U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-255/88004(DRS)

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

License: Consumers Power Company
212 West Michigan Avenue
Jackson, MI 49201

Facility Name: Palisades Nuclear Generating Plant

Inspection At: Palisades site, Covert, MI

Inspection Conducted: January 5-7, 12-14, 21, 22, 1988

Inspector: J. F. Schapker 2/4/88
Date

Approved By: D. H. Danielson, Chief 2/4/88
Materials and Processes Section
Date

Inspection Summary

Inspection on January 5-7, 12-14, 21, 22, 1988 (Report No. 50-255/88004(DRS))
Areas Inspected: Unannounced safety inspection of licensee actions in response to IE Bulletins (92703); review of inservice inspection (ISI) program (73051) and procedures (73052); observations of ISI work and work activities (73753); ISI data review and evaluation (73755); and of the Steam Generator Sludge lancing (73051, 73052, 73753).
Results: No violations or deviations were identified. The activities inspected appeared to meet the safety objectives of the applicable regulatory requirements.

Details

1. Persons Contacted

Consumers Power Company (CPCo)

*D. P. Hoffman, Plant General Manager
J. G. Lewis, Technical Director
*C. S. Kozup, Technical Engineer
*R. P. Margol, QA Administrator
*B. V. VonWagner, Inservice Inspection (ISI) Supervisor
*K. V. Cedarquist, ISI Engineer
*K. E. Osborne, Projects Superintendent
*M. C. Sniqowski, Steam Generator Outage Manager
*R. D. Orosz, Engineering and Maintenance Manager
S. R. Willman, NDT Project Supervisor
R. M. Rice, Operations Manager
T. D. Fouty, ISI Engineer
G. Y. Yeisley, QA Engineer

Allen Nuclear Associates, Inc. (ANA)

B. L. Curtis, President, Level III ET

U.S. Nuclear Regulatory Commission (NRC)

E. R. Swanson, Senior Resident Inspector
C. D. Anderson, Resident Inspector
N. R. Williamsen, Reactor Inspector

Other members of the plant staff and contractors were also contacted.

* Denotes those present at the exit interview.

2. Licensee Action Taken on Bulletins

(Open) Bulletin No. 87-01 Thinning of Pipe Walls in Nuclear Power Plants. The purpose of this bulletin is to request that licensees submit information concerning their programs for monitoring the thickness of pipe walls in high-energy single phase and two-phase carbon steel piping systems.

Background

On December 9, 1986, Unit 2 at the Surry Power Station experienced a catastrophic failure of a main feedwater pipe, which resulted in fatal injuries to four workers. Investigations of the accident and examination of data by the licensee, NRC, and others led to the conclusion that failure of the piping was caused by erosion/corrosion of the carbon steel pipe wall.

Main feedwater systems, as well as other power conversion systems, are important to safe operation. Failures of active components in these systems, for example, valves or pumps, or of passive components such as piping, can result in undesirable challenges to plant safety systems required for safe shutdown and accident mitigation. Failure of high-energy piping, such as feedwater system piping, can result in complex challenges to operating staff and the plant because of potential systems interactions of high-energy steam and water with other systems, such as electrical distribution, fire protection, and security systems. All licensees have either explicitly or implicitly committed to maintain the functional capability of high-energy piping systems that are a part of the licensing basis for the facility. An important part of this commitment is that piping will be maintained within allowable thickness values.

Licensee action: The licensee's program for inspection of pipe wall thinning was initiated in the 1983-1984 refueling outage due to a Westinghouse Electric Corporation memo recommending an inspection of the Palisades turbine crossunder piping for wear resulting from steam erosion. The program was expanded in 1986-87 to include the following systems:

- Main Steam
- Feedwater
- Condensate
- Extraction Steam
- Auxilliary Steam
- Service Water
- Heater Drains and Vents

The program will follow the basic outline set forth by EPRI NP-3944. The inspection points are selected using maintenance history, input from other utilities and Keller's equation: $s=f(T)\cdot f(x)\cdot c\cdot Kc-Ks$.

where:

s is the maximum local depth of material loss in $mm/10^4$ hours.

$f(T)$ is a dimensionless variable denoting the influence of temperature on E/C damage.

$f(x)$ is a dimensionless variable denoting the influence of steam wetness on E/C loss. For subcooled water it has been suggested that this has a value of unity, but for two-phase mixtures it has the form $f(x) = (1-x)^{K_x}x$, where x is the steam fraction and $0<K_x<1.0$. A value of $K_x = 0.5$ is considered the most appropriate one.

K_c is a variable accounting for the effect of local geometry on the fluid flow.

c is the fluid velocity in m/s.

K_s is a threshold value constant which the product of $f(T)$, $f(x)$, c, and K_c must exceed before E/C is observed. A value of 1.0 $mm/10^4$ hours has been given by Keller.

This initial inspection utilizing the above guidelines was completed January 16, 1987. The following areas were inspected:

- High pressure turbine main steam supplies.
- Turbine cross over piping.
- Extraction steam lines.
- Feedwater pump turbine inlets.
- Feedwater pump inlets.
- Heater drain pumps inlet and discharge.
- Feedwater heater drain lines.
- Air ejector piping.
- Service water piping (for sand abrasion).

The result of the inspections revealed no degradation below minimum wall. Minimum wall was calculated utilizing ANSI B31.1, 1973 Edition, Section 104.

The NRC inspector reviewed the secondary side ISI program specification for the current outage, applicable procedures, and ultrasonic examination data. Inspection data to date has not identified erosion/corrosion which violates minimum wall thickness. However, substantial erosion/corrosion was exhibited in localized areas. The licensee elected to repair these areas. A trending program for erosion/corrosion wear is in the process of development and will be incorporated in the secondary side inspection program.

This program area requires further review as the inspection and trending program are newly instituted and insufficient data has been gathered to conclude the pipe wall thinning inspection program is adequate.

3. Inservice Inspection (ISI) Program Review (73051)

The NRC inspector reviewed the second ten year ISI Plan for the Palisades plant. The ISI plan conforms to the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section XI, 1977 Edition through the Summer 1978 Addenda. Relief requests in accordance with 10CFR 50.55a (g)(5)(iv) were reviewed. The licensee only performed ISI for Class 1 components on steam generator tubes for this outage. The remainder of the ISI will be performed in the Fall '88 scheduled maintenance outage.

The Program reviewed is effective with respect to meeting the safety objectives of the ASME Section XI requirements.

4. Steam Generator Eddy Current Examination

As a result of a steam generator (SG) tube leak indication, the Palisades Plant was shutdown on December 4, 1987. Eddy current examination (ET) which was planned for the 1988 fall outage was performed during this forced outage due to the SG tube leak indication.

The NRC inspector verified that the ET was performed in Accordance with the augmented ISI program for steam generators as specified in the Palisades Technical Specification (TS). A relief request was made by the licensee concerning the ET of previously installed sleeves. (Technical Specification 4.14.5), due to high radiation exposure times to perform the examination, and that the previous ET of sleeves had shown no degradation. The relief request was not formally approved at this date; however, verbal approval had been granted by NRR. The NRC inspector informed the licensee that the exclusion of the ET of installed sleeves would be identified as an open item pending official approval of the relief request by the NRC (255/88004-01(DRS)).

The NRC inspector reviewed ET tapes of examinations performed during the 1983 and the current outage, including the leaking SG tube. The ET of the leaking tube revealed a circumferential 90° thru wall indication, whereas the previous examination of this tube (1983 outage) did not reveal this indication. The leaking SG tube was located in Row 122, Line 35, at the lower edge (both inside and outside) of the No. 13 tube support plate of SG "B".

As required by the Palisades Technical Specification, ET inspection of all unplugged tubes with ET indications of greater than or equal to 30% in either of the previous two inspections was performed. In addition, a random sample of 2% of the tubes in the hot leg and 1% of the tubes in the cold leg of each SG was performed. One crack-like indication was observed in the "B" cold leg random sample. Consequently, a 6% supplementary sample was performed as required. The licensee also elected to inspect an additional 12% sample in the "B" SG, together with 40 tubes in the vicinity of the leaker. The licensee utilized two ET procedures for these examinations - NDT-ET-07, Revision 4, "Circumferentially Wound Bobbin Type probe (540SFW) Differential Coil, Multifrequency, Multiparameter", and NDT-ET-08, Revision 4, "Pancake Probe, (4C4F) Differential, Multicoil, Multifrequency, Multiparameter."

The 540SFW "Bobbin" examination is required by TS and is sensitive to tube degradation associated with wastage and pitting. The 4C4F "Pancake" examination which is not required by TS is utilized to detect intergranular corrosion and circumferential cracking.

The licensee utilized a motorized rotating pancake coil (MRPC) to examine locations where 4C4F signals were indeterminate as to flaw condition. The results of these examinations confirmed that the defects detected in this outage are of the same size or smaller than those observed in 1983. The MRPC is not a "pull through" technique, but a special tool to examine selected areas of interest. The equipment used during this inspection was identical to that used during the 1985 inspection, except for the MRPC probe and its signal analysis by a Zetec MIZ-18 analyzer. As in the previous two inspections, the 540 SFW probe was employed to detect and size "wastage" type defects. The 4C4F probe was used to detect and size circumferentially oriented defects, including volumetric IGC and cracking. The Zetec MIZ-12 signal analyzer was used with both of these probes. The licensee is developing programs and qualifying procedures for the use of the MIZ-18 analyzer for future examinations. This system enhances the interpretation ability of the indications detected.

The results of the ET for this outage required 14 SG tubes to be plugged in "B" SG and 4 SG tubes requiring plugging in SG "A". The licensee also performed a profilometry examination to detect denting growth. This examination is also voluntary and is utilized to determine SG degradation due to denting of the SG tubes. During this examination it was discovered that SG "B" tube in Quadrant 3, Line 2, Row 121 was misplugged in 1985. Further investigation disclosed that the misplugging was due to the installation of the template, utilized for locating the correct tube for plugging, was installed in reverse. The licensee issued a deviation report and took appropriate corrective action to correct the misplugging and prevent recurrence. The NRC inspectors review and observations concluded that the licensee appeared to have satisfactorily completed all required examinations with the exception of the installed sleeves for which relief was requested. In addition, the licensee performed additional examinations to assure the cause of the tube leak was not due to a prevailing degradation of the SG tubes. Of the 18 tubes requiring plugging, 7 crack-like indications were observable in the 1983/1985 tapes. These indications were not reported as defects at that time due to small amplitude signal responses, poor signal to noise ratio inherent to the 4C4F technique, and interpreter oversight due to these conditions. With the addition of the MRPC combined with the MIZ 18 analyzer the ability to interpret and size defects will be greatly enhanced.

The ET program inspected appeared to be adequate to assure the steam generators do not exhibit degradation which would be safety significant.

5. Augmented Inservice Inspection Program For High Energy Lines Outside of Containment

This is a Technical Specification requirement which applies to welds in piping systems or portions of systems located outside of containment where protection from the consequences of postulated ruptures is not provided by a system of pipe whip restraints, jet impingement barriers, protective enclosures, and/or other measures designed specifically to cope with such ruptures.

For the Palisades Plant, the applicable welds in the main steam and main feedwater lines are located inside the Main Steam and Feedwater Penetration Rooms.

The Tech Spec requirement for examination of the specified welds requires volumetric examination of all welds in the first inspection interval at each three and a third year increment of the ten year plan. The successive inspection intervals requires volumetric examination of one third of the specified welds at the expiration of each one third of the ten year inspection interval. The welds selected during each inspection period is distributed among the total number to be examined to provide a representative sampling of the conditions of all welds. The current inspection plan is in the second ten year interval.

The NRC inspector reviewed the secondary side ISI program for the high energy lines, the ultrasonic and liquid penetrant examinations, equipment personnel certifications, applicable nondestructive examination procedures, and reviewed the radiographs performed for this inspection.

No violations or deviations were identified.

6. Steam Generator Sludge Lancing

The licensee performed their initial sludge lancing of the steam generators during this outage. Sludge lancing is the removal of undesirable deposits on the secondary side which can contribute to intergranular corrosion of the SG tubes. Eddy current examinations of the sludge pile revealed a deposit of 15 inches at the tube sheet. Combustion Engineering (CE) Services Inc. performed the sludge lancing. The sludge is removed by use of high pressure, high flow, closed loop water lancing and filtering system.

The high pressure lance is directed into the sludge pile from various angles, once dislodged and flushed to the outside of the tube bundle, the slurry is picked up by the filtering system suction lines and directed to the diatomaceous earth and particulate filters where the sludge is removed from the slurry and returned to the high pressure pump. A total of 4400 pounds of sludge was removed from the steam generators. The remaining sludge pile was reduced to approximately 2 to 3 inches in the cold leg and 5 to 7 inches in the hot leg of the S.G..

The NRC inspector reviewed the program, procedures, personnel certifications and observed the sludge lancing process.

No violations or deviations were identified.

7. Open Items

Open items are matters which have been discussed with the licensee, which will be reviewed further by the inspector, and which will involve some action on the part of the NRC or licensee or both. An open item disclosed during the inspection is discussed in Paragraph 4.

8. Exit Meeting

The inspector met with licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection on January 22, 1988. The inspector summarized the scope and findings of the inspection activities. The licensee acknowledged the inspection findings. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspectors during the inspection. The licensee did not identify any such documents/processes as proprietary.