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

February 21, 2013

LICENSEE: Entergy Nuclear Operations, Inc.

FACILITY: Palisades Nuclear Plant

SUBJECT: SUMMARY OF THE FEBRUARY 14, 2013, MEETING REGARDING PALISADES NUCLEAR PLANT COMPONENT COOLING WATER HEAT EXCHANGER LEAK

On February 14, 2013, at 10:30 p.m. EST, the U.S. Nuclear Regulatory Commission (NRC) held a Conference Call Meeting with members of the Palisades management team at the NRC's request. The discussion was related to the operability of the component cooling water (CCW) system based on leakage that was possibly the result of a damaged tube in the 'A' CCW heat exchanger. The conference call was held after the licensee's investigation discovered the source of the leak to be the 'A' CCW heat exchanger based on indications of lowering CCW surge tank level, in addition to the presence of the red dye tracer (used for troubleshooting the leak which was placed on the CCW side of the heat exchanger) on the service water side of the heat exchanger.

The licensee stated that the leak rate from the CCW system was approximately 30 gallons per hour (gph) and appeared to be stable. The purpose of the 'A' CCW heat exchanger was to cool the CCW on the shell side using service water on the tube side. Component Cooling Water was leaking into the service water and the leak was well within the capacity of the make-up system. Service water was valved in to both the CCW heat exchangers and CCW was flowing through both the heat exchangers. Technical Specification 3.7.7 Condition A (72 hour Limiting Condition of Operation (LCO)) was entered for one train of CCW being inoperable. The licensee determined that they have 100 percent post-accident cooling capability with the leak in the CCW system which allowed them to remain in Technical Specification 3.7.7. Condition A. The plant was at 100 percent power with no other known issues at that time.

The NRC asked if the licensee believed the leak to be a through wall leak. The licensee confirmed that there was no evidence of leakage outside the heat exchanger and the leak was in the interface between the service water and CCW. The leak was not isolated. When the NRC asked the licensee if the basis for operability was the availability of 100 percent post-accident cooling and make-up capability, the licensee said it was. The licensee added that the CCW system is designed as a closed system and the make-up system is a non-safety system.

The NRC asked the licensee to describe the basis for identifying the 'A' CCW heat-exchanger as the source of the leak. The licensee stated that they introduced a red dye into the CCW system and closed a manual isolation valve to isolate the temperature control valve on the 'A' CCW heat exchanger maintaining the heat exchanger operable at that time. The red dye appeared at the outlet of the vents related to the service water which led them to believe the leak existed in the 'A' CCW heat exchanger.

When the NRC asked the licensee for a timeline of the leak, the licensee stated the leak in the CCW system started approximately 2 weeks ago with a rate of about 2-5 [gallons per day (gpd)]. A week ago, the licensee believed they identified the source of the leak as the 'A' Radwaste Evaporator. They isolated the Radwaste Evaporator and observed that CCW surge tank level ceased lowering. However, 2 days later, the leak resumed at approximately 2-5 gph and the licensee continued their troubleshooting activities. The leak increased slowly to the current rate of 30 gph. The NRC asked if the licensee was suggesting that the leak was growing or that more than one leak existed. The licensee responded they had no evidence that suggested the existence of more than one leak.

The licensee described that the 'A' CCW heat exchanger consisted of 2021 tubes of 5/8 inch outside diameter thickness made of original Admiralty brass material. 111 tubes were plugged in the 'A' CCW heat exchanger when it was last inspected during 2007. 101 tubes were plugged in the 'B' CCW heat exchanger during its last inspection in 2009. The licensee mentioned they cover 39 percent of tubes using eddy current tests during each inspection. They typically observed flow induced vibration, very slight wall thinning, and very few cases of pitting on the internal diameter of the tubes due to service water. Additionally, they observed wear near the baffle plates on the CCW side. The NRC asked the licensee if they observed any similar leaks in the past. The licensee stated their records indicated possible through wall leaks in the early 1990s due to flow induced vibration. The licensee mentioned that there were some earlier occurrences of these leaks where most of the wear was observed on the shell inlet and shell outlet sides of the heat exchanger.

The licensee calculated the unobstructed flow from a sheared tube to be 50 gallons per minute (gpm) at the location of the shear. The current leak rate of 30 gph was significantly lower relative to the leak rate of a sheared tube. The NRC asked if there was any basis for the current leak rate of 30 gph to remain stable. The licensee responded that they did not have enough data to answer the NRC's question at this time. They said they were currently reviewing flow induced vibration as a degradation mechanism based on past eddy current inspection data available. Based on trend data, the licensee concluded the wear rates in the tubes did not support a very fast degradation mechanism. The NRC asked if they would expect the leak rate to continue increasing as the wear/operations continue. The licensee responded that they were still in the process of determining if the leak rate would continue to increase.

The NRC questioned if the licensee did not isolate the leak, would this render the CCW system inoperable. However, in order to conduct repairs, the licensee will have to isolate CCW to the 'A' CCW heat exchanger which would in turn render the CCW system inoperable (100 percent post-accident cooling would not be available), thereby requiring the licensee to shut down the plant per Technical Specification requirements. The licensee said they were reviewing a calculation given the current leak rate to determine the flaw size from Bernoulli's equation. The NRC noted that because they are unable to visually discern the condition of the tube, they would have to reasonably assume that if another event (such as a Loss of Offsite Power or Loss of Coolant Accident) were to occur, the heat exchanger tube could further degrade and the CCW system must mitigate the design basis events. The NRC also mentioned that, for such an event, where all the CCW and service water pumps start and all CCW heat exchangers are placed in service, the transient could cause the flaw to propagate; and that will need to be evaluated.

The NRC also said it is concerned that the CCW system is not designed to have make-up capability and the licensee may need to credit operator action for system operability, since the licensee is leaving the CCW heat exchanger in service without reasonable predictability of flaw propagation. The NRC emphasized that in the event of a design basis accident requiring CCW mitigation, the flaw could change unpredictably (on the order of gpm) which would challenge the make-up capability, and hence, the operability of the CCW system. Also, the NRC asked why the licensee was delaying plant shutdown when they were aware that the CCW heat exchanger cannot be repaired in the 72 hour LCO timeframe. The licensee said that they would like to have the ability to perform just-in-time training, staff the operations crews, and provide proper oversight for a planned shutdown. They added that the engineering department was researching any potential success paths that might be available to them. The licensee stated that they are developing an operability evaluation and that their intent is not to operate for full 72 hours before shutting down the plant. The NRC mentioned that with the potential change of leak rate that could occur, it would not normally credit compensatory operator actions during short periods of time without a formal 10 Code of Federal Regulations (CFR), Part 50.59 review, and possible NRC approval. Therefore, the licensee will either have to conclude that the leak rate will not get worse or credit the appropriate operator actions. The NRC stated that both the options needed to be reviewed since the licensee was considering an engineering evaluation as a solution in the respective 72 hour LCO time window.

When the NRC asked the licensee for the CCW heat exchanger tube plugging criteria, the licensee said they plug tubes when wall thinning exceeds 70 percent of the wall thickness. They trended wall loss based on 9 percent wall thickness increments. The licensee said that they had a very small number of tubes in the 'B' CCW heat exchanger with small amount of wall loss. In 2009, 8 tubes exhibited 40-49 percent wall loss and 2 tubes exhibited 50-59 percent wall loss. Of the 184 tubes inspected in the 'A' CCW heat exchanger in 2007, 6 tubes exhibited 20-29 percent wall loss, 3 tubes exhibited 30-39 percent wall loss and one tube exhibited 60-69 percent wall loss (this tube was plugged). The NRC asked, if one tube was severed or failed completely, in the worst case scenario, if it would impact the other tubes in the heat exchanger. The licensee replied if a full sever of the tube was assumed, it would probably come to rest against another tube. The licensee stated that, in 2007, they randomly sampled tubes in the center section of the 'A' CCW heat exchanger and discovered no discernible wear rates from flow induced vibration or pitting.

The NRC asked if the licensee had conducted an operating experience search to identify any other nuclear plants, or their site, which experienced a complete tube failure in a service water or CCW heat exchanger resulting in a large leak (in the order of several gpm). The licensee replied they had conducted an operating experience search on the Institute of Nuclear Power Operations website and, although they were not searching for that specific topic, they did not note any cases where a tube rupture resulted in the heat exchanger for the information they looked at. They read several operating experience reports related to CCW heat exchangers and said that they did not come across any cases that resulted in a large leak rate. The NRC asked the licensee to provide a synopsis of the plant's response if the tube were to fail completely. The licensee said that tube failure would result in a 50 gpm leak rate. In this case, they would shut down the plant with no further issues since the make-up supply would be in excess of the leakage. They added that both the CCW heat exchangers would perform their required function. The licensee said that the automatic make-up capability is powered from non-safety related equipment with one power supply from offsite power and the other power supply from the safety-related 'C' bus (left train power) which is powered by an emergency safety-related diesel generator. However, the 135 gpm capacity make-up pumps themselves are not safety related.

The NRC asked if the licensee had completed an operability evaluation for the 'A' CCW heat exchanger to review if the heat exchanger can perform its function with the existing leak. The licensee stated that they declared the heat exchanger inoperable, and an operability evaluation was in progress and would be complete within the next day. They said the operability evaluation may conclude the 'A' CCW heat exchanger was operable [degraded] with additional compensatory measures and a temporary modification for make-up fill capability. The temporary modification would establish a source of fire protection water from the 649 elevation to the surge tank with a two valve manipulation. This set up would enable the diesel driven fire pump to be used as an emergency source of water. The licensee responded that the operators would be able to establish these compensatory measures within several minutes in the worst case scenario of a 50 gpm tube leak. The NRC added that the flaw is an existing condition and that the licensee will still have to assume design basis events. The licensee stated that, in the event of a Loss of Offsite Power, the 'C' bus and the 1-1 emergency diesel generator would power the make-up pump and fill the CCW surge tank automatically without any operator actions. The site noted a single failure would not be required to be assumed since the site was in a LCO action at the time.

The NRC asked if the licensee had reviewed the Updated Final Safety Analysis Report, Chapter 14, for an event or analyzed accident which could create a containment bypass pathway resulting in a CCW leak to the environment via service water in the event of a CCW system breach. The licensee stated that, if such a condition were to occur, they will enter Off Normal Procedure, ONP 23.1, for a primary coolant system leak which would be evidenced by the radiation monitors and will take actions to address the leak as directed by the procedure.

The NRC summarized their concerns and their actions:

- The site needs to promptly complete the operability evaluation. The NRC stated that the licensee should review Part 9900: Technical Guidance: Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety, operating experience section for through-wall leaks on page [C-12]: "To be readily apparent [in order to support a determination of operability], the degradation mechanism must be discernible from a visual inspection or substantial operating experience must exist with the degradation mechanism on the system at the facility." This item needs to be addressed by the licensee to determine if they can develop an engineering solution for considering the 'A' CCW heat exchanger operable. The NRC strongly encouraged the licensee to review operating experience to determine if they could meet the burden in Part 9900.

- Additionally, page [C-13] of Part 9900 states licensees may allow continued temporary service for operable but degraded Class 2 or 3 piping systems. This seems to imply the need to remove from service Class 2 and Class 3 equipment with through wall leaks that are inoperable. The leaking component is currently still in service with the component being declared inoperable. The NRC agreed to follow up on this issue to see if a requirement exists, and noted the site should evaluate the operability of the entire CCW system with the system not isolated from the leak.

- Also, the NRC assessed that the plant's licensing basis did not allow crediting non-safety related pumps (even if they are powered from safety related buses) during design basis accidents. In addition, the NRC encouraged the licensee to review the guidance for crediting response time for operators as a compensatory action since the system was not designed to have manual operator actions for makeup fill capability; specifically, ANSI 58.8, "Time Response Design Criteria for Safety-Related Operator Actions," and Information Notice 97-78, "Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times." The NRC is concerned that the leak in the 'A' CCW heat exchanger may worsen. The NRC said that it was encouraged by the fact that the licensee had established a shutdown limit at a leak rate of 100 gph.

- The licensee asked for clarification on which operability determination needs to be done promptly since the 'A' CCW heat exchanger was already inoperable. The NRC stated that the licensee still needed an operability evaluation for the CCW system to show that the CCW system can perform its safety function with the existing tube leak while the 'A' CCW heat exchanger was in service, although declared inoperable.

The NRC concluded the conference by suggesting all parties reconvene the following day before noon to discuss these issues.

The call lasted about an hour and a half. The enclosure is a list of attendees for the meeting.

Sincerely,

/RA/

John B. Giessner, Chief
Branch 4
Division of Reactor Projects

Docket Nos. 50-255 and 72-007
License No. DPR-20

Enclosure: List of Meeting Attendees for the February 14, 2013, Conference Meeting

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LIST OF MEETING ATTENDEES FOR THE FEBRUARY 14, 2013 CONFERENCE MEETING

NRC Attendees

John Giessner, Chief, Division of Reactor Projects, Branch 4
David Hills, Chief, Division of Reactor Safety, Engineering Branch 1
Mel Holmberg, Senior Reactor Inspector, Division of Reactor Safety, Engineering Branch 1
Thomas Taylor, Palisades Senior Resident Inspector
David Alley, Senior Materials Engineer, Nuclear Reactor Regulation, Piping and NDE Branch
Swetha Shah, Reactor Engineer, Division of Reactor Projects, Branch 4
Diana Betancourt, Reactor Engineer, Division of Reactor Projects, Branch 4
Mahesh Chawla, Nuclear Reactor Regulation, Division of Operating Reactor Licensing, Branch III-1
Gerald Waig, Senior Reactor Systems Engineer, Nuclear Reactor Regulation, Technical Specification Branch

Licensee Attendees

Anthony Vitale, Palisades Site Vice President
Dave Mannai, Senior Manager Nuclear Safety & Licensing Entergy Northeast
Barry Davis, Palisades Engineering Director
Darrell Corbin, Operations Manager
Otto Gustafson, Licensing Manager
Todd Mulford, Assistant Ops Manager – Shift
Tom Fouty, Engineering Supervisor, Mechanical Systems
Jake Milliken, Engineering Supervisor, Code Programs

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Letter to Entergy Nuclear Operations, Inc. from J. Giessner dated February 21, 2013.

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