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SOUTHERN COMPANY

October 24, 2011

Docket Nos.: 50-321

NL-11-2155

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

Edwin I. Hatch Nuclear Plant - Unit 1
HNP-ISI-ALT-14, Version 1
Temporary Non-Code Repair of Plant Service Water Piping

Ladies and Gentlemen:

Pursuant to 10 CFR 50.55a(a)(3)(ii), Southern Nuclear Operating Company (SNC) hereby requests Nuclear Regulatory Commission (NRC) approval of the enclosed Alternative HNP-ISI-ALT-14, Version 1, which proposes a temporary non-code repair to leaks discovered in the Hatch Nuclear Plant Unit 1 (HNP-1) Plant Service Water (PSW) System. During inspection of HNP-1 buried demineralized water transfer piping adjacent to the HNP-1 Reactor Building to address tritium leakage, two leaks were identified in a nearby run of PSW piping exposed by the excavation. An operability determination concluded that PSW system operability is maintained. However, that determination is based in part on river temperature (the PSW source) remaining above 46°F.

As discussed in the enclosure, the proposed non-code repair meets most of the requirements for a "full code repair"; however, to perform a repair/replacement activity, IWA-4412 of the 2001 Edition of the ASME Section XI Code with Addenda through 2003, requires that "defect removal be accomplished in accordance with the requirements of IWA-4420." Removing the defects would require that the system be taken out of service, necessitating a plant shutdown. In order to preclude a shutdown, SNC proposes to leave the defects in service and perform a temporary non-code repair requiring NRC approval.

SNC requests NRC approval of HNP-ISI-ALT-14, Version 1, by Thursday, October 27, 2011 to support repairs scheduled to begin Friday, October 28, 2011. The SNC need date is based on the plant's ability to begin the repair and on the fact that the minimum temperature for repair based on welding preheat requirements is 60°F, while the current river temperature is 64°F and trending down. In addition, considering the structural limit of 46°F established by the operability determination, historical seasonal river temperature trends and allowing for a 30 day mission time, the repair should be completed by November 9, 2011. If approved, the non-code repair would remain in place until the next refueling outage (scheduled for February 2012) or until the next cold shutdown of sufficient duration to perform the repair/replacement activity, whichever comes first. A similar temporary non-code repair was approved for HNP previously (reference NRC SER dated January 14, 2011 for HNP-ISI-ALT-10).

The excavations where the leaks in the PSW piping were observed are located in the Protected Area of the plant adjacent to the Unit 1 Reactor Building, and are surrounded by concrete or steel structures on 75% of the access pathway. The Protected Area is a heavily controlled, low-traffic environment, and metal barriers placed to increase awareness of the excavation site will also prevent smaller vehicles (such as golf carts) from reaching the excavation. In addition, the excavation site is covered by grating material evaluated to meet missile protection criteria for the exposed pipe.

The details of the proposed alternative are contained in Enclosure 1 to this letter. Documentation of Engineering Judgment (DOEJ)-HRSNC341070-S001 performed by SNC is provided as Enclosure 2 and addresses the PSW piping leaks with respect to ASME Section XI Code Case N-513-3. Enclosure 3 provides DOEJ-HRSNC341070-M001, also performed by SNC, which addresses the potential for PSW flow diversion due to the observed pipe degradation.

This letter contains no NRC commitments. If you have any questions, please contact B. D. McKinney at (205) 992-5982.

Respectfully submitted,

Mark J Ajluni

M. J. Ajluni
Nuclear Licensing Director

MJA/DWD

Enclosures:
1. Alternative HNP-ISI-ALT-14, Version 1.0, Temporary Non-Code Repair of Plant Service Water Piping
2. Documentation of Engineering Judgment (DOEJ)-HRSNC341070-S001, Evaluation of Plant Service Water Pipe Leaks per ASME Code Case N-513-3
3. Documentation of Engineering Judgment (DOEJ)-HRSNC341070-M001, Evaluation of Unit 1 Plant Service Water (PSW) Flow with Pipe Degradation

cc: Southern Nuclear Operating Company
Mr. S. E. Kuczynski, Chairman, President & CEO
Mr. D. G. Bost, Chief Nuclear Officer
Mr. D. R. Madison, Vice President – Hatch
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Mr. W.C. Gleaves, NRR Senior Project Manager - Hatch
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Edwin I. Hatch Nuclear Plant – Unit 1
HNP-ISI-ALT-14, Version 1
Temporary Non-Code Repair of Plant Service Water Piping

Enclosure 1

Alternative HNP-ISI-ALT-14, Version 1.0
Temporary Non-Code Repair of Plant Service Water Piping

UNIT: Hatch Unit 1
This unit is in the fourth ISI interval which ends on December 31, 2015.

COMPONENT: 10-inch Nominal Pipe Size (NPS) carbon steel piping with a nominal wall thickness of 0.365-inch.

SYSTEM: Plant Service Water (PSW)

ASME CODE CLASS: The PSW system was built to the requirements of ANSI B31.1, Power Piping Code. The portion of PSW containing this piping is treated as Class 3 for Section XI purposes.

FUNCTION: This 10-inch diameter piping is the supply header for the Unit-1, Division II, Reactor Building loads listed below:

- RHR and Core Spray Pump Room Coolers 1T41B003A/B
- RHR Pump Seal Coolers 1E11B002B/D
- HPCI Pump Room Coolers 1T41B005A/B
- CRD Pump Room Coolers 1T41B001A/B
- Main Control Room HVAC Condensing Units 1Z41B008B/C

CODE REQUIREMENT: Two leaks are located on the straight run of buried pipe adjacent to the Unit-1 Reactor Building and were identified by Maintenance personnel during the buried piping inspections. This piping was uncovered initially to address suspected leakage coming from Unit-1 buried piping. To perform a repair/replacement activity, IWA-4412 of the 2001 Edition of ASME Section XI with Addenda through 2003 requires that "defect removal shall be accomplished in accordance with the requirements of IWA-4420." The defects will not be removed during PSW system operation because of the significant increase in the leak rate that would be incurred by removal of the degraded material. Therefore, a modification is proposed which is considered a "temporary non-code repair," necessitating this alternative. See the Proposed Temporary Non-Code Repair section of this alternative for more details.

ALTERNATIVE REQUIREMENT:

In lieu of performing an ASME Code-compliant repair, Southern Nuclear Operating Company (SNC) is implementing the alternative requirements of ASME Code Case N-513-3, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping." This Code Case will be implemented until the next refueling outage which is currently scheduled to begin in February 2012 or until the next cold shutdown of sufficient duration to perform the repair/replacement. Compliance with the specified requirements of the Section XI Code would result in hardship without a compensating increase in the level of quality and safety; therefore, approval of this alternative per 10 CFR 50.55a(a)(3)(ii) should be granted.

POSITIVE FLAW DETECTION DURING PLANT OPERATION:

On October 21, 2011, two through-wall leaks were discovered in the PSW system. The initial leakage is documented in Hatch Condition Report 364491.

HARDSHIP OF REPAIR:

HNP-1 Technical Specifications (TS) 3.7.2 requires that two PSW subsystems and one UHS (Ultimate Heat Sink) be operable. Performing an ASME Code repair at this location during power operation would require that Division II of PSW be taken out of service. With a division of PSW out-of-service, TS 3.7.2 Condition E requires that the PSW subsystem be restored to Operable status within 72 hours. While the Technical Specification provides 72 hours for repair, doing so would result in the loss of one train of emergency cooling components during the repair window. In addition, isolation and draining of a PSW loop during power operation is complex and would expend a significant portion of the 72 hours allowed. Shutting the plant down to perform a Code repair vs. using the proposed temporary non-code repair is considered by SNC to be a hardship.

DEGRADATION MECHANISM:

The exact cause of the degradation has not been confirmed, as it is internal to the pipe. However, based on the degradation pattern, the cause is expected to be localized corrosion. Additional areas of this piping were examined and found to have no degradation. This data, along with the required broadness examinations of ASME Code Case N-513-3, provides assurance as to a lack of potential additional broadness issues.

FLAW SIZING:

Detailed ultrasonic (UT) measurements were obtained around the area of the two leaks to better understand the scope of the degradation (See Figures 1 and 2 for Locations 1 and 2, respectively). At the location of one of the leaks, Location 1, the pipe wall thickness was found to be less than 0.200-inch in a circular shape that is 1-1/8-inches in diameter. At the location of the other leak, Location 2, the pipe wall thickness was found to be less than 0.200-inch in an elliptical shape that is 2-1/4-inches on the major axis and 2-inches on the minor axis. The published minimum wall thickness for this piping is 0.100-inches. However, an acceptable reading could not be obtained on any piping with a thickness less than 0.200-inches. The rest of the piping in the examination grid was found to have a wall thickness greater than 0.200-inches. For details, see Documentation of Engineering Judgment (DOEJ)-HRSNC341070-S001 as provided in Enclosure 2.

EVALUATION APPROACH AND RESULTS:

Because PSW is functioning in an operable but degraded condition, the following issues as identified below were addressed to ensure that no harm to plant safety or public health exists. Once the proposed temporary non-code repairs are made, any potential adverse effects due to leakage would be mitigated.

Flaw Evaluation: A flaw evaluation was conducted in accordance with Section 3.0 of Code Case N-513-3 to evaluate the leak. The Code Case N-513-3 flaw evaluation determined that structural integrity is being maintained.

Stress Analysis: The added weight of the two plates to be welded to the affected piping (See Proposed Temporary Non-Code Repair below) was reviewed, and did not impact the stress analysis calculations.

Flow Diversion: An analysis was performed to estimate the leakage from the piping based on the area of the flaw size that was below the thinnest measurable wall thickness, or 0.200 inches. Although the current leakage area is smaller than the flawed area that is below 0.200 inches, the analysis conservatively assumed that the area of the leakage would be equal to the flawed area below 0.200 inches. Based on the ultrasonic thickness readings, Location 1 was assumed to be 1.125 inches in diameter and Location 2 was assumed to be elliptical with a 2.25 inch major axis and a 2 inch minor axis. Conservatively this was modeled by assuming two 2" x 3" holes which is modeled as a 2.45" diameter hole. The model was run for this case and additionally for the loss of inventory from a 3.97" diameter hole in Division II of the PSW system. The results were then evaluated against the design flows to safety-related components during a LOCA using the PROTO_FLO model (2007 benchmark update). The results of this evaluation showed that with a 3.97-inch diameter hole in the 10-inch line, that all safety-related components would receive adequate PSW flow during a LOCA. The details are described in DOEJ-HRSNC341070-M001 for details. Therefore, with the worst case leak due to loss of material from the existing location, the PSW system would still be capable of providing the required cooling to all components.

Water Temperature: The Hatch Prompt Determination of Operability (PDO) discussed that the SNC Corporate Piping Stress Engineer noted that the piping will remain structurally sound and meet the B31.1 Code requirements as long as the pipe temperature remains above 46°F. The reasonable assumption is that the pipe temperature is the same as the process piping. The process system, in this case, is PSW. The present temperature of the PSW piping is greater than 46°F. To determine a PSW temperature projection, a review of fourteen years of PSW temperature data was performed which revealed that the earliest date that PSW was 46°F was December 9th. Based on the 30-day mission time for PSW piping, repairs must be completed by November 9, 2011.

Spraying: The leak locations were considered for impact on other components. There is no equipment in this area that could be affected by these leaks. This information provides a reasonable expectation that this condition would not affect ability of the PSW systems, or other components located in the area to perform as designed.

Flooding: With respect to the potential for flooding due to excessive leakage into this area, there is only piping and no equipment in the excavated pit. This provides reasonable assurance that the components in this area would be capable of performing the necessary design functions in the event of flooding. Therefore, the amount of leakage into the area will not affect the operability determination of the PSW system.

Flaw Growth Rate: As stated previously, the cause of the degradation is believed to be from localized corrosion. If further degradation were to occur on this area of the piping, it would be minimal and gradual with respect to the time frame for the next opportunity for piping repair (next refueling outage or until the next cold shutdown of sufficient time to perform the repair/replacement). This assumption is further justified by the fact that the piping with the degradation is original plant piping, and has been in service for approximately 36 years. There is reasonable assurance that the calculations and evaluations associated with the current degradation would remain valid until a Code-compliant repair/replacement is performed. The daily rounds and the ongoing ultrasonic examinations performed on a 30-day frequency will enable Hatch to verify that structural integrity is maintained.

Based on the above discussion, SNC has determined that the structural integrity of the PSW piping at this location is being maintained and will continue to be maintained until a Code-compliant repair/replacement is performed.

AUGMENTED EXAMINATIONS:

To determine the extent of condition, five sample points, as specified by Code Case N-513-3, will be examined using ultrasonic thickness techniques. If any of these examinations identify piping with thickness measurements below the required minimum wall thickness, the condition will be documented in a condition report and this operability determination will be re-evaluated. This will meet the guidance of Code Case N-513-3.

The five sample points will be at the following locations:

- Point 1 – Scan 2 feet of piping downstream of valve 1P41F380A
- Point 2 – Scan 2 feet of piping downstream of valve 1P41F380B
- Point 3 – Scan the 8 feet area in excavation #1 as previously directed by the Buried Pipe Program
- Point 4 – Scan 2 feet of piping between valve 1P41F066 and the wall penetration
- Point 5 – Scan 2 feet of piping between valve 1P41F067 and the wall penetration.

The UT thickness examinations for the five sample points identified above are expected to be completed prior to November 20, 2011.

PROPOSED TEMPORARY NON-CODE REPAIR:

Several repair/replacement activities were evaluated and it is proposed that the addition of two contoured plates to the affected sections of piping by means of welding be made to isolate the leaks (see Figure 4). This option allows the welding on the two attachments to be located in an area with minimal degradation, ensuring a structurally sound load path while minimizing the risk of "burn-through" and increased leakage. The design will also ensure that the configuration of the repair will allow continued wall thickness monitoring of the region by ultrasonic examination to ensure that future degradation will not adversely impact the structural capability of the repaired section.

The degraded piping is 10-inch, Schedule 40 (0.365-inch nominal wall), seamless carbon steel piping. The repair plates will be constructed from either plate or pipe; the Hatch site plans on using plate. In either case, the thickness of the repair plates will be 0.365-inch nominal wall from P-No.1 carbon steel material having an allowable stress of 15,000 psi up to 650°F. If it is determined that plate will not work, piping will be used.

Plate #1 covering Location #1

This location is essentially at the 12 o'clock position. The size of this plate was based on inputs from the ultrasonic thickness measurements taken as requested by the SNC Corporate Stress Group. The UT examiner was asked to find where the wall thickness measured at least 0.200-inches and at least 0.300-inches away from each leaking location in four directions. The examiner was able to get the requested eight ultrasonic measurements; a copy of the test report is enclosed as Figures 1A & 1B. Based on these measurements (ref. Figure 2), a 3-inch by 3-inch plate will be positioned over Location #1 as shown in Figure 4.

Plate #2 covering Location #2

This location is at the 7 o'clock position looking south. The size of this plate was based on inputs from the ultrasonic thickness measurements taken as requested by the SNC Corporate Stress Group (ref. Figure 3). The UT examiner was asked to find where the wall thickness measured at least 0.200-inches and at least 0.300-inches away from each leaking location in four directions. The examiner was able to get seven UT readings; however, a measurement was not able to be obtained for the ultrasonic point for the 0.200-inch location at the "upper" side for Location #2 because of ID surface irregularities. The Hatch site design engineering group evaluated the NDE results and designed the 3-inch by 6-inch plate as shown in Figure 4.

Additional details from Figure 4 are provided in the enclosed Sketch 1, which includes dimensions between the edges of Plate # to the 0.300-inch dimension.

As noted above, ID surface irregularities limited the UT thickness measurements. Although this cannot be confirmed, SNC is of the opinion that a better representation of the thickness at Location #2 is depicted in the enclosed Sketch 2.

All welders and welding procedure specifications shall be qualified for groove welding in accordance with the ASME Section XI Code. The new pressure boundary will now be located at the reinforcing plate attaching weld. The welding process to be used for attaching the reinforcing plate will be the shielded metal arc welding (SMAW) process. If rejectable indications are identified during performance of nondestructive examination, the indications will be removed and the attachment weld repaired in accordance with applicable provisions of ASME Section XI and ANSI B31.1.

The welding is to be performed with water in the line and with the system pressurized to approximately 120 psig. SNC believes that this will not create any problems based on the following factors:

- Welding with water in a pipe is performed frequently in the industry and, as discussed above, the water temperature meets the 60°F minimum preheat.
- The measurements noted in Figures 2 and 3 indicate that the welding will be performed on thicknesses ranging from 0.200-inch to 0.300-inch thick.
- With the water in the system acting as a heat sink, the resulting heat affected zone of the piping base material caused by the welding should be relatively shallow.
- Since only the inner 0.200-inch of the base material is required for pressure containment, welding on 0.200-inch thick to 0.300-inch thick base material would not be expected to encroach upon the Code-required minimum wall thickness and should have no impact on the load bearing capability of the piping during the welding process.

The completed welds will be VT examined per ANSI B31.1 and any indications evaluated per the requirements of ANSI B31.1. A pressure test will then be performed as required by IWA-4540 of the Section XI Code. The pressure test with be accompanied by a visual VT-2 examination.

Additionally, a liquid penetrant examination will be performed in accordance SNC procedure NMP-ES-024-301. The examination will be performed no less than 48 hours after completion of the weld to ensure no delayed cracking occurs. (This examination is consistent with the requirements for weld overlay repair examinations made on P-No. 1 material using ASME Code Case N-661-1, which has been accepted for use in Regulatory Guide 1.147). NMP-ES-024-301 provides techniques and acceptance criteria to be used for the performance of Liquid Penetrant Examinations at the Hatch, Farley, and Vogtle nuclear plants. Indications will be evaluated per the following procedural acceptance criteria:

1. Relevant indications are indications which result from imperfections. Only indications with major dimensions greater than 1/16-inch shall be considered relevant imperfections.
2. Imperfections producing the following indications are unacceptable:

   Any cracks or linear indications.

   Rounded indications with dimensions greater than 3/16-inch.

   Four or more rounded indications in a line separated by 1/16-inch or less edge-to-edge.

   Ten or more rounded indications in any six square inch area with the major dimension of this area not to exceed six inches with the dimension taken in the most unfavorable location relative to the indications being evaluated.
3. An operating system VT-2 pressure test will then be performed as required by IWA-4540 of the Section XI Code.

CODE CASE N-513-3 ACTION PLAN:

The following actions will be performed by SNC for this component until the proposed temporary non-code repair is performed:

- Site personnel will perform daily rounds to identify further degradation of the affected area as evidenced by a significant increase in the leakage rate. If a significant increase in leakage is detected an ultrasonic examination will be performed to assure that the criteria used to evaluate the structural integrity remains valid.
- The area will be ultrasonically examined on a 30 day frequency to assure that unexpected degradation is not occurring and that the structural integrity of the piping is being maintained.

- The PSW temperature will be monitored to ensure that it remains above 46°F.

The following actions will be subsequently performed by SNC in the time period after the temporary non-code repair is made until the ASME Section XI repair/replacement is performed:

- An ASME Section XI repair/replacement will be performed before the completion of the Hatch Unit 1 1R25 refueling outage currently scheduled to begin in February 2012 or during the next cold shutdown judged to be of sufficient time to perform the repair/replacement, whichever occurs first.
- Site personnel will perform daily rounds to identify any signs that additional degradation is occurring.
- The area around the temporary repair will be ultrasonically examined on a 30-day frequency to assure that degradation outside of the repaired area is not occurring and that the structural integrity of the piping is being maintained.

STATUS: This alternative is awaiting NRC approval.

ALTERNATIVE DURATION This alternative will remain in effect until an ASME Section XI Code repair/replacement is performed during the Hatch Unit-1 1R25 refueling outage or until the next cold shutdown of sufficient duration to perform the repair/replacement, whichever occurs first.

Southern Nuclear Operating Company		
SOUTHERN COMPANY — Nuclear Management Instruction	Ultrasonic Thickness Examination Procedure	NMP-ES-024-511 Version 3.0 Page 15 of 17

Ultrasonic Thickness Report — **Southern Nuclear Operating Company**

Plant / Unit: Hatch / 1	Date: 10-21-11 / Sheet Number: N/A
Component: 10" Pipe / ISO / Drawing No.: S00631	
System: PSW	
Examination Area and Location: See attached	
Description of Item Examined: See attached	
Material Type: ☒ C/S ☐ S/S Other:	
Calibration Standard Serial Number: 87-3542 .1-.50"	Instrument Manufacturer: GE Inspection Technologies
	Model Number: USN-60 / Serial Number: 01DNLX
Sound Path Screen Distance: 1.0" Screen Range	Transducer Manufacturer: KBA / Type: Dual / Size: .38
Smallest Screen Division: .02	Serial Number: M04923 / Frequency: 5.0 MHz
Procedure: NMP-ES-024-511/Version 3.0	☒ A-Scan ☐ Metered / Digital
Remarks: None	☐ Spot ☒ Continuous
	Couplant: Sonotech/Ultragel II 10225
	Cable Type / Length: 5'
	EXAMINATION RESULTS: See page 2
Examiner: Kevin White [signature] / Level: III	Examiner: N/A / Level: N/A
Reviewed By: Danny Carons [signature]	Level: III / Date: 10/24/11

Figure 1A – Ultrasonic Thickness Test Report – Page 1 of 2

<u>Hatch 1 PSW Buried Pipe – 10/21/11</u>

Hatch 1 – 10" Plant Service Water UT around areas of leakages located in excavation number 2, where 9 feet of pipe was exposed. Reference S-00631 / H11139.

Leakage from area number 1 - is located top dead center of the pipe at ~ 2 feet from the north end of the dirt wall. The area was gridded I 48 for UT FAC inspection.

Leakage from area number 2 – is located ~ 2-1/2 feet from the north dirt wall at 7:00 when facing north. The area was gridded F40 for UT FAC Inspection.

East Side

1.25" (.3)

.625 (.2)

North End 1.375(.3) .50(.2) + .625(.2) 1.375(.3) South End

.50(.2)

1.75(.3)

West Side

<u>Area 1</u>

Up

1.5(.3)

None(.2)

North End 3(.3) 1.0(.2) + 1.25(.2) 2.5(.3) South End

.5(.2)

1.25(.3)

Down

<u>Area 2</u>

+ = center of the leak

Inches from the leak (thickness at that location)

North and South is the longitudinal axis of the pipe.

Most other areas were difficult to obtain UT readings of .100 or less.

The examination was performed using a USN 60 with a 5.0 MHz 3/8" dual transducer where a one inch screen range was established.

Figure 1B – Ultrasonic Thickness Test Report – Page 2 of 2

Location 1

East

			1.25(.3)			
			0.625(.2)			
North	1.375(.3)	0.50(.2)	X	0.625(.2)	1.375(.3)	South
			0.50(.2)			
			1.75(.3)			

West

Note:
1) X- Location of the Indication
2) The numbers represent the distance of the ultrasonic thickness measurement from the leak and the numbers in parentheses are the thicknesses of the base material. All measurements are in inches.

Figure 2 - Leak Location 1

Location 2

Up

			1.5(.3)			
			None(.2)			
North	3.0(.3)	1.0(.2)	X	1.25(.2)	2.5(.3)	South
			0.5(.2)			
			1.25(.3)			

Down

Note:
1) X- Location of the Indication
2) The numbers represent the distance of the ultrasonic thickness measurement from the leak and the numbers in parentheses are the thicknesses of the base material. All measurements are in inches.

Figure 3 - Leak Location 2

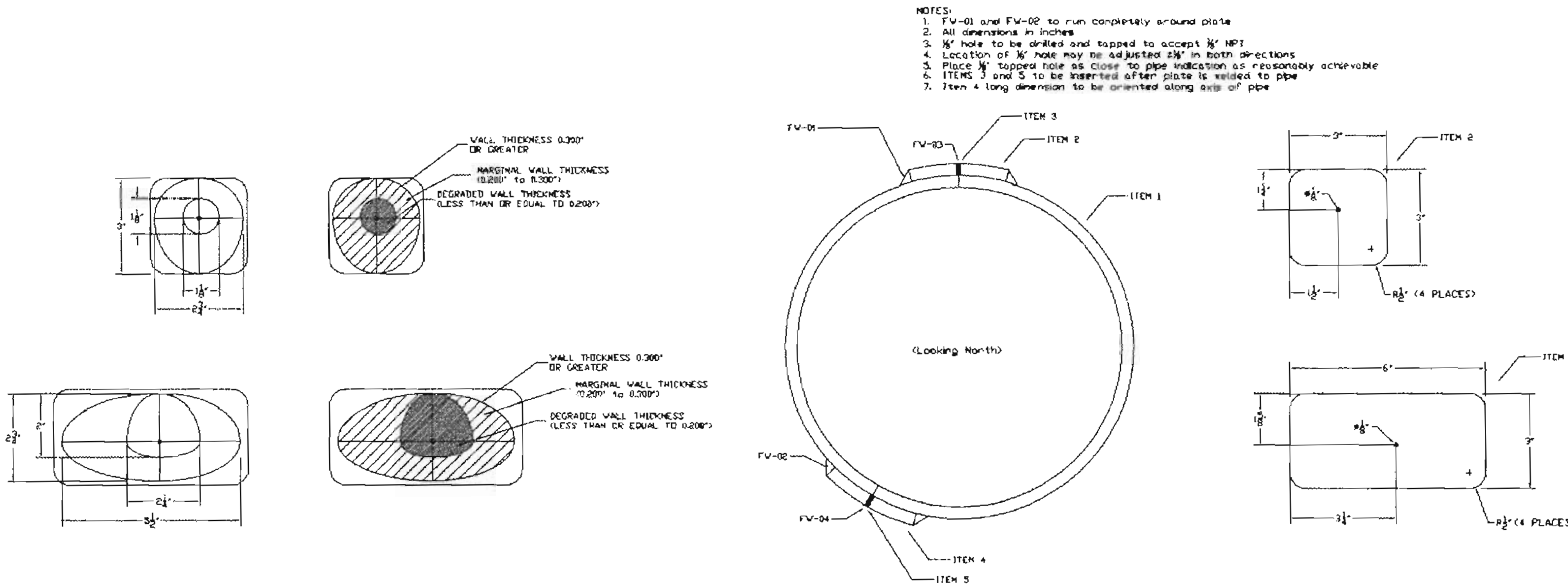
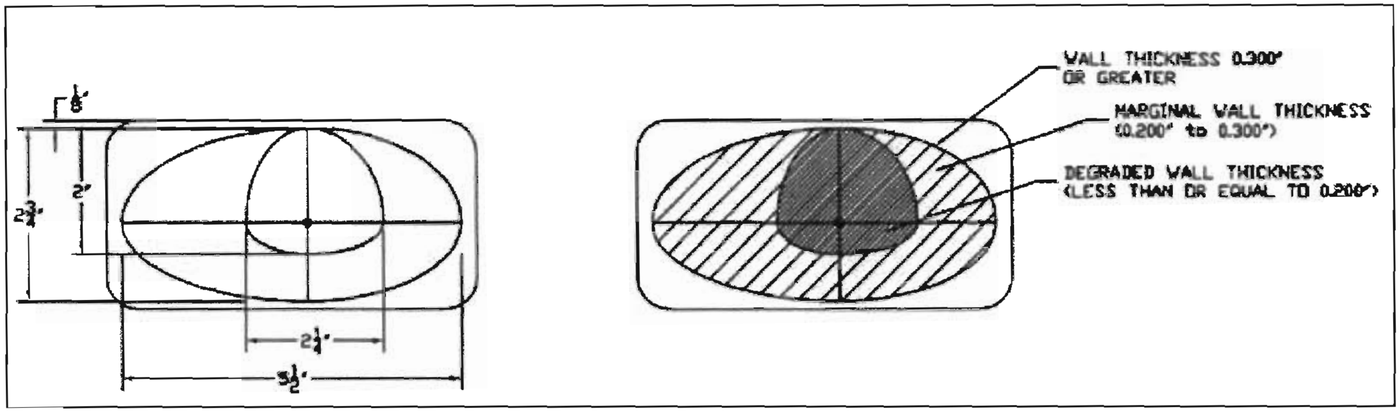
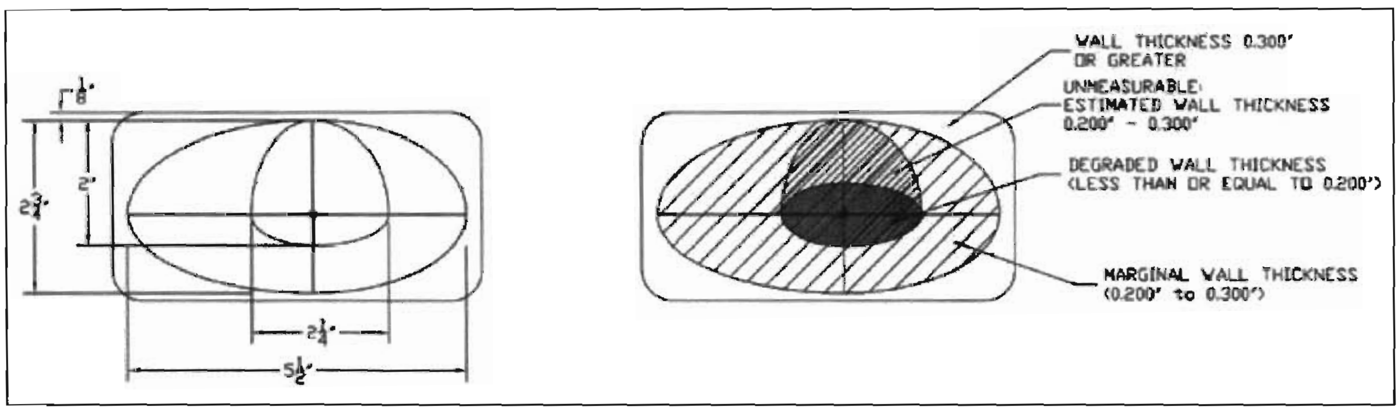


Figure 4 - Proposed Non-Code Repair



Sketch 1 from Figure 4 – Measured Details for Plate #2



Sketch 2 from Figure 4 – Best Estimate Details for Plate #2

Edwin I. Hatch Nuclear Plant – Unit 1
HNP-ISI-ALT-14, Version 1
Temporary Non-Code Repair of Plant Service Water Piping

Enclosure 2

Documentation of Engineering Judgment
(DOEJ)-HRSNC341070-S001, Evaluation of
Plant Service Water Pipe Leaks per ASME Code Case N-513-3

Southern Nuclear Operating Company

DOCUMENTATION OF ENGINEERING JUDGMENT

DOEJ-HRSNC341070-S001

Evaluation of Plant Service Water Pipe Leaks per ASME Code Case N-513-2 and N-513-3

Version Record

Version No.	Originator/Date Signature	Reviewer/Date Signature
1	An Nguyen / October 22, 2011	Y. Jani / October 22, 2011
2	An Nguyen / October 24, 2011	Y. Jani / October 24, 2011

 Southern Nuclear Operating Company

Purpose:
The purpose of this DOEJ is to support RER SNC341070. The scope for this DOEJ is the evaluation of the piping structural integrity for the plant service water system. This piping has developed through wall seepage and UT inspection has been performed.

Design Inputs (Reference NMP-ES-042):

1. S00631.
2. S00779.
3. Attachment to E-mail from Kevin White to An Nguyen, 10/21/11 (Attachment 1 shows the sketch redrawn in Temporary Non-Code Repair plan)
4. Exposed Piping Evaluation (Attachment 3)

References:

1. Code Case N-513-2 and N-513-3.
2. ASME Section XI, 2003 (Code of Record).
3. ASME Section XI, 2010.
4. RASEARCH Results for N-513-2 and N-513-3 (Attachment 2)

Assumptions:
In this evaluation, a representative flaw geometry enveloping the geometry of the two flaws was used. From the UT report (attachment 1), the flaw can be characterized as 2.5 inch in the circumferential direction and 2.25 inch in the longitudinal direction. The minimum pipe wall thickness outside of the flaw is at least 0.2 inch.

Due to the size of the flaw and the nominal thickness of the pipe wall, the evaluation is limited to temperature higher than the upper shelf temperature of carbon steel. In this case, for the thickness of 0.365 inch, the upper shelf temperature is determined from Table C-8321-2 of Reference 3 as 45.6°F.

The design pressure and design temperature are 180 psig and 125°F, respectively.

The piping system was classified as buried pipe. As such, this piping system does not have stress calculation. Now the pipe is exposed in the pit. The exposed piping was evaluated as shown in attachment 3 of this DOEJ. Since the temperature of piping system is low (125°F), no secondary stress evaluation is required.

Evaluation:
This evaluation is in accordance with Code Case N-513-2 and 513-3. The difference between the two versions of the code case is not applicable to this case as discussed in reference 4.

The exposed pipe span is approximately 12 ft span. The natural frequency is calculated to be ~40 hz; hence, there is no concern for seismic. A conservative value of 1500psi for bending stress was used for primary longitudinal stress in the code case calculation. Frequency calculation and primary stress due to weight and seismic are shown in attachment 3.

Circumferential Flaw Calculation:

This spreadsheet provides an evaluation of pipe wall flaws, including through wall, per Section XI, Appendix C and is primarily focussed on Code Case N-513-2, for Class 2 or 3 piping only (service level B controls)

Color indicates cells requiring inputs
Color indicates output or result information

Constant

pi=	3.14159	

Nominal Condition

NPS=	10.000	NPS
OD=	10.750	Pipe OD, inch
tnom=	0.365	Pipe nominal thickness (in)
Snom=	29.904	Pipe Section modulus, in^3
Stress_pri=	1.500	primary nominal stress Sb (ksi)
moment_pri=	44.856	primary moment, (in-kip)
Pressure=	0.180	pressure, ksi
Stress_sec=	0.000	Secondary Stress, (ksi)
moment_sec=	0.000	secondary moment (in-kip)

Safety Factors per C-2621

SFb=	2.300	safety factor for bending stress: 2.3 (A), 2 (B), 1.6 (C), 1.4 (D)
SFm=	2.700	safety factor for membrane stress: 2.7 (A), 2.4 (B), 1.8 (C), 1.3 (D)

As Found Condition

tpipe=	0.200	corrode pipe thickness, in.
Rm=	5.28	mean pipe radius, in.
Scorr=	17.16	corrode pipe section modulus, in^3
Sigma_b=	2.61	adjusted bending stress, ksi
sigma_e=	0.00	adjusted bending stress, ksi
Rm / tpipe=	26.38	Compare R/t to 20 per Code Case N-513-2, Section I-2.

Flaw Sizing

L_circ=	2.50	circ flaw length, in
theta=	0.24	half flaw angle, rad
theta/pi=	0.08	
C_=	1.25	flaw half length C_ to be used in C-7000, in.

Fracture Mechanics Properties ~~per Table G-8321-1, Section II, Part D, and Seeyion XI, Fig C-4220-1~~

J_ic=	300.00	J_ic (in-lbf/in^2) - OP TEMP > Upper Shell Temperature
E=	2.94E+0	E, ksi

	4	
E_prime=	3.23E+04	E_prime= E / (1-nu^2)
sigma_y=	27.10	yield strength, ksi
sigma_u=	60.00	ultimate strength, ksi

Calculate Sr_prime

sigma_m=	2.42	sigma_m = pD/4t (ksi)
beta=	1.36	beta angle (rad) in figure 1 of code case
sigma_b_prime=	29.72	limit load primary bending stress
theta+beta=	1.60	Check for short crack: theta +beta < pi
phi=	0.12	phi = =ASIN(0.5*SIN(theta)), rad.
sigma_m_prime=	23.03	sigma_m_prime= sigma_y*(1-theta/pi-2*phi/pi), ksi
(sigma_b+sigma_e)/sigma_m=	1.08	check for (sigma_b+sigma_e) / sigma_m > 1.
S_R_prime=	0.09	S_R_prime=(Sigma_b+sigma_e)/sigma_b_prime

Calculate K_r_prime per C-4311

Appendix I of N-513-2

Am=	18.95	Am = -2.02917+1.67763*(Rm/tpipe)-0.07987*(Rm/tpipe)^2+0.00176*(Rm/tpipe)^3
Bm=	-48.20	Bm = 7.09987-4.42394*Rm/tpipe+0.21036*(Rm/tpipe)^2-0.00463*(Rm/tpipe)^3
Cm=	72.36	Cm = 7.79661+5.16676*(Rm/tpipe)-0.24577*(Rm/tpipe)^2+0.00541*(Rm/tpipe)^3
Ab=	15.84	Ab =-3.26543+1.52784*(Rm_over_tpipe)-0.072698*(Rm_over_tpipe)^2+0.0016011*(Rm_over_tpipe)^3
Bb=	-37.56	Bb = 11.36322-3.91412*(Rm/tpipe)+0.18619*(Rm/tpipe)^2-0.004099*(Rm/tpipe)^3
Cb=	44.91	Cb =-3.18609+3.84763*(Rm/tpipe)-0.18304*(Rm/tpipe)^2+0.00403*(Rm/tpipe)^3
Fm=	1.33	Calculate per Code Case Appendix I
Fb=	1.27	Calculate per Code Case Appendix I
K_im_C4000=	6.35	K_im=sigma_m*(pi*C_)^0.5*Fm
K_ib_C4000=	3.24	K_ib=(moment_pri+moment_sec)/(2*pi*Rm^2*tpipe)*(pi*C_)^0.5*Fb
K_i_C4000=	9.59	K_i=K_im+K_ib
K_r_prime=	0.10	K_r_prime=(1000*K_i^2/(E_prime*J_ic))^0.5
SC=	1.11	Screening Criteria SC=K_r_prime/S_R_prime
Screening Procedure:		SC<0.2 Use C5000
	Use C6000	0.2<SC<1.8 Use C6000

--- SC>1.8 Use C7000

For SC< 0.2 Use C5000 (to be provided)

For 0.2< SC < 1.8, Use C6000

Calulation sigma_c_b per C-5320

sigma_f=	43.55	Flow stress = (sigma_y+sigma_u)/2
beta=	1.37	beta angle from figure 1
sigma_c_b=	47.77	bending stress at collapse
S_c_5320=	19.25	allowable bending stress per C-5320

Calculation sigma_c_m per C-5222

sigma_c_m=	37.00	membrane stress at collapse= sigma_f*(1-(theta/pi)-2*phi/pi)
S_t per C-5322=	13.70	allowable membrane stress per C-5320 = sigma_c_m/SFm

Calculation per C-6320

Z=	1.38	load multiplier for ductile flaw
S_c=	13.30	S_c= 1/SFb*(sigma_c_b/Z-sigma_e)-sigma_m*(1-1/(Z*SFm))
S_t=	9.95	S_t = sigma_c_m/Z/SFm

Calculate per C-2612

sigma_b_over_S_c=	0.20 OK	sigma_b / S_c < 1.0 ==> OK
sigma_m_over_S_t=	0.24 OK	sigma_m / sigma_t < 1 ==> OK

For SC >1.8 Use C7000

Fm_C7000=	1.33	Fm = 1+Am*(theta/pi)^1.5+Bm*(theta/pi)^2.5+Cm*(theta/pi)^3.5
Fb_C7000=	1.27	Fb =1+Ab*(theta/pi)^1.5+Bb*(theta/pi)^2.5+Cb*(theta/pi)^3.5
K_im=	17.16	K_im = SFm*Fm_C7000*sigma_m*(pi*C_)^0.5
K_ib=	15.18	K_ib = (SFb*Sigma_b+sigma_e)*Fb_C7000*(pi*C_)^0.5
K_ir=	0.00	Residual stress intensity
K_I_C7000=	32.34	K_I_C7000 = K_im+K_ib+K_ir
K_C=	98.45	K_C = (J_ic*E_prime/1000)^0.5
K_I_C7000/K_C=	0.33 OK	K_I_C7000 < K_C ==> OK

Axial Flaw Calculation:

Constant

pi=	3.14159	

Nominal Condition

NPS=	10.000	NPS
OD=	10.750	Pipe OD, inch
tnom=	0.365	Pipe nominal thickness (in)
Snom=	29.904	Pipe Section modulus, in^3
Pressure=	0.180	pressure, ksi
S	15.000	Allowable design stress per Section II, Part D, Table 1A
t_min	0.064	per Code case, Eq'n 4

As Found Condition

tpipe=	0.200	corroded/degraded pipe thickness, in.
Rm=	5.275	mean pipe radius, in.
sigma_h=	4.748	hoop membrane stress, ksi
Rm / tpipe=	26.375	
		Compare R/t to 20 per Code Case N-513-2, Section I-2.

Flaw Sizing

L_axial=	2.250	axial flaw length, in
c_axial=	1.125	half crack length, in
lambda=	1.095	
F_=	1.603	
sigma_y=	27.100	yield strength, ksi
sigma_u=	60.000	ultimate strength, ksi
Sigma_f=	43.550	
SFmaxial=	2.700	safety factor for membrane stress: 2.7 (A), 2.4 (B), 1.8 (C), 1.3 (D)
Sigma_L=	27.100	Sigma L is defined as yield strength in this case

Calculation per C-4312

Q_=	1.000	
K_i_axial=	14.306	=(Pressure*Rm/tpipe)*(pi*c_axial)^0.5*F_
K_r_prime_axial=	0.145	=(1000*K_i_axial^2/(E_prime*J_ic))^0.5
S_r_prime_axial=	0.175	=Pressure*Rm/tpipe/Sigma_L
SC_axial=	0.829	Screening Criteria SC=K_r_prime/S_R_prime
Screening Procedure:	Use C6000	SC<0.2 Use C5000
	---	0.2<SC<1.8 Use C7000 in lieu C6000, since under preparation per C-6420
	---	SC>1.8 Use C7000

Calculation per C-5400 (Not available for through wall)

L_all=	5.269	Code case equation 1

Calculate per C-7400 for flaw length
L_axial

K_Im_axial=	38.625	K_Im_axial = K_i_axial*SFmaxial
K_c=	98.450	K_Im_axial < K_c
	OK	
K_Im_axial / K_c =	0.392	

Conclusion:
Current flaw configuration meets the criteria for temporary acceptance of flaws in moderate energy class 3 piping system. This evaluation is in accordance with Code Case N-513-2 and N-513-3. Hence, the following compensatory actions are also required:

Compensatory Measures

- Daily monitoring of leakage for noticeable changes
- UT – at least monthly based on no noticeable leakage change
- PSW supply temperature monitoring (river). Minimal acceptable temperature is 46deg. Projection of temperature for 30 days should ensure minimum temperature is not challenged.

List of Attachments:

1. UT Results.
2. RASEARCH Results
3. Exposed Pipe Evaluation.

Location 1

East

			1.25(.3)			
			0.625(.2)			
North	1.375(.3)	0.50(.2)	X	0.625(.2)	1.375(.3)	South
			0.50(.2)			
			1.75(.3)			

West

Note:
1) X- Location of the Indication
2) The numbers represent the distance of the ultrasonic thickness measurement from the leak and the numbers in parentheses are the thicknesses of the base material. All measurements are in inches.

Location 2

Up

			1.5(.3)			
			None(.2)			
North	3.0(.3)	1.0(.2)	X	1.25(.2)	2.5(.3)	South
			0.5(.2)			
			1.25(.3)			

Down

Note:
1) X- Location of the Indication
2) The numbers represent the distance of the ultrasonic thickness measurement from the leak and the numbers in parentheses are the thicknesses of the base material. All measurements are in inches.

DOEJ-HRSNC341070-S001 – Attachment 1 – 1/1

Nguyen, An N.

From:	Nguyen, An N.
Sent:	Friday, October 21, 2011 7:46 PM
To:	Retherford, Rebecca Sue
Cc:	Edwards, James A. (Jim - SNC); Agold, James M.
Subject:	RE: Code Case N-513-3

Thank you. Below is the commentary on N-513-3.

An Nguyen, PE
Telephone: 8-992-7307

Gathered from Rasearch NUC Files\Revision - Nuclear Cases.wpd (7/16/2010)

\# #

Code Case Revisions

N-513-3 (07-S8) (07-1303)

Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping, Section XI, Division 1

TECHNICAL

This revision provides significant clarifications regarding evaluation of through-wall, nonplanar flaws, which are the flaw type most commonly dispositioned using this Case. The acceptability criterion for the prior branch reinforcement evaluation approach (based on ASME Section III Class 2 and 3 rules) was ambiguous. This revision specifies that the required area of reinforcement is to be calculated in accordance with Class 1 rules, and proves new (acceptance criteria for this approach. Also, the depth at which a through-wall, nonplanar flaw is characterized for planar evaluation in both the axial and circumferential directions is made less restrictive in the proposed revision, to account for NDE capabilities. A new equation is introduced to address the potential for pressure blowout if an area larger than the current through-wall, nonplanar leak is evaluated to provide a bounding analysis.

N-513-2 (04-S1) (BC03-249) (Acceptable - Regulatory Guide 1.147 - Rev. 15)

Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping, Section XI, Division 1

TECHNICAL

This revision adds a procedure for evaluation of non-planar through-wall flaws in moderate energy piping. Service experience has shown that some piping suffer degradation from non-planar flaws, such as pitting and microbiological attack, where local inconsequential leakage can occur. Some Owners have used N-513-1 as guidance for evaluation of non-planar leaking flaws, but relief requests from Code requirements were still required, because the scope of N-513-1 was limited by section 3.0 of the Case. This revision extends the Case to cover all types of non-planar flaws. The analysis procedures have been expanded to address the general case of through-wall degradation. This revision also includes the improved flaw evaluation procedures for piping added to Section XI, Appendix C, in the 2002 Addenda.

*

N-513-1 (98-S12) (BC00-572)

Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping, Section XI, Division 1

TECHNICAL

The Case has been expanded to permit application to Class 2 moderate energy piping. The analysis procedures have been expanded to address degradation mechanisms, such as stress-corrosion cracking, that may be an issue for Class 2 piping.

*

N-513 (95-S10) (97-208) (Conditionally Acceptable - Regulatory Guide 1.147 - Rev. 14)

Evaluation Criteria for Temporary Acceptance of Flaws in Class 3 Piping, Section XI, Division 1

NEW CASE

This Case provides for the temporary acceptance of flaws, including through-wall (leaking) flaws in low and moderate energy Class 3 piping, providing that the conditions of the Case are satisfied. Acceptance criteria are based on the same margins as contained in Appendices C and H and Case N-480. The problem with the Case is that the provisions are more restrictive than the current requirements in Section III and Section XI. The Case applies only to Class 3 components, but it requires the use of a Class 1 type stress analysis to justify the delay of the replacement. The Case is not needed, because current Code requirements provide rules that can be used for more economical evaluations and repairs.

(Regulatory Condition -

(1) Specific safety factors in paragraph 4.0 must be satisfied.

(2) Code Case N-513 may not be applied to:

(a) Components other than pipe and tube.

(b) Leakage through a gasket.

(c) Threaded connections employing nonstructural seal welds for leakage prevention (through seal weld leakage is not a structural flaw; threadintegrity must be maintained).

(d) Degraded socket welds.)

From: Retherford, Rebecca Sue
Sent: Friday, October 21, 2011 5:50 PM
To: Nguyen, An N.
Cc: Edwards, James A. (Jim - SNC); Agold, James M.
Subject: FW: Code Case N-513-3

An:
N-513-3 is the version approved for use at Hatch and reflected in the ISI Plan Volume 1. Technically, version 3 evaluation is essentially the same as in N-513-2. The NRC requirement is the requirement is that the permanent repair be done in the next refueling outage. Copy attached.
Rebecca

From: Retherford, Rebecca Sue
Sent: Friday, October 21, 2011 04:13 PM
To: Altizer, J. Mike
Subject: Code Case N-513-3

Mike:
Code Case N-513-3 is attached. This code case is referenced in the Hatch ISI Plan, Vol . 1 as acceptable for use at Hatch.
Rebecca

Frequency of Exposed Pipe

Purpose:

To determine the natural frequiency of the NPS 10, standard wall, simply supported, 12 foot long.

len := 12ft   Dia := 10.75in

$E := 27.6 10^{6} psi$

$Inertia := 160.7 in^{4}$

$mass := (40.5 + 34.2)\frac{lb}{ft}$

$\omega := \frac{\pi^{2}}{len^{2}}\sqrt{\frac{E\ Inertia}{mass}} = 249.638\frac{rad}{sec}$

$\omega = 39.731 hz$

Prmary stress due to weight (1g):

$Moment := \frac{mass\ g\ len^{2}}{8} = 1.345\times 10^{3} ft\ lbf$

$stress := \frac{Moment\ Dia}{2 Inertia} = 539.681 psi$

Conclusion: no seismic load required if bending stress of 1500psi is used.

DOEJ-HRSNC341070-S001 Attachment 3 – 1/1

Edwin I. Hatch Nuclear Plant – Unit 1
HNP-ISI-ALT-14, Version 1
Temporary Non-Code Repair of Plant Service Water Piping

Enclosure 3

Documentation of Engineering Judgment (DOEJ)-HRSNC341070-M001,
Evaluation of Unit 1 Plant Service Water (PSW) Flow with Pipe Degradation

Southern Nuclear Operating Company

DOCUMENTATION OF ENGINEERING JUDGMENT

DOEJ-HRSNC341070-M001

Evaluation of Unit 1 Plant Service Water (PSW) Flow with Pipe Degradation

Version Record

Version No.	Originator/Date Signature	Reviewer/Date Signature
1.0	Scott Kirk Scott Kirk 10/22/2011	Steve Berryhill Steve Berryhill 10/22/11

Purpose:
Unit 1 Plant Service Water (PSW) piping has been inspected with degradation discovered. The purpose of this evaluation is to use the PROTO-FLO hydraulic model to simulate through-wall leaks and determine if safety-related components will still receive design PSW flow.

Design Inputs (Reference NMP-ES-042):

1. The safety-related components that receive PSW flow post-LOCA are identified in Reference 1 with the design flowrates listed. These components and flowrates are provided in Table 1 below.

References:

1. SMNH-02-012, version 5, Generate Unit 1 Plant Service Water (PSW) PROTO-FLO Database for Latest Test Data
2. RER SNC119724, Sequence 02, Evaluate 97°F River Temperature
3. RER 1100341001, Sequence 03, Main Control Room Air Conditioning PSW Flow Evaluation

Assumptions:

- The PROTO-FLO hydraulic model contained in Reference 1, which was benchmarked in 2007, is an adequate representation of the current Unit 1 PSW system for the purpose of this evaluation.
- For conservatism, the LOCA case is used as defined in Reference 1 (i.e., Technical Specification minimum river level of 60.7 feet MSL, single failure of a diesel generator, all reactor building loads in service, etc.).
- For conservatism, the river temperature is assumed to be 97°.
- For conservatism, assume the Division II PSW strainer has a 125 gpm packing leak (reference Attachment 3).

Evaluation:
Reference 1 contains the PROTO-FLO file PSW HATCH UNIT 1 2007 LOCA.PDB. This file was used as the basis for this DOEJ. Two new files were created to simulate holes in the 10" Division II supply header to the reactor building. The first case simulates two holes, each equivalent to 2" x 3" (reference Attachment 4), in the Division II supply header to the reactor building, and determines if design flow is still provided to safety-related components that receive PSW. The second case determines the maximum hole size the header can withstand and still provide design flow to safety-related components that receive PSW. For both cases, a 125 gpm packing leak is assumed as flow out of Node 0020.

Case 1 (*PSW HATCH UNIT 1 2007 LOCA with break.PDB*)
Pipe section 101 in the model is the 10" Division II supply header to the reactor building. In PROTO-FLO, a hole is modeled at a node. In order to model two different holes, pipe section 101.1 and Node 0270A were added since only one hole can be modeled at a single node. The original length of piping was maintained by placing 600 feet in pipe section 101 and 4.2 feet in pipe section 101.1. At Nodes 0270 and 0270A, a hole was modeled on the Nodal Flow tab.

For a hole 2" x 3",
Area for ellipse = $\pi R_1 R_2 = \pi(2/2)(3/2) = 4.71$ in^2
[Total through-wall leakage area = (2)(4.71)=9.42 in^2.]

Since PROTO-FLO models circular holes, determine equivalent diameter of a circular hole:
$(\pi D^2)/4 = 4.71$
D = 2.45"
With two 2.45" holes in the Division II supply header to the reactor building, PROTO-FLO predicts the following flows to safety-related components:

Table 1

Component	Pipe	Design Flow (GPM)	Predicted Flow (GPM)
1E11C001A	906	4	8.3
1E11C001B	920	4	8.9
1E11C001C	914	4	8.4
1E11C001D	926	4	9.0
1P41C001A	38	2	4.7
1P41C001B	53	2	5.1
1P41C001C	43	2	4.8
1P41C001D	59	2	5.1
1T41B002A	603	100	217
1T41B002B	612	100	212
1T41B003A	733	100	188
1T41B003B	740	100	185
1T41B004A	672	25	40
1T41B004B	669	25	36
1T41B005A	721	25	38
1T41B005B	724	25	33
1R43S001A	139	700	844
1R43S001C	128	700	762
1Z41B008A (Div. I)	1318	120	100
1Z41B008C (Div. II)	1332	120	74

All of the safety-related components receive design flow except the control room HVAC units. The Division I HVAC unit (1Z41-B008A) receives approximately the same flow as indicated in Reference 1. This flowrate was determined to be acceptable as discussed in Reference 1. The Division II HVAC unit (1Z41-B008C) receives 74 gpm which is less than design. This flowrate is judged to be acceptable because:

- The current model (Reference 1) has not been revised since control room HVAC pipe replacement and cleaning; therefore the predicted flow is underestimated.
- Reference 2 evaluated the control room HVAC units for 97° water and determined the minimum acceptable flow to be 75 gpm. Current river temperature is 66°; therefore, 74 gpm is judged to be acceptable.
- Unit 2 provides backup flow, and credit could be taken for the Unit 2 PSW system to perform its safety function of supplying adequate flow to the control room HVAC units.

Case 2 (*PSW HATCH UNIT 1 2007 LOCA with maximum break.PDB*)
Pipe section 101 in the model is the 10" Division II supply header to the reactor building. A single hole is modeled at Node 0270. Since the control room HVAC units are already receiving less than design flow in Case 1, and those flows have been evaluated for acceptability, the hole size will continue to be increased until the next safety-related component reaches its design flow. By trial and error, with a single 3.97" diameter hole in the Division II supply header to the reactor building, PROTO-FLO predicts the following flows to safety-related components:

Table 2

Component	Pipe	Design Flow (GPM)	Predicted Flow (GPM)
1E11C001A	906	4	8.3
1E11C001B	920	4	8.6
1E11C001C	914	4	8.4
1E11C001D	926	4	8.6
1P41C001A	38	2	4.7
1P41C001B	53	2	4.9
1P41C001C	43	2	4.8
1P41C001D	59	2	4.9
1T41B002A	603	100	217
1T41B002B	612	100	213
1T41B003A	733	100	170
1T41B003B	740	100	168
1T41B004A	672	25	41
1T41B004B	669	25	36
1T41B005A	721	25	34
1T41B005B	724	25	30
1R43S001A	139	700	844
1R43S001C	128	700	725
1Z41B008A (Div. I)	1318	120	100
1Z41B008C (Div. II)	1332	120	64

All of the safety-related components receive design flow except the control room HVAC units. The Division I HVAC unit (1Z41-B008A) receives approximately the same flow as indicated in Reference 1. This flowrate was determined to be acceptable as discussed in Reference 1. The Division II HVAC unit (1Z41-B008C) receives 64 gpm which is less than design. This flowrate is judged to be acceptable because:

- The current model (Reference 1) has not been revised since control room HVAC pipe replacement and cleaning; therefore the predicted flow is underestimated.
- Reference 3 evaluated the control room HVAC units for reduced flow and determined the minimum acceptable flow to be 63.9 gpm at a maximum water temperature of 91.8°

cooling water (with margin limitations as discussed in Reference 3). Current river temperature is less than 91.8°; therefore, 64 gpm is judged to be acceptable.

- Unit 2 provides backup flow, and credit could be taken for the Unit 2 PSW system to perform its safety function of supplying adequate flow to the control room HVAC units.

Determine maximum through-wall leakage area based on 3.97" hole:
$Area_{max} = (\pi D^2)/4 = \pi(3.97^2)/4 = 12.38\ in^2$

Conclusion:
With two 2" x 3" holes (modeled as 2.45" diameter holes for a total through-wall leakage area of 9.42 in^2) in the PSW Division II supply header to the reactor building, PROTO-FLO predicts all safety-related components will receive design flow, with the exception of the control room HVAC units. By judgement, the control room HVAC units will receive sufficient flow to perform their safety function.

With a maximum through-wall leakage area of 12.38 in^2 in the Division II supply header to the reactor building (modeled as a single 3.97" diameter hole), PROTO-FLO predicts all safety-related components will receive design flow, with the exception of the control room HVAC units. By judgement, the control room HVAC units will receive sufficient flow to perform their safety function.

List of Attachments:

1. PROTO-FLO summary report for Case 1
2. PROTO-FLO summary report for Case 2
3. Email from Eric King to Scott Kirk, October 22, 2011, with strainer packing leak flow
4. Email from Eric King to Scott Kirk, October 21, 2011, with pipe hole sizes

Southern Nuclear - P:\Models\Hatch\SMNH-02-012\PSW HATCH UNIT 1 2007 LOCA with break.PDB - Version 4.6

DOEJ-HRSNC341070-M001 - Attachment 1

Flow Summary Report

Convergence: Pressure=1.0E-5 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pipe 38	0.493	4.74	2.0		
Pipe 43	0.493	4.75	2.0		
Pipe 53	0.493	5.07	2.0		
Pipe 59	0.493	5.08	2.0		
Pipe 128	6.065	762.35	700.0		
Pipe 139	6.065	844.42	700.0		
Pipe 603	2.469	216.69	100.0		
Pipe 612	2.469	212.30	100.0		
Pipe 669	1.939	35.92	25.0		
Pipe 672	1.939	40.46	25.0		
Pipe 721	1.278	37.94	25.0		
Pipe 724	1.278	32.86	25.0		
Pipe 733	2.469	187.78	100.0		
Pipe 740	2.469	185.43	100.0		
Pipe 906	0.493	8.33	4.0		
Pipe 914	0.493	8.35	4.0		
Pipe 920	0.493	8.94	4.0		
Pipe 926	0.493	8.99	4.0		
Pipe 1318	3.068	99.62	** < 120.0		
Pipe 1332	3.068	74.34	** < 120.0		

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

Southern Nuclear - P:\MODELS\HATCH\SMNH-02-012\PSW HATCH UNIT 1 2007 LOCA WITH MAXIMUM BREAK.PDB -

DOEJ-HRSNC341070-M001 - Attachment 2

Flow Summary Report

Convergence: Pressure=1.0E-5 Sum Q=1.0E-2 Friction=1.0E-6 FCV=1.0E-4 PCV=1.0E-3 Temperature=5.0E-3

Flow Summary Title	Diameter (in)	Flow (gpm)	Minimum Flow (gpm)	NPSHA (ft)	NPSH Ratio
Pipe 38	0.493	4.74	2.0		
Pipe 43	0.493	4.75	2.0		
Pipe 53	0.493	4.85	2.0		
Pipe 59	0.493	4.87	2.0		
Pipe 128	6.065	725.44	700.0		
Pipe 139	6.065	844.33	700.0		
Pipe 603	2.469	216.91	100.0		
Pipe 612	2.469	212.51	100.0		
Pipe 669	1.939	35.96	25.0		
Pipe 672	1.939	40.50	25.0		
Pipe 721	1.278	34.30	25.0		
Pipe 724	1.278	29.71	25.0		
Pipe 733	2.469	169.98	100.0		
Pipe 740	2.469	167.85	100.0		
Pipe 906	0.493	8.33	4.0		
Pipe 914	0.493	8.35	4.0		
Pipe 920	0.493	8.57	4.0		
Pipe 926	0.493	8.62	4.0		
Pipe 1318	3.068	99.70	** < 120.0		
Pipe 1332	3.068	63.92	** < 120.0		

!! Reverse Flow Through Check Valve

** Flow Below Minimum

&& Pump Flow is Past End of Curve

$$ NPSH Available Below NPSH Required

Kirk, Scott

From: King, John Eric
Sent: Saturday, October 22, 2011 9:29 AM
To: Kirk, Scott
Subject: PSW Leakage Calculations

2 Holes have been identified in the Unit 1 Division II PSW Reactor Building Header

Hole 1:

Hole 1 is round with 1-1/8" diameter

Flow	Q =	.6*A*sqrt((2*g*P)/p)			
Pressure	P =	180	lbf/in^2		
Density	p =	0.03657	lbf/in^3		
Gravity	g =	32.174	ft/s^2		
Area Hole 1	A =	pi*(d^2)/4	=	0.99402	in^2
Hole 1 Diameter	d =	1.125	in		
Conversions					
12	in/ft				
0.004329	gal/in^3				
60	s/min				
Hole 1 Flow	Q=	302	gpm		

Hole 2:

Hole 2 is elliptical with a major axis of 2-1/4" and a minor axis of 2"

Flow	Q =	.6*A*sqrt((2*g*P)/p)			
Pressure	P =	180	lbf/in^2		
Density	p =	0.03657	lbf/in^3		
Gravity	g =	32.174	ft/s^2		
Area of 1 hole	A =	pi*a*b	=	3.534292	in^2
Major Axis/2	a =	1.125	in		
Minor Axis/2	b =	1	in		
Conversions					
12	In/ft				
0.004329	gal/in^3				
60	s/min				
Hole 2 Flow	Q=	1074	gpm		

A packing leak on PSW strainer 1P41D103B

The hole is round with a 2-1/2" diameter

The shaft is round with a 2.393" diameter

Flow	Q =	.6*A*sqrt((2*g*P)/p)			
Pressure	P =	180	lbf/in^2		
Density	p =	0.03657	lbf/in^3		
Gravity	g =	32.174	ft/s^2		
Hole Area	Ah =	pi*(dh^2)/4	=	4.908739	in^2
Shaft Area	As=	pi*(ds^2)/4	=	4.497543	
Leak Area	Al =	Ah-As	=>	0.411196	

Hole Diameter	dh=		2.5	in	
Shaft Diameter	ds =		2.393	in	
Conversions					
12	in/ft				
0.004329	gal/in^3				
60	s/min				
Strainer Flow	Q=		125	gpm	
All Leakage Considered					
Total Flow	Q=		1501	gpm	
Leakage Impacts:					
Pump Capacity	Qp=		8500	gpm	From flow model
Required Flow	Qr=		4428	gpm	From H16012
Leakage Flow	Ql=		1501	gpm	From above
Flow Margin	Qm=	Qp-Qr		4072	gpm
Acceptable if Qm > Ql					
Is Qm > Ql?	Yes				

Kirk, Scott

From:	King, John Eric
Sent:	Friday, October 21, 2011 1:45 PM
To:	Kirk, Scott
Subject:	Unit 1 Division II PSW Leak

Scott,
Could you help me figure out the effect that a leak would have on the 10" Unit 1 Division II PSW line to the reactor building? There are 2 pits found on the pipe. Both pits have an oval shape and are 2" x 3" in size. There is currently through wall leaks at both pits. For the operability evaluation, we are assuming that the entire pit is a through wall leak. I calculated the flow from this size hole to be 2863 gpm. See the calculation below:

(2) Holes
Each hole is 2"x3" elliptical

Flow	Q =	.6*A*sqrt((2*g*P)/p)			
Pressure	P =	180	lbf/in^2		
Density	p =	0.03657	lbf/in^3		
Gravity	g =	32.174	ft/s^2		
Area of 1 hole	A =	pi*a*b	=	4.712389	in^2
Major Axis/2	a =	1.5	in		
Minor Axis/2	b =	1	in		
Conversions					
12	in/ft				
0.004329	gal/in^3				
60	s/min				
1 Hole =>	Q=	1432	gpm		
2 Holes =>	Q=	2863	gpm		

Thanks,
Eric