DUKE ENERGY®

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10 CFR 50.55a

November 4, 2020
Serial: RA-20-0312

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400/Renewed License No. NPF-63

Subject: Relief Request, Service Water Pinhole Leak in a Socket Weld, Inservice Inspection Program, Fourth Ten-Year Interval

Ladies and Gentlemen:

Pursuant to 10 CFR 50.55a(z)(2), Duke Energy Progress, LLC (Duke Energy), hereby requests Nuclear Regulatory Commission (NRC) approval of the attached relief request for the Shearon Harris Nuclear Power Plant, Unit 1 (HNP). The provisions of this relief are applicable to the fourth ten-year inservice inspection interval at HNP, which commenced on September 9, 2017, and is currently scheduled to end on September 8, 2027, as identified in the Fourth Interval Inservice Inspection Plan, HNP-PM4-002 Revision 0, submitted to the NRC on October 23, 2017, per Agencywide Documents Access and Management System (ADAMS) Accession Number ML17296A323. The request is similar to a relief request previously approved by the NRC staff per ADAMS Accession No. ML110060442, “Relief Request I3R-06, Temporary Non-Code Repair of Service Water Supply System Piping.”

Approval is requested for deferral of a code repair of a through-wall leak in a line in the HNP Emergency Service Water (ESW) system. A pinhole leak has been identified in the socket weld associated with the ‘B’ Train ESW pipe 3SW1-141SB-1. The leak appears to be at the stop-start interface of the weld, which joins the 1-inch pipe to a 1-inch sockolet fitting on return header 3SW24-73SB-1 from the Component Cooling Water heat exchanger. The flaw is located in a section of piping that cannot be isolated to complete a code repair within the time period permitted by the applicable Technical Specifications (TS) Limiting Condition for Operation (LCO).

In accordance with Generic Letter (GL) 90-05, code repair of the identified flaw at this time is impractical since a plant shutdown would be required. Evaluation of the flaw in accordance with the fracture mechanics methodology provided in GL 90-05 has determined that the structural integrity of the ESW piping is maintained. Therefore, Duke Energy requests NRC approval to defer implementation of code repairs to no later than the next scheduled refueling outage, as permitted by GL 90-05.

The attached relief request addresses the present condition of the weld and implementation of the compensatory actions taken per GL 90-05. Operability and functionality of the system have been maintained and Duke Energy has concluded that deferring repair of the flaw will not affect the health and safety of the public. Since compliance with the specified Code requirements would result in unnecessary hardship without a compensating increase in the level of quality and safety, Duke Energy requests verbal approval of this relief request, pursuant to 10 CFR 50.55a(z)(2), by April 1, 2021, to support the next scheduled refueling outage.

This letter contains no new regulatory commitments. Please refer any questions regarding this submittal to Chuck Yarley, HNP Regulatory Affairs, at (984) 229-2477.

Sincerely,

John R. Dills

Enclosures:

1. Relief Request in Accordance with 10 CFR 50.55a(z)(2)
2. Generic Letter 90-05 Flaw Evaluation

cc: J. Zeiler, NRC Senior Resident Inspector, HNP
M. Mahoney, NRC Project Manager, HNP
NRC Regional Administrator, Region II

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Shearon Harris Nuclear Power Plant, Unit 1
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Service Water Pinhole Leak in a Socket Weld,
Inservice Inspection Program, Fourth Ten-Year Interval

Enclosure 1

Relief Request in Accordance with 10 CFR 50.55a(z)(2)

1. ASME Code Components Affected

Components:	Emergency Service Water (ESW) System piping line 3SW1-141SB-1
Code Class:	American Society of Mechanical Engineers (ASME) Class 3
Description:	This is a connection line for a pressure transmitter located at the outlet of the ‘B’ Component Cooling Water heat exchanger within the ESW return line.
Size:	1 Inch, Schedule 80
Nominal Outside Diameter:	1.315 inches
Nominal Wall Thickness:	0.179 inches
Material:	Carbon Steel SA-106, Grade B
Maximum Operating Temperature:	125°F
Maximum Operating Pressure:	130 psig

2. Applicable Code Edition and Addenda

The fourth inspection interval for the Shearon Harris Nuclear Power Plant, Unit 1 (HNP) began on September 9, 2017 and is scheduled to end September 8, 2027. The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI, 2007 Edition through 2008 Addenda is used for this inspection interval.

3. Applicable Code Requirements

ASME Code, Section XI, 2007 Edition through 2008 Addenda, Article IWA-4421, General Requirements, requires that defects be removed or mitigated in accordance with code requirements IWA-4340, IWA-4411, IWA-4461, or IWA-4462 (Note: Use of IWA-4340 is prohibited by 10 CFR 50.55a(b)(2)(xxv)(A).).

4. Reason for Request

On September 20, 2020, HNP personnel identified a pinhole leak (flaw) in ESW piping line 1SW1-141SB-1 during operator rounds, due to weepage coming from the flaw. The piping that contains this flaw is a connection line for a pressure transmitter located at the outlet of the ‘B’ Component Cooling Water (CCW) System heat exchanger off the ESW return line, 3SW24-73SB-1, between the return line and the associated root valve, 1SW-265. The flaw is in the welded joint at the 1 inch sockolet, attached to the ESW returned header, and appears to be at the stop-start interface of the socket weld. A drawing of the flaw location and photographs of the flaw are shown in Figures 1 and 2 of this enclosure.

Figure 1: Drawing of the Flaw Location

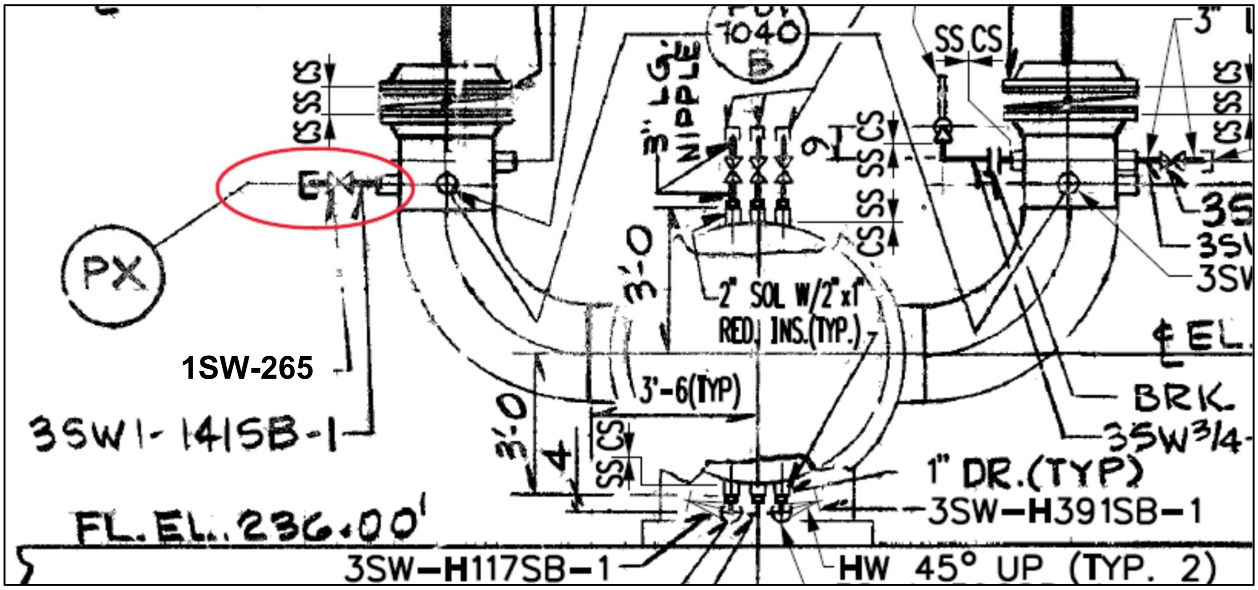

Figure 2: Photographs of the Flaw

ASME Code, Section XI, 2007 Edition requires a code repair. The ESW system removes essential plant heat loads associated with reactor auxiliary components for dissipation in the plant ultimate heat sink during emergency operation. This is a reactor safeguard system and has an associated Technical Specification (TS), TS 3/4.7.4. This TS requires two independent trains of ESW to meet the limiting condition of operation. With one train removed from service for repair, the inoperable train would need to be restored within 72 hours or the plant would have to be in hot standby in the following 6 hours.

Isolation of the affected line is not practical given the location of the line relative to the ESW return header. Repair will require removing the affected train of ESW from service for the repair duration. Consideration was given to performing a flaw evaluation per Code Case N-513-4, however, this code case excludes evaluating flaws in socket welds. Generic Letter (GL) 90-05, Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping, contains a through-wall flaw evaluation in Enclosure 1, which may be used to assess the structural integrity of Class 3 piping and does not exclude socket welds.

The flaw appears to be at the stop-start interface of the socket weld and is likely the result of a lack of fusion or other defect at this location following installation. The result would be a small crevice created between the inner diameter and outer diameter of the weld and sockolet interface, which would permit stagnant water between the outer diameter of the pipe and the inside diameter of the sockolet fitting. This defect could be a result of impurities, work practices or workmanship. This is considered an isolated incident, with no programmatic or widespread deficiencies currently identified.

An accurate measurement of the pinhole diameter could not be obtained since the size of the pinhole leak is small (less than 1/16 inch diameter). The area of the leak was observed dripping at approximately 1 drop per minute. The flaw is a small hole that most likely extends in the radial direction from the pipe to outer edge of the coupling (from where there is stagnant water between the outer diameter of the pipe and the inside diameter of the sockolet fitting). The flaw was not a result of vibration. There was no vibration detected on line 3SW1-141SB-1 during a field walkdown with the system in service. A flaw diameter of 0.100 inches was used to further evaluate the defect. Ultrasonic testing (UT) measurements indicate some wall thinning, with pipe wall thickness varying between 0.150 inch and 0.167 inches around the pipe circumference. The lowest reading obtained was 0.137 inches at the root of the socket weld. There is no evidence that the flaw extends into the base metal.

GL 90-05 states, “The staff has determined that an ASME Code repair is required for code Class 1, 2 and 3 piping unless specific written relief has been granted by the NRC. However, the staff has determined that temporary non-code repair of Class 3 piping that cannot be isolated without a plant shutdown is justified in some instances.” Guidance in GL 90-05 Enclosure 1 for assessing the acceptability of relief, based on the structural integrity of the flaw along with factors such as potential flooding, water spraying on equipment, and loss of flow for design loading conditions. Based on the difficulty of isolating the affected area of service water piping and performing a code repair within the time period permitted by the limiting condition of operability, relief is being requested from ASME Code, Section XI, 2007 Edition through 2008 Addenda, Article IWA-4421, in accordance with 10 CFR 50.55a(z)(2) to prevent an unnecessary hardship caused by requiring a unit shutdown without a compensating increase in quality and safety.

5. Proposed Alternative and Basis for Use

Proposed Alternative

As an alternative to the code repair required by IWA-4421, Duke Energy is proposing the following strategy to address the identified flaw.

Duke Energy proposes to defer the code repair of the identified flaw until the next planned outage of sufficient duration, but no later than the next refueling outage, currently scheduled to begin in April 2021. During the interim period, augmented inspections will be performed at a three-month frequency to detect changes in the condition of the identified defect. This testing will use suitable nondestructive examination methods, including UT. Additionally, a qualitative assessment of leakage will be performed at least once a week during plant walkdown inspections to determine if there is additional degradation of structural integrity.

Basis for Request

Complying with IWA-4421 requirements to remove defective portions of this piping prior to performing a repair/replacement activity represents a hardship or unusual difficulty without a compensating increase in the level of quality and safety for the following reasons:

- Removal of defective portions of this piping would require that the piping be isolated and depressurized. Based upon the locations of the closest isolation boundaries, isolation of ESW through the CCW heat exchanger would be necessary, rendering these systems inoperable.
- The current loss of flow from the ESW system is negligible compared to the total system flow. The leak rate is approximately one drop per minute at normal operating pressure with the Normal Service Water System supplying the "B" Train ESW header. The ESW system flow rate through the Component Cooling Water System is a minimum of 8,500 gallons per minute.
- Currently, there is no water spray from the pinhole leak. There is no equipment in the area that would be damaged due to spray from the leak, should spray develop. The leakage present does not present any flooding concerns in the area.
- Augmented UT was completed per GL 90-05 on five additional accessible locations deemed most susceptible to a similar flaw. No additional flaws were detected requiring characterization or evaluation.
- Generic Letter 90-05 "through-wall" flaw evaluation criteria was used to assess the structural integrity of the pipe with the flaw. This evaluation determined that crack length did not exceed either 3 inches or 15 percent of the length of the pipe circumference, calculated to be 0.62 inches. Total crack length in the socket weld was calculated to be approximately 0.1 inches. Currently, the flaw is stable and shows no signs of growth or propagation. The current stress intensity factor is below allowable limits, with a safety factor over three. Therefore, the piping associated with 3SW1-141SB-1, including the socket weld, is structurally adequate in accordance with GL 90-05 to accept as-is until the next repair opportunity.

Based on the structural integrity evaluation, the low risk of impact to nearby components, and the monitoring, Duke believes deferring the repair to the next refueling outage is acceptable.

6. Duration of Proposed Alternatives

Repair of the defect will be deferred until the next scheduled outage exceeding 30 days, but no later than the next refueling outage scheduled to begin in April 2021, provided the condition continues to meet the acceptance criteria of Generic Letter 90-05. HNP personnel are currently monitoring the leak location.

7. Related Industry Relief Requests

Similar relief requests approved by the NRC include:

1. Shearon Harris Nuclear Power Plant, Unit 1, Relief Request I3R-06, April 21, 2011, Agencywide Documents Access and Management System (ADAMS) Accession Number ML110060442

2. Millstone Power Station, Unit 3, Relief Request IR-4-03, July 16, 2020, ADAMS Accession Number ML20189A206

8. References

1. Engineering Database Entry for Item ‘3SW1-141SB-1, PX CONNEC AT CC WATER HEAT EXCH 1B-SB SW RETURN’

2. HNP Drawing CAR-2165-G-047, Flow Diagram Circulating and Service Water Systems, Sheet 1-Unit 1

3. Duke Energy Nuclear Condition Report Number 2349411, generated in Consolidated Asset Suites on September 20, 2020

4. HNP Design Basis Document, DBD-128 Revision 32, Service Water System, Traveling Screens and Screen Wash System, and Waste Processing Building Cooling Water System, dated April 23, 2019

5. Generic Letter 90-05, Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping, dated June 15, 1990

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Enclosure 2

Generic Letter 90-05 Flaw Evaluation

Description of Leak

The flaw is a small hole that most likely extends in the radial direction from the pipe to outer edge of the coupling (from where there is stagnant water between the outer diameter of the pipe and the inside diameter of the sockolet fitting). The flaw is evaluated in accordance with Generic Letter 90-05 using "through-wall" flaw evaluation approach.

Ultrasonic Testing (UT) measurements of the pipe wall thickness were obtained around the pipe at the toe of the weld with the pinhole. The pipe wall thickness varies between 0.150 inches and 0.167 inches around the pipe circumference with the lowest reading measured at 0.137 inches. Since the UT measurements indicate some wall thinning, the minimum wall thickness is also calculated. The pipe material is ASTM A106, Grade B. The allowable stress is:

$S := 15000 \cdot psi$ reference ASME Section III, Appendices

The pipe properties for 3SW1-141SB-1 (1-inch, schedule 80 pipe) are:

$D_o := 1.315 \cdot in$ $t_{nom} := 0.179 \cdot in$ Pipe Outer Diameter and Nominal Wall Thickness

$Z := 0.1606 \cdot in^3$ Section Modulus

$t_{act} := 0.137 \cdot in$ Actual measured thickness used for flaw eval which is greater than t min

$i := 2.1$ Stress Intensification Factor

$d := D_o - 2 \cdot t_{act} = 1.041 \cdot in$

$$Z_{act} := 0.0982 \cdot \frac{\left(D_o^{\,4} - d^4\right)}{D_o} = 0.136 \cdot in^3$$ Section Modulus using actual t of 0.137"

Structural Evaluation

The maximum Operating temperature is 125 deg F and the Design pressure is 150 psig.

$P := 150 \cdot psi$ Design Pressure $T := 125 \cdot deg$ Operating temperature

- **Minimum pipe wall thickness based on hoop stress due to design pressure:**

$$t_m := \frac{P \cdot D_o}{2(S + 0.4 \cdot P)} \qquad t_m = 0.0065 \cdot in$$ **(Eq. ND-3641-1)**

- **Bending moment Mi acting on pipe:**

Mi=(w*a2)/2+(Vwght)*b resultant moment calculated

Where:

$w := 2.17 \cdot \frac{lbf}{ft}$ weight of 1", sch 80, pipe

$V_{wght} := 15 \cdot lbf$ valve weight (1 lbs added for pipe cap)

$Cap := 1 \cdot lbf$ Estimated weight of pipe nipple and cap at end of valve

$a := 4 \cdot in$ pipe length (spool piece), field measured

$b := 9 \cdot in$ location of valve CG (pipe length + length of valve)

$sif := 2.1$ Stress Intensification Factor (SIF),
Reference: ANSI B31.1

$$M_i := \frac{w \cdot a^2}{2} + \left(V_{wght} + Cap\right) \cdot b = 145.4 \cdot in \cdot lbf$$

- **Longidudinal Pressure Stress due to design pressure:**

$\sigma_p := P \cdot \frac{D_o}{4 \cdot t_{act}}$ $\sigma_p = 360\,psi$

- **<u>Level A - Sustained Stress due to Pressure and Deadweight)</u>**

$M_A := M_i$ Deadweight moment $S_h := S = 15000\,psi$

$\sigma_{EQ\_8} := \sigma_p + 0.75 \cdot sif \frac{M_A}{Z_{act}} = 2049\,psi$ < Sh = 15,000 psi

- **Level B - Occasional Stresses due to Pressure, Deadweight and Seismic**

The resultant seismic (DBE) acceleration is equal to: $G_R=(Gx^2+Gy^2)^{.5}$ (Note: Z is the axial direction of the pipe which the pipe stresses are negligible). The seismic accelerations for the 1" valve, 1SW-265 are are: Gx = 0.972g, Gy = 0.824g and Gz = 0.812g.

$G_X := 0.972$ $\qquad G_Z := 0.824$

$$G_R := \left(G_X{}^2 + G_Z{}^2\right)^{.5} = 1.274$$

$$M_{BE} := M_i \cdot G_R = 185.3 \cdot in \cdot lbf$$

$$\sigma_{BE} := \frac{0.75 \cdot i\, M_{BE}}{Z_{act}} = 2152.7 \cdot psi$$

$$\sigma_{EQ\_9E} := \sigma_{EQ\_8} + \sigma_{BE} = 4202\, psi$$

< 1.2*Sh = 18000 psi (EQ 9E)
Upset allowable used for Emergency, conservative

- **Level C - Thermal Stress**

Thermal stress is zero for this segment of pipe due to the pipe and valve being a cantilever segment off of the CCW return header.

- **Minimum Required Wall Thickness due to Level A and Level B Loading**

Level A - Sustain Stress (DW + P)

$$t_{reqA} := \frac{\sigma_{EQ\_8}}{S_h} \cdot t_{nom} \qquad t_{reqA} = 0.024 \cdot in$$

< 0.137" min. inspected wall

Level B - Occasional Stress (DW + P + DBE)

Note: Allowable of 1.2*S (Upset) is used for Level B will provide conservative wall thickness

$$t_{reqB} := \frac{\sigma_{EQ\_9E}}{1.2 \cdot S_h} \cdot t_{nom} \qquad t_{reqB} = 0.042 \cdot in$$

< 0.137" min. inspected wall

GL 90-05 Through-wall Flaw Evaluation

This approach assumes a through-wall flaw and evaluates the flaw stability by a linear elastic fracture mechanics methodology. The code-required minimum wall thickness "t min" should be determined. The maximum length of the portion of the flaw that extends beyond "t min", independent of orientation with respect to the pipe, is the through-wall flaw length "2a".

Use tm = 0.007" for through-wall flaw evaluation (conservative)

$t_m := 0.007 \cdot in$ Minimum value for equations: ND-3641-1, 8 & 9

Allowable Stress Intensity Factor

$ksi := 1000psi$

The allowable stress intensity factor, K for determining the acceptability of flawed piping is:

$K_{si} := 35 \cdot ksi \cdot in^{0.5}$ CS allowable stress intensity factor for flaws, reference NRC GL 90-05

Through-Wall Flaw Evaluation

The following through wall flaw evaluation is per GL 90-05 Enclosure 1, Section C.3.a. The stress intensity factor for through-wall flaw (including safety factor of 1.4) is:

$$K = 1.4\,(s)(F)(3.1416 * a)^{0.5} \qquad (1)$$

where the geometry factor "F" is:

$$F = 1 + Ac^{1.5} + Bc^{2.5} + Cc^{3.5} \qquad (2)$$

where:

"2a" equals the flaw length, in. (reference GL 90-05)

"s" equal to the combination of deadweight, pressure, thermal, seismic stresses

R = mean pipe radius

$a := 0.05 \cdot in$

Note: The flaw length (size) is equal to (2a) or 0.100" diameter.
"a" or 0.050" is half the flaw diameter.

$R := \frac{D_o - t_m}{2}$ $R = 0.654 \cdot in$ Mean Radius

$c := \frac{a}{3.1416 \cdot R} = 0.024$ (3)

$s := \sigma_{EQ\_9E}$ $s = 4202\ psi$ From above

$r := \frac{R}{t_m}$ $r = 93.429$ (7)

$$A := -3.26543 + 1.52784\left(\frac{R}{t_m}\right) - 0.072698\left(\frac{R}{t_m}\right)^2 + 0.0016011\left(\frac{R}{t_m}\right)^3 \qquad A = 810.6 \qquad (4)$$

$$B := 11.36322 - 3.91412\left(\frac{R}{t_m}\right) + 0.18619\left(\frac{R}{t_m}\right)^2 - 0.004099\left(\frac{R}{t_m}\right)^3 \qquad B = -2071.9 \qquad (5)$$

$$C := -3.18609 + 3.84763\left(\frac{R}{t_m}\right) - 0.18304\left(\frac{R}{t_m}\right)^2 + 0.00403\left(\frac{R}{t_m}\right)^3 \qquad C = 2045.1 \qquad (6)$$

$$F := 1 + A \cdot c^{1.5} + B \cdot c^{2.5} + C \cdot c^{3.5}$$

$$F = 3.891$$

$$K(a) := 1.4 \cdot s \cdot F \cdot (3.1416 \cdot a)^{0.5}$$

$K(a) = 9.071 \cdot ksi \cdot in^{.5}$ **less than** $K_{si} := 35 \cdot ksi \cdot in^{0.5}$

Safety Factor: $\frac{K_{si}}{K(a)} = 3.858$ for $2 \cdot a = 0.1 \cdot in$

Per GL 90-05, the crack length "2a", in this case (2)x0.05"=0.100", shall not exceed either 3 inches or 15 percent of the length of the pipe circumference.

- Pipe circumference $C_p := \pi \cdot D_o$ $C_p = 4.131 \cdot in$
- 15 percent of the length of the pipe circumference $C_{15} := 15 \cdot \frac{C_p}{100}$ $C_{15} = 0.62 \cdot in$

$2 \cdot a = 0.1 \cdot in$ < 15% of the pipe circumference or 0.62" Acceptable

Conclusion

The through-wall flaw evaluations above for the pinhole flaw demonstrate that the piping including the weld joining the pipe to the sockolet for line 3SW1-141SB-1 is structurally adequate per GL 90-05.