "Potential Failure to Prevent Recurrence of a Significant Condition Adverse to Quality")

.8 Review licensee's root cause evaluation plan and schedule. Evaluate whether the root cause evaluation plan is of sufficient depth and breadth. Confirm that the time allowed to perform the evaluation is commensurate with the safety significance of this issue. Communicate to the licensee that the NRC will inspect the completed root cause evaluation and the associated corrective actions during follow-up inspection activities.

a. Inspection Scope

The inspectors reviewed the licensee's root cause charter, schedule, root cause team make-up and action plan; and interviewed the root cause team. The inspectors confirmed that the licensee's root cause team had sufficient depth in terms of subject matter expertise and sufficient breadth in terms of diverse scientific disciplines to adequately perform the root cause evaluation.

b. Findings and Observations

No findings were identified.

Based on the information reviewed, the inspectors did not identify any issues or concerns associated with the root cause evaluation plan.

.9 Evaluate circumstances surrounding the leak for potential generic issues.

a. Inspection Scope

The inspectors reviewed the licensee's initial/apparent cause determination and interviewed members of the root cause evaluation team.

b. Findings and Observations

No findings were identified.

Based on the information reviewed by the inspectors, no potential generic issues were identified. However, the root cause report was not completed by the end of the inspection period.

4OA6 Meetings, Including Exit

On September 5, 2012, the special inspection team leader presented the preliminary inspection results to Mr. Anthony Vitale and members of his staff. No proprietary information is included in this inspection report.

Attachments: 1. Supplemental Information
2. Memo to Phillips
3. Palisades Timeline
4. Palisades Rack and Pinion CRDM
5. Results of Dye Penetrant Test

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel

T. Vitale, Entergy/Site Vice President
T. Williams, Entergy/General Manager Plant Operations
B. Davis, Entergy/Engineering Director
D. Fitzgibbon, Entergy/Design Engineering Manager
J. Miska, Entergy/Programs Engineering Manager
J. Haumersen, Entergy/Systems Engineering Manager
J. Dills, Entergy/Operations Manager
G. Heisterman, Entergy/Maintenance Manager
C. Plachta, Entergy/Quality Assurance Manager
D. Mannai, Entergy/Fleet Senior Licensing Manager
O. Gustafson, Entergy/Licensing Manager
P. Deniston, Entergy/Root Cause Team Lead
R. VanWagner, Entergy/Forced Outage Manager
M. Sicard, Entergy/Inspection Site Lead
B. Dotson, Entergy/Licensing

NRC Personnel

G. Shear, Acting Director, Division of Reactor Projects
J. Giessner, Branch Chief
T. Taylor, Senior Resident Inspector, Palisades
A. Scarbeary, Resident Inspector

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

URI 05000255/2012012-01	URI	TS for PCS Pressure Boundary Leakage
URI 05000255/2012012-02	URI	Potential Inadequate Degradation Evaluation of CRDM Housings
URI 05000255/2012012-03	URI	Potential Failure to Prevent Recurrence of a Significant Condition Adverse to Quality

Closed

None.

LIST OF DOCUMENTS REVIEWED

Condition Reports	Title	Date/Revision No.
CR-PLP-2012-05623	During the Mode 3 walkdown a steam leak was found on CRD-24	August 12, 2012
CR-PLP-2012-05163	Plant entered ONP-23.1, Primary Coolant Leak, due to slowly rising PCS Leakrate over the last several days.	July 19, 2012
CR-PLP-2012-0532	Rising Level in T-82C Safety Injection Tank	July 20, 2012
CR-PLP-2012-5875	NRC Questions Adequacy of ONP-23.1, “PCS Leak”	August 24, 2012
CR-PLP-2012-5867	NRC Questions the Appearance of Boric Acid Left Behind	August 23, 2012
CR-PLP-2012-5862	NDE Examination Did Not Follow Procedure WDI-STD-119-C	August 23, 2012
CR-PLP-2012-5864	NRC Concerned About Transducer Set Up For NDE on CRDM Housings	August 23, 2012
CR-PLP-2012-5825	Rx Head Bare Metal Evaluation	August 21, 2012
CR-PLP-2012-05992	NRC Concern Over UT Scan Coverage of EOC Housings	August 30, 2012
CR-PLP-2012-5820	Control Rod Drvie Housing CRDM 24 Replacement requires omega seal weld removal	August 21, 2012
CR-PLP-2012-3377	Volumetric Inspection of the Reactor Closure Head Nozzle Welds Requires Lifting Yokes are installed on each CRDM Support Tube.	April 29, 2012
CR-PLP-2012-4556	Difficulties were encountered when attempting to uncouple CRD-21	October 7, 2010
CR-PLP-2012-4549	Difficulties were encountered when attempting to uncouple CRD-37	October 7, 2010
CR-PLP-2010-5402	Difficulty was encountered removing the Support Tube Lift Rig Yoke attached to CRD-44	October 21, 2010

Documents	Title	Date/Revision No.
ANP-2587NP	Transgranular Stress Corrosion Cracking of Austenitic Stainless Steels in CRDM Applications	Revision 1 March 2008
DBD-2.06	Design Basis Document For Control Rod Drive System (CRD)	Revision 5
C-PAL-01-02186	Primary Coolant System Pressure Boundary Leakage CRD-21 Upper Housing Assembly	2001
	Operating Log Entries	July 10 to August 12, 2012
	Extent of Condition Recommendation	Revision 1, August 18, 2012
	Palisades CRDM #24 Housing Examination Summary	August 24, 2012
12-PAL-0151	Evaluation/Screening of Boric Acid Leakage From CRD-24, Upper Housing	August 31, 2012
EPRI NDE Report	Review of NDE of Control Rod Drive Housing Welds at Palisades	November 2001
	Dimensional Measurements of CRDM #24 Housing	August 27, 2012
	Dimensional Measurements of CRDM #24 Housing	August 28, 2012
CRD-M-13, Attachment 4	CRDM Post-Maintenance Head Map	Revision 32
	Certificate of Conformance No. 38 for CRDM Housing #24	December 9, 2001
WPS-1149-5	Ionics Incorporated FCAW Welding Procedure Specification	September 20, 2001
WPS-1149-4	Ionics Incorporated GTAW Welding Procedure Specification	August 20, 2001
WPS-1149-7	Ionics Incorporated GTAW Welding Procedure Specification	October 8, 2001
	Ionics Incorporated Liquid Penetrant Test Report for CRDM Housing #24 I.D. Weld Build Up	November 11, 2001
	Ionics Incorporated Radiographic Inspection Report for CRDM #24 Upper Housing	November 7, 2001
MMP-30, Attachment 1	Receipt Inspection Checklist for CRDM Housing #24	December 10, 2001

Documents	Title	Date/Revision No.
WDS 1149-2	Weld Control Record and NDE LOG for I.D. Weld Build-Up on CRDM #24 Housing	Revision 2
Receipt Number 00013230	Replacement CRDM Housing #24 Receipt Package	August 18, 2012
PL-904141-05	Palisades-Unit 1 CRDM Omega Seal Welding Package	Revision 2
Report No. 1R22-VT-12-157	Reactor Head Bare Metal Visual Examination Report	April 25, 2012
EC 39372	Start up Justification from CRDM-24 Forced Outage	August 27, 2012
PLP-RPT-12-00123	Examination of Cracks in CRDM Housing #24	August 27, 2012
PLP-RPT-12-00120	Evaluation of Residual Stresses in Flaw in CRD Housing Weld Overlay-Palisades Nuclear Plant	August 26, 2012
PLP-RPT-12-00121	Evaluation of Thermal Stresses at Flaw Location in CRD Upper Housing – Palisades Nuclear plant	August 26, 2012
PLP-RPT-12-0122	Palisades CRDM Upper Housing stress Corrosion Cracking Evaluation	August 26, 2012
PLP-RPT-12-00124	Critical Flaw Size	August 26, 2012
PLP-RPT-12-00125	Leakage Calculation for CRDM Housing	August 26, 2012
PLP-RPT-12-00126	Technical Justification for Start-up of Palisades Nuclear Plant as a result of Detection of Leakage in Control Rod Drive Mechanism (CRDM) Housing 24	August 27, 2012
EN-LI-100 Att. 9.1	Process Applicability Determination Form for EC 39174, Replacement of the upper Housing at Control Rod Drive 24	August 18, 2012
EA-C-PAL-01-2186-02	CRD Upper Housing and Nozzle Weld Susceptibility Comparison	October 22, 2003
EC 39174	Replacement of the Upper Housing at Control Rod Drive 24	Revision 0
WO 323898 06	CRD-24: Perform UT of CDR-24 to Determine Source of Defect	August 13, 2012
WO 323898 05	CRD 24: Perform VT/PT of CRD 24to Determine Defect	August 13, 2012
LPI Letter : A12315-LR-002	Evaluation of Thermal Stresses at Flaw Location in CRD Upper Housing – Palisades Nuclear Plant	August 24, 2012

Documents	Title	Date/Revision No.
LTR-MRCDA-12-138	Palisades CRDM Upper Housing Stress Corrosion Cracking Evaluation	August 25, 2012
ANP-2587NP	Transgranular Stress Corrosion Cracking of Austenitic Stainless Steels in CRDM Applications	Revision 1
Purchase Order G0361396	CRD Housing Assemblies	August 15, 2001
EA-EAR-2001-0426-01	CRD Upper Housing Redesign	Revision 2
EA-EAR-2001-0426-03	Addendum to the Analytical Report for CRDM Housing	Revision 2

Procedures	Title	Date/Revision No.
CEP-NDE-0955	Visual Examination (VE) of Bare-Metal Surfaces	Revision 303
EN-AD-102	Procedure Adherence and Level of Use	Revision 7
EN-LI-118	Root Cause Evaluation Process	Revision 17
EN-LI-118-01	Event & Causal Factor Charting	Revision 0
EN-LI-118-02	Change Analysis	Revision 0
EN-LI-118-03	Barrier Analysis	Revision 0
EN-LI-118-04	Task Analysis	Revision 0
EN-LI-118-05	Fault Tree Analysis	Revision 0
EN-LI-118-06	Common Cause Analysis	Revision 1
EN-LI-118-07	Behavioral Analysis	Revision 0
EN-LI-118-08	Failure Modes Analysis	Revision 0
EN-OP-104	Operability Determination Process	Revision 6
EN-DC-319	Inspection and Evaluation of Boric Acid Leaks	Revision 8
CEP-NDE-0901	VT-1 Examination	Revision 4
EM-09-14	VT-2 Examinations	Revision 8
CEP-NDE-0640	Non-Section XI Liquid Penetrant Examination (PT)	Revision 9
CEP-NDE-0641	Liquid Penetrant Examination (PT) for ASME Section XI	Revision 7
WDI-STD-119-C	Generic Procedure for Ultrasonic Examination of Piping Welds Using the Intraspect Automated Imaging System	Revision 0
RO-19	Control Rod Position Verification	Revision 24

LIST OF ACRONYMS USED

ADAMS	Agencywide Document Access Management System
ASME	American Society of Mechanical Engineers
BMV	Bare Metal Visual Examination
CFR	Code of Federal Regulations
CRDM	Control Rod Drive Mechanism
EC	Engineering Change
GPM	Gallons per Minute
IMC	Inspection Manual Chapter
IP	Inspection Procedure
IR	Inspection Report
NDE	Non-Destructive Examination
NRC	U.S. Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation
ROP	Reactor Oversight Process RS Reactor Safety SBO Station Blackout
SCAQ	Significant Condition Adverse to Quality
SIT	Special Inspection Team
TGSCC	Transgranular Stress Corrosion Cracking
TS	Technical Specification
URI	Unresolved Item
UT	Ultra-sonic Testing

August 15, 2011

MEMORANDUM TO: Charles J. Phillips, Senior Resident Inspector
Dresden Nuclear Power Station
Division of Reactor Projects, Branch 6

FROM: Gary L. Shear, Acting Director ***/RA/***
Division of Reactor Projects

SUBJECT: SPECIAL INSPECTION CHARTER FOR PALISADES NUCLEAR PLANT LEAK FROM CONTROL ROD DRIVE HOUSING 24

On August 12, 2012, Palisades operators completed a controlled reactor shutdown to hot shutdown to investigate the source of elevated Primary Coolant System (PCS) unidentified leakage. At the point of the shutdown, unidentified leakage was approximately 0.3 gallons per minute (gpm) and had been gradually increasing.

Following a containment entry, the leakage was identified as a steam leak on Control Rod Drive Mechanism (CRDM) 24 housing, which was determined to be pressure boundary leakage. The plant was subsequently taken to cold shutdown to further evaluate CRDM-24. The licensee is currently investigating the cause of the leak and evaluating what repairs need to be completed prior to restarting the unit.

Based on the deterministic and risk-based criteria in Management Directive 8.3, a Special Inspection at Palisades will commence August 15, 2012. The Special Inspection Team, which is being led by you, will include Elba Sanchez-Santiago and Atif Shaikh. Other members may be assigned if specific needs are identified.

The special inspection will evaluate the facts, circumstances, and the licensee's actions surrounding this issue. The Special Inspection Charter for you and your team is enclosed.

Enclosure: As Stated

DISTRIBUTION
See next page

CONTACT:
John Giessner
630-829-9619

Attachment 2

Memo to C. Phillips from G. Shear dated August 15, 2012.

SUBJECT: SPECIAL INSPECTION CHARTER FOR PALISADES NUCLEAR PLANT LEAK FROM CONTROL ROD DRIVE HOUSING 24

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PALISADES SPECIAL INSPECTION CHARTER

This Special Inspection Team is chartered to assess the circumstances surrounding the pressure boundary leakage from control rod drive housing mechanism Number 24. The special Inspection will be conducted in accordance with Inspection Procedure 93812, "Special Inspection." The special inspection will include, but not be limited to, the items listed below. This charter may be revised based on the results and findings of the inspection.

1. Establish a historical sequence of events related to leak recognition, leakage trend/rate and subsequent plant shutdown. Review related licensee actions with respect to monitoring of plant conditions and decision making.

2. Evaluate if the licensee missed prior opportunities to have identified this leak at an earlier point in time (e.g. ASME Code pressure test post refueling outage VT-2 examination or during the more recent forced outage).

3. Review the licensee's reportability requirements to confirm necessary notifications were made per 10 CFR 50.72 and possible Emergency Action Levels.

4. Review the licensee's extent of condition evaluation and related activities including underlying non-destructive examinations, initial/apparent cause determination, analytical calculations and rationale, and relevant plant specific and industry operating experience, to determine if the repair scope is adequate.

5. Review the repair activities including human performance, repair method, and post-maintenance/modification testing plan to ensure that applicable plant procedures, plant instructions, Code, and other requirements are followed.

6. Review licensee's evaluation that assessed for potential degradation/wastage on the reactor vessel head from the leak to verify adequacy of corrective actions.

7. Review repair activities and causal analysis completed for similar event in 2001 to verify that designated corrective actions were completed as prescribed and the causal analysis was adequate.

8. Review the licensee's root cause evaluation plan and schedule. Evaluate whether the root cause evaluation plan is of sufficient depth and breadth. Confirm that the time allowed to perform the evaluation is commensurate with the safety significance of this issue. Communicate to the licensee that the NRC will inspect the completed root cause evaluation and the associated corrective actions during follow-up inspection activities.

9. Evaluate circumstances surrounding the leak for potential generic issues.

<u>Additional Inspection Requirements</u>

1. Determine if there are any lessons learned from this Special Inspection.

Charter Approval

/RA/ 8/15/12 J. Giessner, Chief, Branch 4, Division of Reactor Projects

/RA/ 8/15/12 G. Shear, Acting Director, Division of Reactor Projects

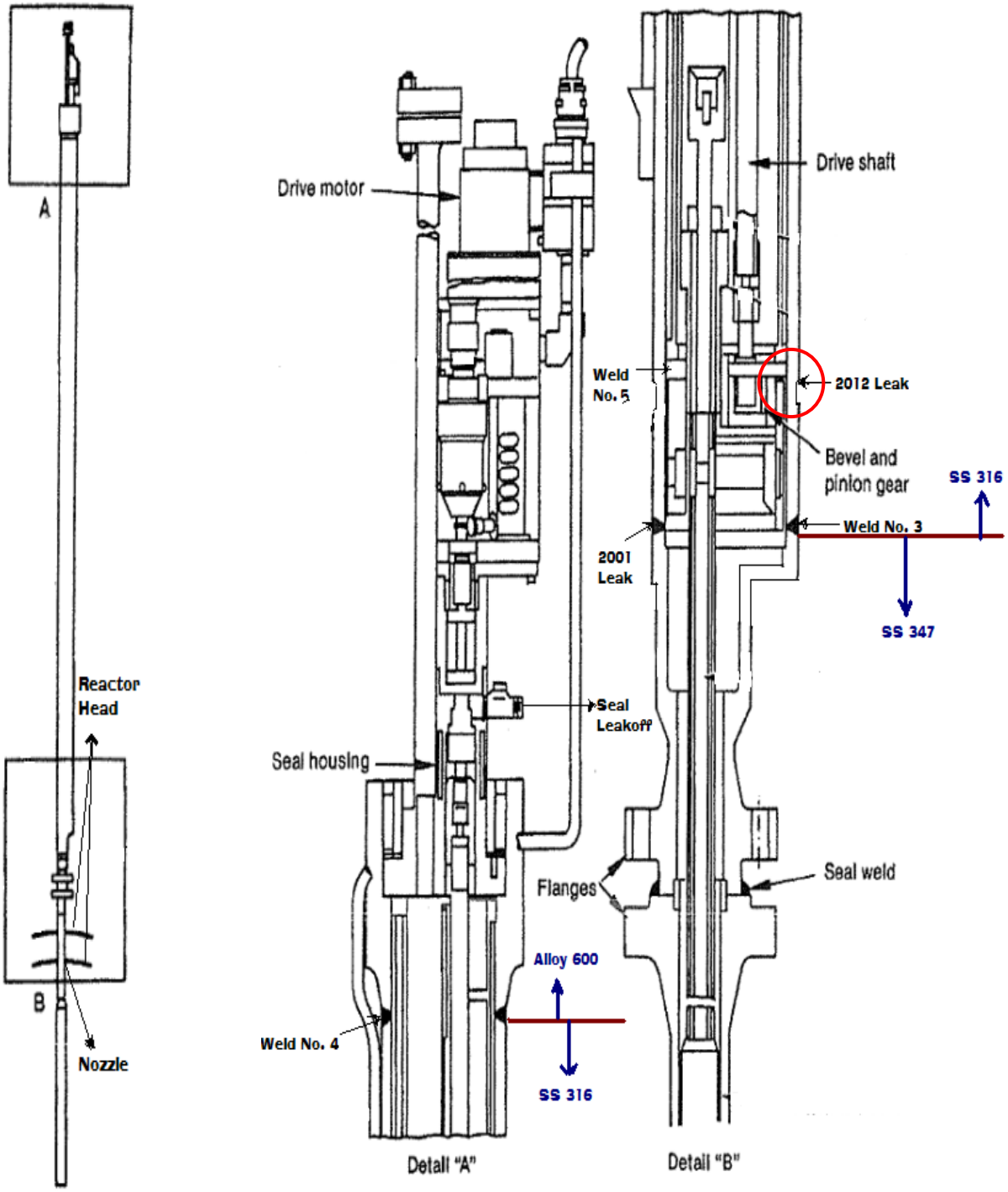
Attachment 2

Palisades Control Rod Drive Mechanism Housing Through Wall Crack

June 21, 2001	A pressure boundary leak was identified in the upper housing assembly for CRD-21. The cracking was limited to Weld No. 3 which is the junction between the lower flange and the CRDM nozzle. Indications from Non-destructive testing (NDE) of the remaining 44 CRDMs showed similar flaws in the vicinity of Weld No.3. All of the CRDMs were replaced. This event was reviewed by the inspectors to determine if the root cause of the event was properly identified and the corrective actions were adequate to prevent recurrence and were completed.
July 10, 2012	Reactor Start up from previous forced outage. A leak rate of .203 gallons per minute (gpm) was recorded in the shift log. There was no discussion on entry into either procedure ONP-23.1, "Primary Coolant Leak," Revision 25 or Admin 4.19, "PCS [primary coolant system] Leak Rate Monitoring Program," Revision 3. Slightly higher leak rates immediately after reactor startup is a known occurrence.
July 14, 2012	The unidentified PCS leakage rate was measured at .156 gpm. This exceeded administrative leak rate identified in DWO-1,"Operator's Daily/Weekly Items Modes 1, 2, 3, and 4." Procedure DWO-1 stated that for leakage rates in excess of .15 gpm then **Refer To** ONP-23.1,"Primary Coolant Leak." The logs stated that shift personnel determined that entry into ONP-23-1 was not required but there was no statement why.
July 16, 2012	The unidentified PCS leakage rate exceeded the NRC Inspection Manual Chapter (IMC) 2515, Appendix D, three sigma leakage level. The Resident Inspectors took the actions associated with IMC 2515, Appendix D, Action Level III for unidentified leakage.
July 17, 2012	The unidentified PCS leakage rate was measured at .160 gpm at 1:43 a.m. The July 15 and 16 unidentified PCS leakage rate measurements were below .150 gpm. The operating logs again stated that based on the amount of leakage that it was decided by the shift not to enter ONP-23.1. The logs stated that the ONP actions directed for identifying the source of the leakage were being performed under guidance from Admin 4.19. A confirmatory leak rate was taken at 2:48 p.m. which measured .176 gpm of unidentified leakage.
July 19, 2012	The unidentified PCS leakage rate was measured at .247 gpm at 12:53 a.m. The licensee entered ONP-23.1 at 7:23 a.m. The Licensee generated standing orders that stated: "Remain in ONP-23.1, Primary Coolant Leak and perform a DWO-1, 3 hour leakrate shiftly (preferably with no dilutions performed during the leakrate). If ULR [unidentified leakage rate] exceeds .3 gpm then notify the DSM [Duty Station Manager] and AOM [Assistant Operations Manager]-Shift and ensure a confirmatory leakrate is performed. Commence a GOP-8 shutdown (within 2 hours) if a leakrate and the associated confirmatory leakrate exceed .5 gpm."

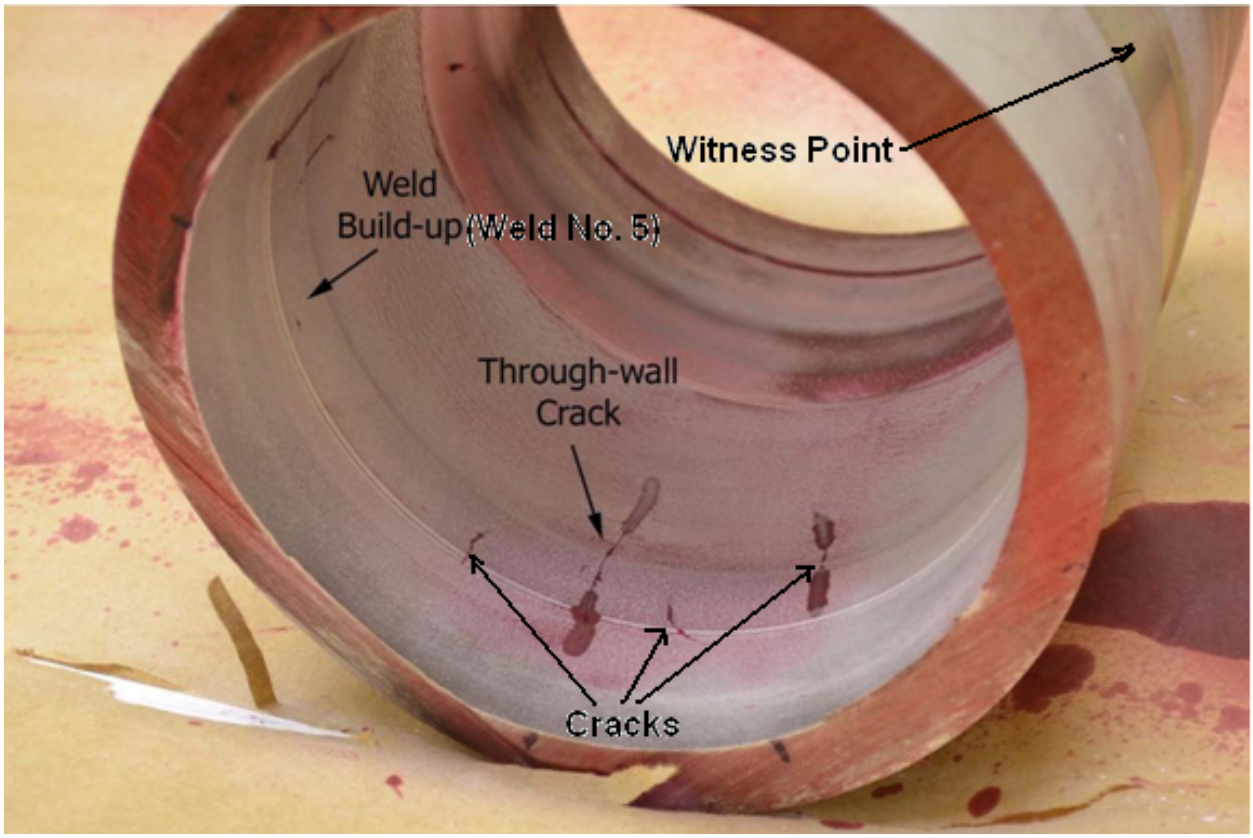
July 20, 2012	The licensee approved an Operational Decision-Making Issue (ODMI) for Unidentified PCS Leakage in Containment which laid out the increased frequency of leak checks and limits and action points on unidentified leakage.
July 23, 2012	Licensee management determined that there was clearly a PCS leak. The licensee commenced containment walkdowns. However, the reactor head could not be observed with the reactor operating. The only areas left to inspect were the reactor head and reactor coolant pump area.
August 1, 2012	Unidentified leakage measured at .383 gpm exceeded the first action point in ODMI (.35 gpm) but the confirmatory leak rate did not.
August 9, 2012	Unidentified leakage began to consistently exceed .30 gpm. The licensee made the decision to shut down the reactor on August 11, 2012.
August 11, 2012	Reactor shutdown commenced at 11:22 p.m.
August 12, 2012	The licensee performed an inspection of the reactor head and identified that the CRDM-24 housing was leaking.

Palisades Rack and Pinion CRDM



Attachment 4

Results of Dye Penetrant Test



Attachment 5

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 and from the Publicly Available Records (PARS) component of NRC's document system, Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Website at http://www.nrc.qov/readinq-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA by Gary L. Shear for/

Steven West, Director
Division of Reactor Projects

Docket No. 50-255
License No. DPR-20

Enclosure: Inspection Report 05000255/2012012;
w/Attachments:
1. Supplemental Information
2. Memo to Phillips
3. Palisades Timeline
4. Palisades Rack and Pinion CRDM
5. Results of Dye Penetrant Test

cc w/encl: Distribution via ListServ

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DATE	10/11/12		10/15/12		10/17/12			

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Letter to A. Vitale from S. West dated October 17, 2012.

SUBJECT: PALISADES NUCLEAR PLANT - NRC SPECIAL INSPECTION TEAM (SIT) REPORT 05000255/2012012

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