CP&L

Carolina Power & Light Company
Harris Nuclear Plant
PO Box 165
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OCT 29 1999

SERIAL: HNP-99-172

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ALTERNATIVE PLAN FOR SPENT FUEL POOLS C & D COOLING AND CLEANUP SYSTEM PIPING

Dear Sir or Madam:

By letter HNP-98-188, dated December 23, 1998, Carolina Power & Light Company (CP&L) submitted a license amendment request to increase fuel storage capacity at the Harris Nuclear Plant (HNP) by placing spent fuel pools C & D in service. The U. S. Nuclear Regulatory Commission (NRC) issued letters dated March 24, 1999, April 29, 1999, June 16, 1999, and August 5, 1999 requesting additional information regarding our license amendment application. HNP letters HNP-99-069, dated April 30, 1999, HNP-99-094, dated June 14, 1999, HNP-99-112, dated July 23, 1999, and HNP-99-129, dated September 3, 1999 provided our respective responses.

By letter dated September 20, 1999, the NRC issued a fifth request for additional information (RAI) regarding our license amendment application to place spent fuel pools C & D in service. The September 20, 1999 NRC RAI specifically requests additional information on the proposed alternative plan to demonstrate compliance with ASME Code requirements for the cooling and cleanup system piping in accordance with 10 CFR 50.55a(a)(3)(i). The Enclosures to this letter provide the HNP response to the NRC staff's September 20, 1999 RAI.

The enclosed information is provided as supplement to our December 23, 1998 amendment request and does not change our initial determination that the proposed license amendment represents a no significant hazards consideration.

Please refer any questions regarding the enclosed information to Mr. Steven Edwards at (919) 362-2498.

Sincerely,

Donna B. Alexander
Manager, Regulatory Affairs
Harris Nuclear Plant

KWS/kws

Enclosures:

1. HNP Responses to NRC Request For Additional Information (RAI)
2. Technical Report: HNP - Material Identification of Chips from Carbon Steel Welds Associated with the Spent Fuel Pool Activation Project (1 page total)
3. Chemistry Sample Data Sheets (2 sheets total)
4. QCI-19.1, Revision 1, entitled "Preparation & Submittal of Weld Data Report, Repair Weld Data Report, Tank Fabrication Weld Record & Seismic I Weld Data Report" (25 pages total)

c: Mr. J. B. Brady, NRC Senior Resident Inspector (w/ Enclosure 1)
Mr. Mel Fry, N.C. DEHNR (w/ Enclosure 1)
Mr. R. J. Laufer, NRC Project Manager (w/ all Enclosures)
Mr. L. A. Reyes, NRC Regional Administrator - Region II (w/ Enclosure 1)

bc: (all w/ Enclosure 1)

Mr. K. B. Altman
Mr. G. E. Attarian
Mr. R. H. Bazemore
Mr. C. L. Burton
Mr. S. R. Carr
Mr. J. R. Caves
Mr. H. K. Chernoff (RNP)
Mr. B. H. Clark
Mr. W. F. Conway
Mr. G. W. Davis
Mr. W. J. Dorman (BNP)
Mr. R. S. Edwards
Mr. R. J. Field
Mr. K. N. Harris

Ms. L. N. Hartz
Mr. W J. Hindman
Mr. C. S. Hinnant
Mr. W. D. Johnson
Mr. G. J. Kline
Mr. B. A. Kruse
Ms. T. A. Head (PE&RAS File)
Mr. R. D. Martin
Mr. T. C. Morton
Mr. J. H. O'Neill, Jr.
Mr. J. S. Scarola
Mr. J. M. Taylor
Nuclear Records
Harris Licensing File
Files: H-X-0511
H-X-0642

SHEARON HARRIS NUCLEAR POWER PLANT
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RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE ALTERNATIVE PLAN FOR SPENT FUEL POOL
COOLING AND CLEANUP SYSTEM PIPING

Requested Information Item 1:

Explain how the Metorex X-Met 880 Alloy Analyzer discriminates between the different standards that you used in your analysis described in Enclosure 3, "Metallurgy Unit Report for Spent Fuel Pool Weld Metal Composition analysis," of your April 30, 1999, RAI response. What are the chemical element ranges associated with the different standards that you used? What determines a match on a particular standard? What chemical elements are not included in the "Match" determination and how are these elements reconciled?

Response 1:

Background:

The primary objective of the field alloy analysis was to confirm with reasonable assurance that the as-deposited weld material for the spent fuel pool piping field welds is an austenitic stainless steel material compatible with Type 304 stainless steel piping material. The chemical composition of the stainless steel filler materials are specified in ASME Section II, Part C, SFA-5.4 / 5.9. The elements controlled under this specification for stainless steel filler materials are: carbon, chromium, nickel, molybdenum, columbium plus tantalum, manganese, silicon, phosphorus, sulfur, nitrogen, and copper.

The Alloy Analyzer was used in a comparison / identification mode. In the comparison / identification mode, the unknown is compared to reference materials which are input by a specific measurement technique and stored in a memory location of the instrument. This method of analysis was selected to provide reasonable assurance that the chemical compositions of analyzed field welds are consistent with an austenitic stainless steel having a chromium content in the range of 18 to 24 weight percent and a nickel content in the range of 8 to 14 weight percent.

Explain how the Metorex X-Met 880 Alloy Analyzer discriminates between the different standards that you used in your analysis described in Enclosure 4, "Metallurgy Unit Report for Spent Fuel Pool Weld Metal Composition Analysis," of your April 30, 1999, RAI response.

The Metorex X-Met 880 Alloy Analyzer utilizes a Cadmium-109 isotopic source to excite the analyzed material and measure the secondary radiation produced by the source excitation. This instrument can detect elements that range between and include chromium and molybdenum on the periodic chart of the elements. (The elements between and including terbium and uranium are also detected by this instrument with a cadmium source.)

The instrument was configured to detect six specific elements using the following pure element standards: (1) chromium, (2) manganese, (3) iron, (4) nickel, (5) copper, and (6) molybdenum. Iron was selected because austenitic stainless steels are considered to be iron-based alloys; chromium, nickel, and molybdenum were selected because they are primary alloying elements; manganese was selected because it is a secondary alloying element; and copper was selected because it is a potential "tramp" (i.e., unwanted) element in this material that is detectable by this instrument. A backscatter standard was used to determine the background spectrum. The pure element standards and the backscatter standard were supplied with the instrument by the manufacturer. A series of comparison standards were loaded into the instrument for this analysis. These standards included: (1) Type 304 stainless steel, (2) Type 309 stainless steel, (3) Type 310 stainless steel, (4) Type 316 stainless steel, and (5) NIST SRM 1154a. These four secondary standards and one National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) were used because: (1) the instrument was used in a comparison mode, and (2) none of the SRMs available from NIST have compositions consistent with either Type 304, Type 308, or Type 309 stainless steels. NIST SRM 1155 (Type 316 stainless steel) and NIST SRM C1287 (Type 310 stainless steel - modified) were used also, as independent reference checks of the instrument during the field analysis.

In the comparison / identification mode, the unknown is compared to reference materials which are input by a specific measurement technique and stored in a memory location of the instrument. The alloy analyzer has a multi-channel analyzer (MCA) having 256 micro channels. These micro channels represent a specific X-ray energy range (e.g., Channel 1 - 1 to 2 eV, Channel 2 - 2 to 3 eV, etc.). Each element has an average value for its excitation X-ray energy and, in practice, the actual response has a Gaussian distribution. Each pure element has a range, or window, consisting of several micro channels based on the full width at half maximum value of the Gaussian distribution. Therefore, counts detected in an element window are due to a detectable and measurable concentration of this element. The pure element standards and the austenitic stainless steel standards have different compositions. The response of the instrument varies with the concentration of a given element in a standard. The counts obtained for a standard by this instrument are proportional to the elemental concentration(s). Each standard will have a unique pattern (or "fingerprint") of counts in the selected element windows based on its chemical composition. The instrument discriminates between standards and unknowns based on the similarity of the instrument response (or counts detected) to the element windows for the stored standards.

What are the chemical element ranges associated with the different standards that you used?

The chemical element ranges for the standards used are shown below in Table 1. The NIST SRM (1154a) that was used to set-up the Alloy Analyzer has a chemical composition that is not within the chemical composition range for any standard UNS stainless steel alloy. However, the nickel and chromium contents of the NIST 1154a standard are similar to the nickel content of the Type 309 comparison standard and the chromium content of the Type 304 comparison standard, respectively. The remaining detectable elements in these three comparison standards are comparable and cannot be used to accurately differentiate between the various unknowns.

TABLE 1

Chemical Element Ranges for Standards Used to Set-up the Metorex Alloy Analyzer						
Standard	Composition, Weight Percent					
	Chromium	Manganese	Iron	Nickel	Copper	Molybdenum
Type 304	**18.28**	1.48	bal.	8.13	0.19	0.17
Type 309	22.60	1.63	bal.	**13.81**	--	--
Type 310	24.87	1.94	bal.	19.72	0.11	0.16
Type 316	16.74	1.44	bal.	10.07	0.11	2.06
NIST 1154a	**19.31**	1.44	bal.	**13.08**	0.44	0.068
Chemical Element Ranges for Standards Used to Check the Alloy Analyzer						
NIST C1287	23.98	1.66	bal.	21.16	0.58	0.46
NIST 1155	18.45	1.63	bal.	12.18	0.169	2.38

The tolerances for the chemical element ranges for the secondary standards (nominal Type 304, Type 309, Type 310, and Type 316 stainless steels) are not known. These secondary standards were provided with mill test reports for their chemical compositions, but the precise accuracy of these standards is not known because they are not certified as traceable to primary reference standards. However, the applicable ASTM standards for these alloys permit a major alloying element range of between 1 and 2.5 weight percent (e.g., carbon content - 0.08 weight percent maximum; silicon content - 1.00 weight percent maximum; nickel content - 8.00 to 10.50 weight percent maximum; etc.) without the applicable product analysis tolerances that depend upon the specific element and its relative concentration.

What determines a match on a particular standard?

During a test, the Alloy Analyzer detects, measures, and compares the counts obtained for the specified elements in the unknown to those for the standards that have been loaded into the instrument (the specified elements are those that were loaded as pure element standards during the instrument set-up). The X-ray energy detection range for each of the specified elements is pre-set in the instrument and is based on physical constants related to the energy difference between electron shells in atomic structures. The number of counts in each pure element range is measured and compared to the counts for these elements in the known comparison standards. The difference in counts between the unknown and the comparison standards is measured. The instrument is configured with three thresholds (or limits) for the difference in counts between the closest standard and the unknown. The least amount of difference between a comparison standard and the unknown is indicated by "GOOD MATCH." If there are differences between the unknown and standard that do not meet the "GOOD MATCH" criteria, but the unknown is similar to one or more standards, the alloy analyzer will indicate "POSSIBLE MATCH." If the difference in counts is too large, the instrument will indicate "NO GOOD MATCH."

What chemical elements are not included in the "Match" determination and how are these elements reconciled?

The primary objective of the field alloy analysis was to confirm with reasonable assurance that the as-deposited weld material was an austenitic stainless steel material compatible with the Type 304 stainless steel piping material. The chemical compositions of stainless steel filler materials are specified in ASME Section II, Part C, SFA-5.4 / 5.9. The elements controlled under this specification for stainless steel filler materials are: carbon, chromium, nickel, molybdenum, columbium plus tantalum, manganese, silicon, phosphorous, sulfur, nitrogen, and copper.

The alloy analyzer was set up to detect the primary alloying elements: chromium, nickel, and molybdenum. In addition, the alloy analyzer was also set up to detect the secondary alloying element manganese, the tramp element copper, and the alloy base iron. The remaining elements addressed in the specification, but not detected by the alloy analyzer, are: carbon, columbium plus tantalum, silicon, phosphorous, sulfur, and nitrogen. None of these elements are capable of being detected with the Metorex Alloy Analyzer using a Cadmium-109 source either due to their relative concentration or their X-ray excitation energy. These secondary alloying elements, while important to the weldability characteristics of the filler material, are not as important to the performance of the weld in service with regard to strength and corrosion resistance.

Samples of three spent fuel pool cooling piping field welds were obtained by plant personnel and submitted to an external commercial laboratory for chemical analysis. The elements that were not determined by field analysis and those that were used in the identification mode of the field welds were measured by this laboratory and are shown in Table 2. Laboratory analysis of this representative sample substantiates the results of the field analysis and provides additional assurance that the chemical compositions of spent fuel pool field welds are satisfactory.

TABLE 2

NSL Chemical Analysis Results			
Identification	**2-SF-36-FW-450**	**2-SF-38-FW-451**	**2-SF-71-FW-329**
Alloy Analyzer Results	304 SS Possible	NIST 1154a Possible	NIST 1154a Possible
NSL Chemical Analysis Results			
Carbon	0.13	0.10	0.064
Niobium	< 0.05	< 0.05	< 0.05
Chromium	20.08	20.11	19.06
Copper	0.054	0.10	0.093
Manganese	1.46	1.39	0.79
Molybdenum	0.12	0.10	0.085
Nickel	9.30	9.24	9.63
Phosphorus	0.021	0.021	0.026
Sulfur	0.007	0.005	0.013
Silicon	0.37	0.39	0.25
Titanium	< 0.01	0.011	< 0.01

In summary, the alloy analyzer was set up to confirm with reasonable assurance that the as-deposited weld material for the spent fuel pool piping field welds is an austenitic stainless steel material compatible with the reported Type 304 stainless steel piping material and the chemical composition requirements specified in ASME Section II, Part C, SFA-5.4 / 5.9. The programmatic and procedural controls which existed at the time of construction, augmented by the testing and analysis effort described above, provide reasonable assurance that the weld material for the spent fuel pool piping field welds is the proper weld material and will perform satisfactorily in service.

Requested Information Item 2:

Provide assurance that the ferrite numbers are acceptable for A-No. 8 weld wire (ND-2433) used in welds with missing weld wire documentation.

Response 2:

Ferrite numbers have been measured for 18 of the 19 accessible field welds remaining in the scope of the Alternative Plan (one field weld is located underneath a grating which could not be removed at the time the measurements were taken). The results of this work show mean ferrite numbers ranging from approximately 4 to 9 FN. SFA 5.9, Section A4.12 states that the ferrite potential for 308, 308L, and 347 is approximately 10 FN, but notes that the ferrite content may vary by +/- 7 FN or more around these midpoints and still be within the limits of the chemical specification. Furthermore, Section A4.13 also states that the ferrite potential of a filler metal is usually modified downward in the deposit due to changes in the chemical composition caused by the welding process and technique used.

Ferrite is know to be beneficial in reducing the tendency for cracking or fissuring in weld metals; however, it is not critical, particularly under the mild service conditions associated with the spent fuel pool cooling system. Assurance that the ferrite numbers are acceptable is demonstrated by the following: (1) the measured ferrite numbers are reasonably consistent with those expected for the type of filler material used, (2) all of the exposed field welds in the scope of the Alternative Plan have successfully completed a liquid penetrant examination which noted no evidence of cracks or fissures, (3) a strict materials control program governed issuance and control of weld materials, and (4) there is no evidence that incorrect or uncontrolled filler material might have been used.

Requested Information Item 3:

Explain the chemical analysis in the Table associated with PQR 6(c), dated 11/15/84, page 2 of 2, laboratory test No. 9-2-149 described in Enclosure 6, "Lab Test Reports," of your April 30, 1999, RAI response. What row(s) are associated with the base material, weld, and standard(s)? What criteria was used to determine acceptability?

Response 3:

Welding Procedure Specification (WPS) 8B2, Revision 16 is supported by four Procedure Qualification Records (PQRs). The original procedure qualification test, as documented on PQR 6, was performed in 1976. The procedure qualification test coupon for this test was prepared from 10 inch schedule 40 pipe, which has a wall thickness of 0.365 inches. This test coupon thickness supports a qualified base metal thickness range of 3/16 (0.1875) inches to 0.730 inches. In 1981, an additional procedure qualification test, as documented in PQR 6(A), was performed to support the extended thickness range of 3/16 inches to 8 inches. This new qualified range was achieved by welding a 1.5 inch thick weld test coupon. In 1982, another procedure qualification test was performed, as documented in PQR 6(B), to expand the thickness range qualified to include a base material thickness as thin as 0.049 inches. This extended range was achieved by welding a 0.049 inch wall thickness test coupon. In 1984, the final procedure qualification test, as documented in PQR 6(C), was performed to extend the qualified thickness range to include materials as thin as 0.031 inches. This new thickness range was achieved by welding a weld test coupon with a thickness of 0.031 inches.

The portion of WPS 8B2, Revision 16 that was used to fabricate the fuel pool piping, based on base metal thickness range, is supported by PQR 6 and PQR 6(A). The fuel pool piping has a nominal wall thickness of 3/8 (0.375) inches, which is within the qualified base metal thickness range of 3/16 (0.1875) inches to 0.730 inches for PQR 6 and 3/16 (0.1875) inches to 8 inches for PQR 6(A).

Relative to the chemical analysis in the Table associated with PQR 6(c), dated 11/15/84, page 2 of 2, laboratory test No. 9-2-149, referenced WPS 8B2 addresses welding of a SA240 TP 304 test coupon with a thickness of 0.031 inch. The documented mechanical test results reference two test specimens having a thickness of 0.031 inch (E&E Laboratory Test Number 9-2-149, specimen numbers 699 and 700). PQR 6(c) references an Arcos welding filler material, which according to the Certified Material Test Reports (CMTRs) attached to PQR 6(c) is Type 316 stainless steel filler material.

A definitive explanation for all of the entries on the data sheet in question, page 2 of 2 of the chemical analysis results, can not be provided due to insufficient documentation. However, based on the documentation supporting the procedure qualification test for PQR 6 (C), Metallurgy Unit test records and anecdotal information, it appears that Harris Welding Engineering personnel requested the E&E Laboratories to perform mechanical testing and chemical analyses for a completed welding procedure qualification coupon performed using 0.031 inch thick Type 316 stainless steel base material. It is believed that the chemical analysis requested was to be performed on a sample of the material taken from the item that was to be welded in production and which provided the impetus to perform the additional weld procedure qualification. This is supported by the fact that chips of the supplied material were provided to the Analytical Chemistry Laboratory on November 12, 1984 (sampled on November 9, 1984) while the PQR is dated November 15, 1984. This indicates that the chemical analysis was performed prior to the welding of the procedure qualification test coupon and should not be considered a part of the procedure qualification test.

Requested Information Item 4:

For the piping and welds examined internally, provide a discussion of the examination results. What inspection criteria is used for evaluating the piping and welds for corrosion and fouling? Describe the corrosion and fouling inspection procedure and inspection personnel qualification process. For the embedded welds not examined internally, describe what is preventing their examination. Discuss why the decision not to inspect all of the embedded welds will result in an acceptable level of quality and safety.

Response 4:

An initial visual inspection of the embedded piping and welds was completed using a pneumatically-powered crawler carrying a high resolution camera. This crawler employed two sets of pneumatic cylinders which expanded and contracted in coordination with a single cylinder between them to produce an "inch worm" effect. Inspections of four of the eight embedded spent fuel pool cooling lines were performed using this crawler, including six embedded field welds. Camera resolution was excellent and the visual inspection of the lines was thorough. This arrangement proved unsuitable, however, for longer lines having multiple elbows, and a decision was made to investigate other possible methods of inspecting the balance of embedded piping. An arrangement was eventually selected which used flexible fiberglass rods to manually drive a camera on rollers through the pipe. A second inspection effort, only recently completed, used this crawler to successfully inspect all 9 of the remaining embedded field welds and associated piping.

The remainder of this response will focus on the initial inspection of four SFP cooling lines and six embedded welds. The results of the inspection of the remaining lines and nine embedded welds is still in the review process. Our preliminary evaluation is that the results of the second visual inspection are consistent with those of the first inspection and demonstrate that the piping and welds have not measurably degraded and are acceptable for their intended purpose.

The pneumatically-powered crawler provided a stable base from which to successfully complete a visual examination of the piping and welds which could be reached using this equipment. Each inspection was preceded by a resolution check wherein the camera was required to discern a 1.0 mil wire at the appropriate focal length, and the level of detail provided of the internal pipe surfaces was excellent. These inspections were conducted in accordance with Special Plant Procedure SPP-0312T, which provided specific acceptance criteria, as well as qualification requirements for the equipment and inspectors. The inspection included welds on four of the eight embedded cooling lines connected to Spent Fuel Pools C & D. All of the lines inspected were 12 inch, schedule 40 stainless steel (304) piping.

The initial inspection included the following field welds:

Field Weld Number	Piping Function
2-SF-8-FW-65	C SFP Cooling Supply
2-SF-8-FW-66	C SFP Cooling Supply
2-SF-143-FW-512	D SFP Cooling Supply
2-SF-144-FW-515	D SFP Cooling Supply
2-SF-144-FW-516	D SFP Cooling Supply
2-SF-159-FW-408	D SFP Cooling Supply

In accordance with the acceptance criteria in Special Plant Procedure SPP-0312T, welds which can be accepted without further evaluation must be completely free of the following defects:

- no Cracks
- no Lack of Fusion
- no Lack of Penetration
- no Oxidation
- no Undercut greater than 1/32"
- no Reinforcement ("Push Through") greater than 1/16"
- no Concavity (Suck Back") greater than 1/32"
- no Porosity greater than 1/16"
- no Inclusions

In addition, any indications not included in the above list of weld attributes but potentially pertinent to the condition of the piping and welds were required by the inspection procedure to be reviewed and formally evaluated by Harris Nuclear Plant Engineering staff. Such indications would include arc strikes, foreign material, evidence of mishandling, pipe mismatch, pitting, and evidence of corrosion.

The inspection procedure requires that personnel performing visual examinations be CP&L Visual Weld Examiners, certified in accordance with the Corporate NDE Manual. In addition, they are required to have successfully completed the CP&L training course on remote camera equipment and/or have demonstrated their capability to utilize the equipment to the satisfaction of the NDE VT Level III. Vendor personnel operating the closed circuit television system were not required to be certified visual weld examiners, but were required to be familiar with their equipment and proficient in its use.

Generally, the inspection results were good. It is noted that the welds in question were not subject to volumetric examination, and were sufficiently far from the open end of the pipe at the time of welding that an internal visual examination would not have been performed at the time of welding. Relative to the inspection criteria pertaining to weld attributes provided above, five of the six field welds were accepted based on the qualified examiner's review of the camera inspection video. A single weld, 2-SF-144-FW-516, was identified as having areas where portions of a consumable insert could be discerned. This weld, which exists in the horizontal piping on the supply line to SFP D, had several locations where a consumable insert had been utilized but was not fully consumed. Generally, these locations were limited to several very small areas where a small portion of the insert could be discerned, but included one area about 1.5 inches long where a continuous portion of the insert could be seen.

The presence of a small amount of unconsumed insert is not considered to be an indication of an unqualified welder, inadequate procedures, or inappropriate materials. The small amount of unconsumed insert is a relatively insignificant imperfection which is not unusual on field welds such as 2-SF-144-FW-516, which was only subject to surface examination and does not lend itself to internal visual examination. ASME Section III, Subsection ND design rules recognize the potential for imperfections of this nature in welds not subject to volumetric examination, and require that a reduction in joint efficiency be assumed for butt welds which are subject to surface examination only (ref. ND-3552.2).

The root pass associated with the indication of unconsumed insert is backed up by multiple weld passes, any one of which would be adequate to establish a leak tight pressure boundary under these conditions. Hydrostatic test records show that field weld 2-SF-FW-144-516 successfully completed hydrostatic testing at 32 psi during construction prior to the line being embedded, and that this test was witnessed by both QC and the ANI. Procedures and processes at the time required that both these field welds were subject to multiple inspections and documentation reviews during construction. Given this, and considering that this weld was subject to multiple inspections at the time of construction, it is highly unlikely that the indications noted on field weld 2-SF-144-FW-516 extend into the root pass, let alone the multiple passes that followed it.

Since field weld 2-SF-144-FW-516 is on a line which connects directly to atmospheric spent fuel pools, hydraulic pressure at the welds is limited to static head and a small amount of friction losses. (The effect of velocity head would be sufficiently small as to be negligible, but would actually tend to reduce the effective pressure.) At the location of field weld 2-SF-144-FW-516, static head due to the elevation difference is approximately 286 - 277.5 = 8.5 feet. Piping friction losses per 100 ft for 12 inch steel piping is only about 3 feet at 4000 gpm, so even considering the effect of elbows in the line, the 55 foot length of piping between this field weld and SFP C would only contribute another few feet for a total head of about 10 feet (i.e., less than 5 psi).

Operation of the SFP cooling and cleanup system for the C & D pools will be at a relatively low temperature and very low pressure. Accordingly, the minimum wall thickness needed to retain this pressure over a localized area of reduced wall is only a very small percentage of the 0.375 inch wall thickness in this piping. The piping in the vicinity of field weld 2-SF-FW-516 is completely embedded in concrete, located approximately at the center of a six foot thick, seismically-designed wall. As such, this piping is not subject to externally induced movement or stresses. Since the SFP cooling and cleanup system operates at a relatively low temperature with little variation, thermally induced stresses and thermal cycling are not of appreciable concern. Given the lack of externally induced stresses or thermal cycling, the small pieces of unconsumed insert will not initiate a crack or otherwise propagate a piping failure.

Based on all of the above considerations, the indications of an unconsumed insert identified on field weld 2-SF-144-FW-516 are acceptable, and no rework or repair to the weld is required.

Videotapes of the first six embedded field welds and associated piping to be visually inspected have been reviewed by CP&L engineering and metallurgical personnel. Aside from localized occurrences of loosely adhering surface film (principally boron deposits from boric acid added to the water), the videotape provides clear evidence that the piping was free from fouling or foreign materials. Where necessary, deposits were removed with pressurized water before the visual inspection. It is the consensus of the reviewers that the condition of the piping and welds is very good. Several inconsequential stains and small pits were noted, indicating that a small amount of minor corrosion may have occurred at some time in the past. Videotapes of all 15 embedded field welds and associated piping have been forwarded to corrosion experts both within CP&L and in the industry.

Requested Information Item 5:

What are the chemical analyses for steel welds 2-CC-3-FW-207, 2-CC-3-FW-208, and 2-CC-3-FW-209?

Response 5:

Chemical analyses for the carbon steel chips have been completed and are provided as Enclosure 2 to this RAI response. The results of these analyses substantiate that the filler material used for these welds is generally consistent with chemical composition requirements found in SFA 5.1 for ER70S-6 and SFA 5.18 for E7018.

Requested Information Item 6:

Describe the paper trail that identifies a specific weld material to a specific weld on the isometric drawings, i.e., show that the weld material being verified with the Metorex X-Met 880 was specified for that location. Identify missing documentation that breaks the paper trial, if any.

Response 6:

The weld metal to be used on a given weld was prescribed by the Weld Procedure Specification. The Weld Data Report (WDR) documented the Weld Procedure Specification to be used, as well as the AWS Classification of filler material. For the field welds for which WDRs are no longer available, it is not possible to directly document the Weld Procedure Specification and filler metal that was used. However, since the vendor data sheets are available on the pipe spools, a review has been done of the Weld Procedure Specifications available at that time and which would have been applicable for this type piping, material, and end prep. These Weld Procedure Specifications were provided to the NRC as Enclosure 6 to HNP-99-069, dated April 30, 1999, the HNP response to the March 24, 1999 NRC RAI on the Alternative Plan.

The pipe spools utilized in the HNP spent fuel pool cooling system are Type 304 stainless steel, a P-8 material. The Weld Procedure Specifications for P-8 to P-8 piping welds such as these in the spent fuel pool cooling system would have used filler metals conforming to SFA No. 5.4 / 5.9, including ER308, ER308L, ER316, ER316L and ER347. For Type 304 to Type 304 piping, ER308 would have typically been specified on the WDR. Given that some chemical changes in composition will be caused by the welding process and that blending of the base metal and filler metal would occur, the Metorex X-Met 880 testing is not intended to confirm the that chemical composition conforms to chemical composition requirements for each element, but rather to assure that weldments are sound by substantiating that the filler metal used was compatible with the piping material and generally consistent with composition requirements of the Weld Procedure Specification. Additional details on the use of the Alloy Analyzer to evaluate filler metal is provided in the HNP response to Requested Information Item 1 above.

Requested Information Item 7:

Discuss the chemical analysis and any other analysis performed on the water in the fuel pool cooling and cleanup system (FPCCS) and component cooling water system (CCWS) for spent fuel pools (SFPs) C and D. Where did the water come from? Discuss any differences between the chemical analysis and the original water source. Provide the staff with a representative analysis of the water.

Response 7:

A review of plant documentation substantiates that the embedded lines connected to SFPs C & D had water in them on two separate occasions during the construction process. Water samples were collected from seven of the eight lines associated with the embedded piping. * Analysis results of those water samples substantiate that the water in these lines originated from the spent fuel pools. Specifically, chloride and fluoride concentrations were very low, and generally consistent with specifications for spent fuel pool chemistry. Sulfate levels and conductivity, while not typically analyzed for spent fuel pool chemistry, were also very low and consistent with high purity water. The water samples also showed low levels of tritium, at a concentration similar to that of the spent fuel pools. Enclosure 3 to this RAI response provides a representative analysis of water samples taken from both the C and D SFP piping.

Initially, these lines were filled with water for hydrostatic testing prior to pouring concrete. Potential sources of hydrotest water included potable water and lake water, although procedures did require that the piping be drained and vented subsequent to test completion. Since these lines could not be isolated from their respective fuel pool liners, they would have been filled again in support of pool liner leak testing. The procedure for liner leak testing required test water to have a chloride content of no more than 100 ppm, which effectively precluded the use of either potable water or lake water for this evolution. Furthermore, procedures required the pools to be drained after testing, then rinsed with distilled or demineralized water. Subsequent to liner leak testing, there was no reason to introduce water into the pools again until they were filled and put into service (1989 - 1990 time frame). Several of these lines were drained one additional time in 1995 - 1996, when drain valves were added to the exposed portions of several of the embedded lines. Since that time, these lines refilled with water from the spent fuel pools. The water samples that were collected and analyzed, as discussed above, were samples of water that leaked past "plumbers plugs" in the pool nozzles since this last evolution.

* One of the eight lines has no drain line with an isolation valve for taking water samples, and was not represented in the initial set of water samples.

Requested Information Item 8:

In Enclosure 8, "Hydrotest Records for Embedded Spent Fuel Pool Cooling Piping and Field Welds," of your April 30, 1999, RAI response, you provided signed hydrostatic test reports for 13 embedded welds. Starting with the signed hydrostatic test report, back track through procedures and program requirements to the point where the missing document(s) were verified as being complete. In other words, identify the specific procedural and program controls requiring verification of completion of the missing documentation (manufacturing/fabrication records, weld data records, updated isometric drawings, and inspections) starting backward from the hydrostatic test report.

Response 8:

Construction procedure WP-115, "Pressure Testing of Pressure Piping (Nuclear Safety Related)," governed the hydrostatic testing of the embedded lines connected to HNP SFPs C and D. This procedure specifically required, prior to hydrotesting, the Mechanical QA Specialist verify that:

1) all required piping documentation is complete, and
2) all required weld documentation is complete.

Reference to piping and weld documentation is found in WP-102, "Installation of Piping." Specific requirements found in this document include:

1) that each weld joint for Code piping receive a WDR, and that these WDRs receive a QA and ANI inspection.
2) that weld procedures utilized be qualified in accordance with MP-01, "Qualification of Weld Procedures."
3) that welders and welding operators be qualified in accordance with MP-02, "Procedure for Qualifying Welders and Weld Operators."
4) that welds be stamped in accordance with MP-05, "Stamping of Weldments."
5) that weld material be controlled in accordance with MP-03, "Welding Material Control."

Generally, items 2 - 5 above ensure that Code welds were performed to appropriate procedures in the plant's Section IX weld program. Relative to item 1, WP-102 provided reference to CQC-19, "Weld Control" which again required that all Code welds received a WDR, and referenced procedure CQI-19.1, "Preparation & Submittal of Weld Data Report & Repair Weld Data Report," for detailed instructions on the use of WDRs. As prescribed by this procedure, the WDR included essentially all of the required attributes and documentation for welds within Code boundaries. Enclosure 4 provides a copy of CQI 19.1 at a revision level existing at or about the time most of the welds in question were made. Similarly, WP-102 contained requirements for layout and dimensional tolerances, as well as references to appropriate procedures for other piping installation processes, such as performance of cold pulls and torqueing of flanged connections. Therefore, in order to satisfy the prerequisites of procedure WP-115, the Mechanical QA Specialist would be required to verify that all the WDRs and RWDRs were complete and approved, dimensional and tolerance inspections had been completed, and all other piping installation processes had been completed and appropriately documented.

Requested Information Item 9:

Identify the concrete pouring procedure that requires checking for the welder symbol and a successful hydrostatic test before pouring.

Response 9:

Since embedding a line in concrete represented a point at which piping was no longer accessible for inspections, rework, etc., procedural controls were established to ensure that all required work activities had been completed and that documentation was in order prior to authorizing concrete placement. Procedure WP-05, "Concrete Placement", included a pre-placement requirement for a craft superintendent sign-off on the concrete placement report to signify completion of the craft's installation and superintendent inspection thereof. This procedure required that this sign-off be made by all craft superintendents, as a safeguard against omissions, whether or not they had material in a particular placement. Subsequently, procedure WP-05 required that the Construction Inspection Unit (QC) be notified when the installation was complete and ready for pre-placement inspection.

Procedure TP-24, "Mechanical Pipe Installation Inspection" provided requirements for the Construction Inspection Unit relative to inspection of piping, and included separate sections on embedded piping inspection. This procedure specifically required the CI inspector to inspect the installation and documentation prior to concrete placement. The CI inspector was required to verify the specific installation attributes:

1) that piping installation was performed in accordance with design drawings and documents, notably including verification of pipe spool identification
2) that piping was free from physical damage, and had no missing parts, and
3) that all piping leak tests were complete and documented.

It can be seen that procedures associated with concrete placement did provide assurance that piping embedded in concrete was the correct piping and was correctly installed. Furthermore, since the hydro-test was generally the final milestone for completion of a pipe segment, verification that all piping leak tests were complete and documented provided assurance that all test and inspection requirements were met. Procedures WP-05 and TP-24 do not specifically require a verification of the welder symbol. Rather, this assurance is provided by the review of weld documentation prior to hydro-testing, as well as the programmatic controls in CQC-19 and related procedures discussed above.

<u>Requested Information Item 10:</u>

Describe how the liner leak tests support weld integrity for welds 2-SF-8-FW-65 and 2-SF-8-FW-66 (Enclosure 3 of your response to NRCs RAI). For these two welds, back track through procedures and program requirements to the point where the missing documents were verified as being completed.

<u>Response 10:</u>

Leak testing of the liner was accomplished under procedure TP-057, "Hydrostatic Testing of Fuel Pool Liners." This procedure provided specific steps to be completed prior to performance of the liner leak test. The procedure required that Engineering prepare the test package, including identification of all boundaries and all isolation points to be utilized. For the north spent fuel pool liner hydrostatic test, the documented test boundaries included the piping runs containing 2-SF-8-FW-65 and 2-SF-8-FW-66.

Subsequent to preparation of the test package, QC was required to complete the "Prerequisites" section of the test form. Similar to the discussion of piping hydro-test procedures provided in the response to Requested Information Item 8 above, these prerequisites included a line item for the QC Inspector to verify "all weld documentation complete." Although the test procedure was specifically concerned with inspection of the liners, this verification would have necessarily extended to the entire pressurized boundary to ensure that no external leakage occurred, that partially completed welds were not overstressed, etc.

Although hydrostatic test packages have not been located at this time for welds 2-SF-8-FW-65 and 2-SF-8-FW-66, plant documentation does support that this hydrostatic test was done. For example, QA Deficiency and Disposition Report (DDR) 794 was initiated to assess hydrostatic test requirements for the plate rings reinforcing the piping to pool nozzle connections. The resolution to this DDR acknowledged that the pipe spools adjacent to these welds had been subject to hydrostatic testing, even going so far as to include the dates of test performance. Four of the ten spools listed are included in the scope of the SFP C and D embedded piping, and two of these spools are in the line in which welds 2-SF-8-FW-65 and 2-SF-8-FW-66 are located. The other two spools referenced are on isometric drawing 2-SF-159, and are specifically included in a hydrostatic test package for which records have been located (provided previously to the NRC as Enclosure 7 to HNP-99-069, dated April 30, 1999). Comparison of the dates listed on DDR 794 against those associated with piping on isometric drawing 2-SF-159 verify that the test dates on these documents are in agreement.

Therefore, even though hydrostatic test records specifically listing welds 2-SF-8-FW-65 and 2-SF-8-FW-66 as inspection items have not been located, it can be established with a high level of confidence that these welds were hydro-statically tested, and that documentation associated with these welds was reviewed and verified as being complete.

Requested Information Item 11:

Describe precautions that were taken to protect system components (e.g., pumps, valves, heat exchangers, piping) from deleterious environmental effects during layup. Describe the layed up condition of the partially completed piping system and how this was determined. How would these layup conditions be different if it was known that SFPs C and D would be put in service later?

Response 11:

The location of system components (e.g., pumps, valves, heat exchangers, piping), the 236' elevation area of the Fuel Handling Building, is fully enclosed and serviced by a safety related HVAC system. This area is also the location of the operating Unit 1 spent fuel pool cooling pumps and heat exchangers, and is completely suitable for the long term storage of piping and equipment. It was anticipated that at some time it would be necessary to place C and D pools into service, and consideration was given to specific requirements for equipment protection. The spent fuel pool cooling pump motors were removed and placed in controlled storage conditions with heaters energized and shafts periodically rotated. The spent fuel pool heat exchangers were capped to preclude introduction of foreign material, and provided with a nitrogen blanket on the shell (CCW) side to prevent moisture and other contaminants from inducing corrosion. Spent Fuel Pool Cooling piping not connected to the spent fuel pools, which had never been wetted and was not connected to any active water systems, also received Foreign Material Exclusion (FME) type covers. Notably, the spent fuel pool cooling pumps and strainers were protected by FME covers on adjacent piping.

Through conversations with cognizant personnel, it is known that when it became necessary to fill the C and D spent fuel pools, the exposed ends of the connected spent fuel pool piping were fitted with leak tight covers and flooded as well. At some point, "plumber's plugs" were fitted in the C and D spent fuel pool cooling nozzles, although it is not clear whether these plugs were installed before or after the lines were flooded by the spent fuel pools. The primary purpose of these plugs was not for equipment protection but instead for ALARA considerations, i.e., to preclude collection of radioactive material in the piping.

Requested Information Item 12:

Why was visual inspection rather than ultrasonic inspection chosen to examine the integrity of the embedded welds?

Response 12:

Examination requirements for the embedded spent fuel pool cooling piping at the time of construction consisted of a surface visual and liquid penetrant examination of the piping OD, consistent with design rules and NDE requirements in ASME Section III, Subsection ND. Numerous programmatic and documentation assurances exist to confirm that these required inspections were indeed completed. In reviewing options for inspection of embedded piping and associated welds under the Alternative Plan, the objective was to implement an inspection program which: (1) provided yet another measure of assurance of construction quality, (2) provided a means to inspect as much of the overall scope as possible, (3) allowed for inspection of not only discrete areas of interest (ie., field welds), but also for qualitative assessment of overall piping condition, including corrosion and fouling, and (4) had a high level of probability to produce meaningful results with existing, proven technology. These criteria are individually discussed as follows:

1) Provides additional measure of assurance of construction quality

A detailed inspection of the interior of the piping with a high resolution camera provides a means to discern and assess numerous attributes pertaining to construction quality, including fit-up and alignment, adequacy of purge, and fusion of the root pass. These attributes, while readily examined with the use of a remote camera, do not lend themselves to detection and evaluation through ultrasonic examination.

2) Provides a means to inspect as much of the overall scope as possible

Camera inspection provides a means to see as much of the overall inspection scope (piping interior surfaces) as possible, as well as focus on specific areas of interest. A number of vendors offer inspection services of piping using remote cameras and a variety of propulsion methods, providing the best probability of inspecting as much of the piping as possible. Using real time feedback, direct camera operators can move relatively quickly over long runs of piping which can be readily observed as clean and in good condition; however, considerable time is spent in adjusting focus, lighting and other parameters to provide a detailed examination of specific areas of interest. Although ultrasonic techniques are commonly used to detect wall thinning in steam piping, this process requires that the entire surface to be examined be mapped, with each grid location receiving an ultrasonic examination. Clearly, the lack of access in the embedded piping precludes the use of a similar technique to assess the overall condition of the embedded piping.

3) Allows for inspection of overall piping condition, but also macroscopic examination for fouling, corrosion, etc.

Camera inspection is the only viable means to identify and assess numerous attributes which pertain to the suitability of piping for service, including surface corrosion, fouling, foreign objects in the line, etc. Visual inspection with a high resolution camera can also detect visual evidence of corrosion (stains, discoloration) even when no loss of material or other degradation is obvious.

(4) Provide a high level of probability of producing meaningful results with existing, proven technology

While not deemed appropriate to evaluate macroscopic examination of piping quality for the reasons discussed above, CP&L has investigated the feasibility of using ultrasonic examination to disposition discrete, localized indications. The obstacles associated with remotely performing ultrasonic examinations of these 12 inch embedded lines are considerable, and include:

- Piping runs approaching 100 feet long
- Piping runs including 4 or more elbows
- Both horizontal and vertical runs
- Since pools are full, inspections must be done from the exposed piping end, meaning that all vertical runs are upward
- The weld joints themselves are irregular to the extent a direct beam method could not be used. In addition, these butt welds utilized consumable inserts with an end prep having a counterbore approximately ¾ inch from the weld joint. This configuration complicates the use of angle beam ultrasonic methods
- The piping surface must be clean and smooth, such that boron crystals or any other film or material which are in the area to be inspected must be removed.
- A means must be devised to inject couplant in the area to be inspected
- The technique must provide a means to precisely locate and control the detector transducers, which would invariably require the use of a remote camera

The device would need to be capable of propelling a camera, UT transducers, and all attendant cabling through long pipe sections with numerous elbows and risers to the location of interest, identify and focus on the indication to be examined, clean it as necessary, inject couplant on the area where the transducer will be placed, then precisely locate the transducer at that point, adjusting it as necessary to provide a good signal. Even then, since the back (outside) surface of the weld joints is irregular, it is not certain that the results will allow an accurate interpretation of the condition of the piping. In summary, while several vendors have expressed an interest in working on a cost and materials basis to provide the propulsion, robotics, and equipment necessary to perform ultrasonic examination of the embedded piping, none have been identified with the proven experience necessary to provide repeatable, reliable results under similar conditions.

Requested Information Item 13:

Describe the post modification testing to be performed to ensure that the system(s) will satisfy all design requirements. Include description of hydro-tests to verify the integrity of the system pressure boundaries, flushing to ensure unobstructed flow through the system components, and pre-operational functional testing under design flow/heat loads.

Response 13:

Post modification testing will include the following:

1) System Hydrostatic testing conforming to Section III requirements will be performed on the completed system. With the exception of embedded piping, components inside Code boundaries will be included in this test effort, including pumps, heat exchangers and strainers. In a previous HNP response to the NRC RAI on the Alternative Plan (ref. HNP-99-069, dated April 30, 1999), CP&L stated that Code Case N-240 would be used to exempt formal requirements for hydro-testing of the embedded piping connected to the atmospheric spent fuel pools. CP&L is continuing to investigate methods to provide additional assurance of the quality of embedded piping and field welds, including consideration of pressure testing. The final disposition of hydrostatic testing of embedded spent fuel pool piping will be provided to the NRC as part of the follow-up report on embedded piping and welds as discussed in the response to Requested Information Item 4 above.

2) A flush procedure will be developed which ensures that piping and components inside Code boundaries are free from fouling and debris which might affect system performance, reliability or spent fuel integrity.

3) Pre-operational testing will include a flow balance and verification which ensures that design flow requirements are met for the Spent Fuel Pool Cooling and Component Cooling Water systems, as well as those heat loads which rely on CCW (such as RHR) and heat sinks downstream of CCW (ESW, UHS). Given the lack of a heat load which would facilitate the performance of a meaningful heat duty test of the Spent Fuel Pool Cooling System, no such test will be performed. Moreover, at the 1.0 Mbtu / hr maximum heat load associated with this license amendment request, performance of such a test would not be viable even at the proposed licensed limit. Although the C and D spent fuel pool cooling heat exchangers were installed in the Fuel Handling Building nearly 20 years ago, they have never been placed into service and, from a design perspective, are still new. Moreover, these heat exchangers were layed up with a nitrogen blanket on the shell side, protecting it from moisture and corrosion. A pre-service inspection of the tubesheets and tubes has been performed on these heat exchangers to ensure that no foreign material or corrosion exists which might obstruct flow or otherwise reduce performance.