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Richard J. St. Onge
Director
Nuclear Regulatory Affairs

10CFR50.55a

December 20, 2010

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

Subject: **Docket Nos. 50-361 and 50-362**
Response to Request for Additional Information regarding Third Ten-Year Inservice Inspection (ISI) Interval Relief Request ISI-3-31, Flaw Evaluation of High-Energy Schedule 10s Emergency Core Cooling System Piping San Onofre Nuclear Generating Station, Units 2 and 3

Reference: Letter from R. St Onge (SCE) to the U.S. Nuclear Regulatory Commission (NRC) dated May 19, 2010; Subject: Docket Nos. 50-361 and 50-362, Third Ten-Year Inservice Inspection (ISI) Interval, Relief Request ISI-3-31, Flaw Evaluation of High-Energy Schedule 10s Emergency Core Cooling System Piping San Onofre Nuclear Generating Station, Units 2 and 3

Dear Sir or Madam,

By letter dated May 19, 2010 (Reference) Southern California Edison submitted Third Ten-Year Inservice Inspection (ISI) Interval Relief Request ISI-3-31 in accordance with 10 CFR 50.55a(a)(3)(ii). The purpose of this relief request is to allow use of alternative evaluation criteria for temporary acceptance of flaws in High-Energy Class 2 and 3 Emergency Core Cooling System (ECCS) Schedule 10s piping.

By e-mail dated August 31, 2010, the NRC requested additional information in support of review of Relief Request ISI-3-31. Responses to the NRC request for additional information are provided in the Enclosure to this letter.

This letter and the enclosure contain no new commitments.

P.O. Box 128
San Clemente, CA 92674

Should you have any questions, please contact Ms. Linda T. Conklin at (949) 368-9443.

Sincerely,

Enclosure: as stated

cc: E. E. Collins, Regional Administrator, NRC Region IV
R. Hall, NRC Project Manager, San Onofre Units 2 and 3
G. G. Warnick, NRC Senior Resident Inspector, San Onofre Units 2 and 3

Enclosure

Response to Request for Additional Information
Regarding
10 CFR 50.55a Request ISI-3-31
Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(ii)
Hardship
Without Compensating Increase in Level of Quality or Safety

RESPONSES TO NRC RAIs REGARDING SCE RELIEF REQUEST ISI-3-31

FLAW EVALUATION OF HIGH ENERGY SCHEDULE 10S
EMERGENCY CORE COOLING SYSTEM PIPING

NRC Question 1:

On page 2 of the enclosure, last sentence, the licensee stated that, "… [t]he maximum operating temperatures listed above [i.e., the temperatures in Table 1 in the relief request] were developed during initial plant design and construction. These are not design temperatures and they contain margin above the maximum operating temperature determined in the analysis of record…." The second sentence is confusing. (1) Explain whether the maximum operating temperatures determined in the analysis of record are different from the maximum operating temperatures in Table 1. (2) If design temperatures are higher than the maximum operating temperature, explain why design temperatures were not used in the flaw evaluation.

SCE Response:

(1) Yes, as explained in paragraphs (a) and (b), below, the maximum operating temperatures in the analysis of record (pipe stress analyses) may be different than the maximum operating temperatures in Table 1. The operating temperatures provided in Table 1 were obtained from the Piping and Instrument Diagrams (P&ID), and represent the current maximum operating temperature for each of the lines listed in the table. The following operating temperatures were used in the piping stress calculations in support of Relief Request ISI-3-31:

(a) Piping stress analyses for Items 1 through 11 in Table 1 are based on an operating temperature of 225°F (equal to the value provided in Table 1) or a bounding value of 275°F in some cases. Use of the higher temperature value is acceptable since it results in higher thermal stresses.

(b) Piping stress analyses for Items 12 through 15 in Table 1 are based on operating temperatures equal to the value provided in Table 1 (275°F).

The calculated allowable through-wall flaw lengths in flaw evaluation Calculation M-DSC-445, Rev.1 are based on the bounding stresses determined from the design stress summaries. In the flaw evaluation calculations for the individual lines given in Table 1, a bounding temperature of 275°F was conservatively assumed, regardless of the actual operating temperature, in determining the yield and ultimate strength for the pipe.

(2) The procedures contained in Code Case N-513-2 use the operating pressure and temperature of interest for the piping system as inputs to the evaluation. Maximum operating pressure and maximum operating temperature therefore meets the requirements of 3(b) of the case. ASME Section XI Appendix C, for which the analytical methods are based, also specifies that the flow stress for the pipe material is based on service temperature as stated in C-8200. Although design temperature is higher than operating temperature, use of maximum operating temperature is appropriate as permitted by N-513-2 and Appendix C.

NRC Question 2:

On page 6 of the enclosure, Table 2 provides allowable lengths of 100% through-wall circumferential flaws for various pipe sizes in the subject ECCS piping. However, it is not clear where the allowable circumferential flaw lengths come from. In Appendix A of Attachment 1 to the enclosure, various tables and figures present allowable lengths based on the limiting of the length calculated by the combined stress criteria and membrane stress criteria. For example, Figures 8-1 and 8-2 in Attachment 1 provide allowable flaw lengths vs. bending stresses. Table 8-1 provides a summary of allowable flaw lengths based on membrane stress criteria. These data feed into Table 2. (1) Clarify exactly which tables or figures provide the allowable circumferential flaw lengths. For example, explain why data in Tables A7-1, A7-2, A11-1, A11-2, A13-1, A13-2, A14-1, and A14-2 are not shown in Table 2. (2) The allowable flaw lengths for pipe diameter sizes 8 to 24 inches in Table 2 can be traced to the tables and calculations in Appendix A. However, the allowable flaw lengths for pipe diameter size 2.5, 4, and 6 inches in Table 2 cannot be traced to the tables and calculations in Appendix A. Provide the source of the allowable flaw lengths for pipe diameter sizes 2.5, 4, and 6 inches.

SCE Response:

With regard to the specific questions:

(1) The allowable lengths in Relief Request Table 2 for circumferential flaws were obtained from Calculation Table 2-1 in Attachment 1 to the relief request. Attachment 1 evaluated ECCS Schedule 10s piping; both moderate energy and high energy. Since the relief request addresses the use of N-513-2 for lines that are high energy by the definition of the case, Relief Request Table 2 only lists the allowable lengths for selected high energy lines fabricated from Schedule 10s pipe (the note below Relief Request Table 2 indicates that the scope of the calculations in Attachment 1 is broader than the lines listed in the table). The high energy lines can be identified in Calculation Table 2-1 by the entry in Column 6. In addition, the Table below re-creates Table 2 of the

Relief Request with a column that references the associated line item from Table 2-1 of the Calculation.

Modified Relief Request Table 2
Correlated to Calculation M-DSC-445 Table 2-1

Relief Request Table 2 Item No.	Calc. Table 2-1 Item No.	Line Number	Section Description	Pipe Size (NPS)	Allowable Final Flaw Length ℓ_{allow} (inch)	
					SAW and SMAW	TIG and Wrought
1	3	1204ML108/003/007/009	Between Valves MU001, MU003, MU007, MU010 and MU062	10	15.19	18.70
				16	15.97	22.95
				24	24.38	36.47
2	4	1204ML007	Between Valves MU007 & High Pressure Safety Injection Pump P017	8	12.41	15.53
3	5	1204ML009	Between Valves MU010, MU011 & High Pressure Safety Injection Pump P018	8	2.94	7.12
4	6	1204ML003	Between Valves MU003 & HV9303	24	11.17	34.79
5	7	1204ML003	Between Valves HV9303 & Containment Emergency Sump	24	11.17	34.79
6	9	1204ML003	Between Valve MU062 & Containment Spray Pump P012	14*	n/a	n/a
				16	15.97	22.95
7	13	1204ML109/004/031/008/010	Between Valves MU002, MU004, MU009, MU011, MU005, & MU199	10	13.03	16.65
				16	19.20	25.53
				24	17.22	33.01
8	14	1204ML008	Between Valve MU009 & High Pressure Safety Injection Pump P019	8	2.94	7.12
9	15	1204ML004	Between Valves MU004 and HV9302	24	6.87	21.06
10	16	1204ML004	Between Valve HV9302 & Containment Emergency Sump	24	6.87	21.06
11	18	1204ML004	Between Valve MU005 & Containment Spray Pump P013	14*	n/a	n/a
				16	19.20	25.53
12	21	1204ML131	Between Valve HV9347 & mini flow tie	4	5.88	7.50
13	22	1204ML151	Between Valve HV9306 & mini flow tie	4	3.68	6.14
14	23	1204ML180	Between Valve PSV9308 & mini flow tie	2.5	1.65	2.98
15	24	1204ML080	Between Valves MU060 & MU068	6	2.60	8.49

*The 14" sections of these two lines are not Schedule 10s pipe and are excluded from the scope of this relief request.

The calculations which produced the allowable lengths in Calculation Table 2-1 are given in Appendix A of the Calculation. Table A1-2 of the Calculation also provides a summary of results by subsystem and the appropriate section in Appendix A where the calculations are presented.

With regard to the example:

Calculation Tables A7-1, A7-2, A11-1, A11-2, A13-1, A13-2, A14-1, and A14-2 are not shown in Relief Request Table 2 because they are for moderate energy lines which are within the scope of N-513-2. Therefore request for relief is not required.

(2) The allowable flaw lengths for NPS 2.5, 4, and 6 inches in Relief Request Table 2 are determined in Appendix A.12 of the Calculation. A summary of these results can be seen in Calculation Table A1-2 as well as Calculation Table 2-1.

As further clarification to the general question, the allowable lengths given in Tables 2 and 3 of the relief request are based on maximum enveloping stresses as determined in Appendix A of the Calculation. With regard to the graphs provided in Calculation Figures 8-1 and 8-2, these graphs define the allowable effective bending stress versus through-wall flaw length. These graphs may be used when location specific stresses are available. This evaluation option may be used in lieu of the tables to obtain a more accurate allowable length, if needed.

NRC Question 3:

In Table 2 on page 6 of the enclosure: (1) Clarify whether the allowable flaw lengths in Table 2 are the initial or final flaw lengths. (2) If Table 2 provides the allowable final flaw length (i.e., the length at the time of the ASME Code repair), the licensee needs to provide the allowable initial flaw length and the crack growth rate for various degradation mechanisms. In addition, the licensee needs to demonstrate that the flaw detected, including its growth in service, will not exceed the allowable length before the ASME Code repair is made. (3) If Table 2 provides the allowable initial flaw length (i.e., flaw length at the time of detection), the staff has the following concerns. Many of the allowable circumferential flaw lengths in Table 2 exceed 50% of the outside diameter circumference of the pipe. Some of the allowable lengths are as high as 62% of the outside diameter circumference of the pipe as shown in Item 2 of Table 2. Also, Tables A7-1 and A7-2 show allowable lengths of 71.8% and 76.2% of the outside diameter circumference of the pipe. The staff is concerned that a leaking circumferential flaw of any length is permitted under the relief request to remain in service when its crack growth is not known. Even if the crack growth rate is known, the licensee needs to consider measurement uncertainty of the flaw length and uncertainty in the crack growth rate when demonstrating that the flaw detected plus its growth to the end of the operating cycle will not challenge the structural integrity of the pipe. Depending on crack growth rates, some allowable circumferential flaw lengths in Table 2 may not be conservative and may be inappropriate. The licensee needs to address the staff's concerns if Table 2 provides the allowable initial flaw length.

SCE Response:

(1) Table 2 of Relief Request ISI-3-31 provides the final allowable through-wall circumferential flaw lengths. The tabulated allowable lengths are those lengths for a through-wall flaw that meets the structural factors of ASME Section XI, Appendix C.

(2) In lieu of an explicit flaw growth analysis, a monitoring plan is implemented based on a shortened inspection interval in combination with daily walkdowns for leaking flaws:

(a) Periodic inspections of no more than 30 day intervals will be used to determine the rate of growth of the flaw, and establish the time at which the detected flaw would to reach the allowable size. This inspection interval is considered conservative since very small flaw growth rate is expected under the operating conditions of the subject piping.

(b) Through-wall flaws will be observed by daily walkdowns to confirm that the analysis conditions remain valid and that flaw size stays within the allowable limit. Under the operating conditions of the subject piping, the flaw growth rate is expected to be very small and daily monitoring will conservatively address any flaw size increase issues.

The flaw monitoring plan described above is consistent with the requirements of Code Case N-513-2 which permits the use of a shortened inspection interval, in combination with daily walkdowns, for monitoring flaw changes and leakage. .

Flaws detected to date in ECCS piping at SONGS have been much smaller than the location-specific calculated the allowable flaws sizes based on Appendix C methods (ISI-3-31, attachment Attachment 1). Furthermore, periodic testing did not reveal any significant size increase in these flaws. Thus, the flaws growth monitoring plan described above provides assurance that any increase in flaw size will be determined in a timely fashion and the flaw will remain within the allowable limit.

(3) The allowable lengths in Table 2 are final lengths and not initial lengths. The stated concern on permitting leaking through-wall circumferential flaws will be mitigated by the frequent inspections and daily monitoring of leakage.

NRC Question 4:

On page 8 of the enclosure, the last sentence, Item 1 states that an "Immediate Operability Determination [will be prepared] based upon visual characterization of the indication and operating experience with the degradation mechanisms of this piping (stress corrosion cracking or cyclic fatigue failure)." Licensees may perform their immediate operability determination based on visual inspection, as long as the degradation mechanism is readily discernable from a visual examination or is determined based on substantial operating experience with the identified degradation mechanism in the affected system. However, it is expected that licensees perform a volumetric NDE examination following the visual examination to support their prompt operability determination. Therefore, discuss whether a volumetric examination will be performed following the initial visual examination or justify how a visual examination can characterize flaw size accurately, especially for the portion of the flaw that is embedded in the pipe wall or in the inside diameter of the pipe.

SCE Response:

Volumetric Non-Destructive Examination (NDE) of flaws found in the piping covered by Relief Request ISI-3-31 will be performed as part of the prompt operability determination process. For details on the NDE methods, see the response to question 5, below.

NRC Question 5:

On page 9 of the enclosure, Item 2 states that the prompt operability determination will be based on non-destructive examinations of flaws. Discuss the exact NDE method(s) that will be used per Item 2.

SCE Response:

SCE intends to use ultrasonic testing as the primary method of characterizing flaws found in the piping covered by Relief Request ISI-3-31. In accordance with Code Case N-513-2, paragraph 2.0(a), this examination will be for the full pipe circumference at the flaw location. If ultrasonic testing is impractical due to geometry, obstructions, or other reasons, then physical measurement of the flaw will be performed.

NRC Question 6:

On page 9 of the enclosure, Section 6, Duration of Proposed Alternative: (1) The licensee stated that the proposed alternative will apply for the duration of the third 10-year inspection interval which ends on August 17, 2013 for both SONGS Units 2 and 3. Provide the cycle number and approximate dates for the remaining cycles from now to August 2013 for each unit. (2) If a flaw is detected during a refueling outage (e.g., in 2011), clarify whether the subject relief request applies. That is, if a flaw is detected during a refueling outage, discuss whether the degraded pipe will be repaired or replaced according to the ASME Code, or if the flaw will be allowed to remain in service for the following operating cycle. If continued operation with the flaw is anticipated, provide justification for not making the repairs during the refueling outage.

SCE Response:

(1) The refueling cycle numbers for the duration of the Third Ten-Year ISI interval and the approximate dates are provided in the table below for both Units 2 and 3.

	Unit 2		Unit 3	
Cycle #	Start	End	Start	End
16	September 2009	January 2012	October 2010	October 2012
17	January 2012	January 2014	October 2012	October 2014

(2) It is SCE's intention to repair flaws in the piping which is covered by Relief Request ISI-3-31 at the earliest opportunity commensurate with safety significance. SCE will exercise its due diligence to identify leaks and repair them before restart, and is planning to inspect the relevant Schedule 10S piping early in a scheduled outage, so that sufficient time would be available to affect necessary repairs within that outage. SCE intends to repair or replace piping with flaws found during a refueling outage prior to the end of that outage, whenever it is reasonable to do so.

Should SCE find a leak after completing our initial Schedule 10S inspections, SCE would apply our Operability Determination process, which includes immediate operability and prompt operability determinations. The prompt operability determination would be based, in part, on the flaw evaluation using the methods described in SCE's proposed alternative. SCE would evaluate the impact of the flaw and, using conservative decision making, take appropriate action based on the flaw characterization, whether it is an active leak, and the overall risk and impact to safe, continued cycle operation.

Should SCE determine the need to operate for one cycle prior to repair, SCE would only make mode changes and restart from an outage with a flaw remaining in service if operation in that condition did not violate the Technical

Specifications or the license. The flaw evaluation using this proposed alternative would be the justification for Operability and for not making the repairs during the refueling outage. Code Case N-513-2, which this proposed alternative is based upon, also provides monitoring requirements for flaws, such that if SCE found flaw growth to be at a greater rate than originally expected and operation for the operating cycle would no longer be justified, SCE would initiate a mid-cycle to effect repairs.

<u>NRC Question 7:</u>

The fluid inside of some the pipes identified in the relief request would be at 275°F with a pressure of 275 psi. (1) Discuss how the leakage from the flaw(s) will be managed to protect plant personnel from the steam/water jet exiting a 100% through-wall flaw. (2) Discuss the potential maximum leak rates from these flaws. (3) Some of the flaw sizes in the proposed relief request could have large leak rates that could potentially generate unacceptable offsite radiological doses for those piping segments that contain radioactive coolant. Discuss the impact on offsite dose if an accident were to occur that results in a release of radionuclides into the atmosphere when the flaws in these pipes are left in-service.

<u>SCE Response:</u>

The NRC's question states that the fluid in some of the pipes identified in the relief request would be at 275°F with a pressure of 275 psi. Please note that the piping runs covered by the relief request have maximum operating pressures not exceeding 110 psi, which is well below the moderate energy pressure limit of 275 psi of the Code Case.

(1) As described in ISI-3-31 in the section entitled, "Basis for Acceptability of Proposed Alternative," leakage from through-wall flaws in Schedule 10s piping at temperatures exceeding 200°F would only be expected following a Recirculation Actuation Signal. There would be sufficient time following an accident initiation to evacuate personnel from areas near any known through-wall flaws.

(2) The proposed alternative described in ISI-3-31 is similar to the requirements of ASME Code Case N-513-2. The Code Case states in paragraph 1.0 (d) that, "The provisions of this Case demonstrate the integrity of the item and not the consequences of leakage. It is the responsibility of the Owner to demonstrate system operability considering the effects of leakage." Based on this provision, SCE believes that leakage and any resulting dose from flaws in Schedule 10 piping affected by Relief Request ISI-3-31 would be addressed by the Operability Determination for the flaw in question, but would be outside the scope of Relief Request ISI-3-31.

It is possible that a flaw evaluation based on Code Case N-513-2 as described in Relief Request ISI-3-31 could conclude that the affected piping is OPERABLE, but the overall Operability Determination would conclude that the piping is inoperable due to leakage concerns.

SCE intends to evaluate leak rates on a case-by-case basis in the event through-wall leakage is detected during normal plant operation. SCE intends to use the EPRI PICEP program or alternate methods published in an EPRI report to compute the flow rates. The PICEP leak rate calculation method uses a two-phase fluid flow taking into account pipe size, flaw orientation, and the internal pressure and fluid temperature for the limiting accident. The calculation of flaw opening area used elastic plastic fracture mechanics methods taking into account the stress-strain properties of the pipe material. Such leak rate evaluation will be used to support the POD.

Potential maximum leak rates have been estimated for potential flaws in the affected piping. As an example, a leak rate estimate, assuming no existing ECCS leakage, and based on a conservative leak rate limit of 0.25 gpm (see response to item 3 of this question, below), shows that the through-wall flaw size for leakage is about 2.5 inches long under the most restrictive conditions. The final allowable flaw length for any flaw to remain in service will be established based on the allowable length for structural integrity, or the case-specific calculated allowable length for leakage, whichever is the smaller.

The projected leak rate would be computed for the specific flaw location, for the given loading conditions and geometry, following the same analysis methods that were used to establish the maximum flaw length based on allowable leakage. The calculated accident-induced leak rate will be compared to the accident leak rate limit for the pipe location under evaluation to determine flaw acceptance and operability. This flaw evaluation would be performed in the Prompt Operability Determination.

Per N-513-2 requirements, leakage from any potential flaw would be monitored on a daily basis during plant operation to confirm leak rates are low, stable, and predictable. This will also ensure the flaw size would not exceed the allowable flaw length based on both the fracture mechanics and the leak rate calculations. Thus, any flaw allowed to remain in service is not expected to exceed the maximum allowable length during the postulated accident. Similarly, any non-leaking flaws are not expected to exceed the maximum allowable length based on similar considerations.

Code Case N-513-2 requires that monthly inspections be implemented to monitor any existing flaws. A non-leaking flaw may develop leakage during the period between inspections. However, it is not expected to reach the critical size within one month period based on either the fracture mechanics or the leak rate evaluation.

(3) Accident dose analyses evaluate dose contributions from all sources, including Engineered Safety Feature (ESF) leakage. Total dose resulting from a LOCA is calculated at the Exclusion Area Boundary, the Low Population Zone, and in the Control Room. The limiting dose with respect to sensitivity to ESF leakage is the CR dose.

The current Control Room dose due to a LOCA is 2.8 rem Total Effective Dose Equivalent (TEDE). This is only 2.2 rem TEDE below the 5 rem TEDE limit.

ESF leakage of approximately 0.25 gpm has been estimated to result in a Control Room Dose equal to the 5 rem TEDE limit. Thus any leakage resulting from a potential flaw in the Schedule 10 piping affected by Relief Request ISI-3-31, when added to existing known leakage, must be limited to 0.25 gpm.

<u>Regarding Attachment 1, Calculation M-DSC-445:</u>

<u>NRC Question 8:</u>

On page 22, second paragraph, the licensee stated that the allowable circumferential flaw lengths were calculated based on the limit load and elastic plastic failure mechanic [fracture mechanics] methods. However, the allowable axial flaw lengths were calculated using the limit load method only. The staff notes that the limit load method is less conservative than elastic plastic fracture mechanics method for the welds that are made with submerged arc welding (SAW) and shield metal arc welding (SMAW). Explain why the allowable axial flaw lengths were not calculated using the elastic plastic fracture mechanics method for the welds that were made with SAW and SMAW.

<u>SCE Response:</u>

Pipe butt welds were fabricated by shop practice or in the field. Depending on fabrication procedures, tungsten inert gas (TIG), SMAW or SAW process may have been used. Circumferential flaws will initiate at pipe butt welds due to weld residual stress. Such flaws will be oriented predominately along the weld. Therefore, both non-flux (TIG) and flux (SMAW and SAW) welds are included in the evaluation of circumferential flaws to cover these situations.

Axial flaws, if found, will be oriented transverse to butt welds, or possibly along external attachment welds. In either case, the tips of axial flaws will be well-contained in base metal so that wrought toughness properties of the wrought base pipe will be controlling, not the weldment. For this situation, fully plastic collapse will be the relevant failure mode and the limit load method of Appendix C will be applicable.

NRC Question 9:

On page 26, Section 5.1.3: (1) Explain why the flaw evaluation does not include loading from emergency conditions as part of the design basis.

SCE Response:

The design of the ECCS piping includes normal, upset, and faulted loading conditions as the design basis. Section 3.9.3 of the UFSAR for SONGS states that no emergency condition has been identified to be more severe than the upset condition. Therefore, faulted is the only postulated accident condition for the subject ECCS piping. This is also reflected in the piping design stress analysis where Equation 9 of ASME Section III, NC-3600 stress calculations for occasional loads were completed for upset and faulted conditions only.

NRC Question 10:

On pages 27 to 29; Section 5.3 discusses an eight-step procedure to calculate pipe stresses. The explanation of the eight-step procedure is confusing. It seems that the pipe stresses resulting from each of the applied loads (e.g., deadweight, thermal, seismic) can be obtained individually and directly from the original pipe stress analyses for each affected pipe without using the eight-step procedure. Explain why the eight-step procedure is needed.

SCE Response:

Many of the original piping stress reports only contain the analysis results for the combined loading that make up Code Equations 8, 9, and 10 of ASME Section III, NC-3600. Individual loads such as dead weight or seismic are not tabulated and therefore not available to compute individual bending stresses directly. In a few cases, only the pipe node that gives the highest combined stress values are documented. Therefore, the equations outlined in the eight-step procedure were developed as a simple way to extract the individual stresses from the Code equations in order to perform the allowable flaw length calculations.

NRC Question 11:

On page 30, last sentence, the licensee stated that "… [e]quation 5-12 will be used in this calculation to verify that the allowable flaw length for circumferential flaws will be bounding for axial oriented flaws…" The allowable axial flaw lengths are presented in Table 8-2 (on page 40). The allowable circumferential flaw lengths are presented in Table 8-1 and Figures 8-1 and 8-2. From these tables and figures, the allowable circumferential flaw lengths are longer than the allowable axial lengths. However, in terms of permitting flaws to remain in service, the shorter, not longer, allowable flaw length should be bounding and should be used. It appears that the allowable circumferential flaw lengths in Table 2 of the relief request will be used to disposition circumferential flaws and allowable axial flaw lengths in Table 3 of the relief request will be used to disposition axial flaws. Therefore, explain why the circumferential flaw lengths which are longer than the axial flaw lengths are bounding as the licensee stated above.

SCE Response:

It is the intent that circumferential and axial flaws will be evaluated individually; Table 2 of the submittal will be used for circumferential oriented flaws and Table 3 will be used for axial oriented flaws. In an earlier revision to Attachment 1, an attempt was made to bound allowable axial flaw length values with the results for circumferential flaws. Using this approach, Eq. 5-12 would have been used to verify that this would have been the case. In the current version of the calculation allowable flaw lengths are provided for both circumferential and axial orientations covering the full range of pipe sizes and loads, so that the subject statement on Page 30 of Attachment 1 is no longer necessary.

NRC Question 12:

On page 40, it appears that for the 24-inch size pipe, there is a large difference (large ratio) between the allowable circumferential flaw length for SAW and SMAW and allowable flaw length for TIG and wrought pipe. This large difference is evident in Tables A2-1 vs. A2-2, A6-1 vs. A6-2, and A10-1 vs. A10-2. However, for the small diameter pipe this difference (ratio) is small as shown in Tables A3-1 vs. A3-2 for the 10-inch and 16-inch pipes. The staff understands that the difference may be caused by the application of the Z factors to the material property of SAW and SMAW, but not to the material property of TIG and wrought pipe. (1) Discuss why a large difference (ratio) exists between the allowable flaw length for the SAW weld vs. TIG weld for the large diameter pipe but not for the smaller diameter pipe. (2) Discuss why a large difference (the ratio) exists between the allowable flaw length for SAW and SMAW and the allowable flaw length for TIG and wrought pipe for the 6-inch diameter pipe as shown in Tables A12-1 and A12-2, but not for other small size pipe.

SCE Response:

(1) The differences between the evaluation for TIG/wrought materials and for SAW/SMAW welds are twofold: 1) use of Z factor greater than unity for SAW/SMAW which increases the applied load thereby reducing the allowable lengths, and 2) the inclusion of expansion stress in addition to the primary bending stress which increases the total effective bending stress thereby reducing allowable lengths. This is reflected in the two flaw acceptance criteria equations, one for EPFM (Eq. 5-2) and the other for limit load (Eq. 5-9).

For TIG welds and wrought base pipe, which are controlled by limit load, a Z factor is defined as 1.0 and the expansion stress can be excluded from the analysis. So a large difference in allowable flaw lengths will be observed when Z factor is high, as would be the case for large diameter pipe, and/or the expansion stresses are large. Looking at Tables A2-1 and A2-2, the maximum enveloping expansion stress is 17,483 psi (see Table A2-3B), which is large compared to the primary bending stresses. The Z factor for 24 NPS pipe is 1.56. So a large difference in allowable lengths for the two weld analysis cases is to be expected. In contrast, for the pipe sizes covered in Tables A3-1 and A3-2, the expansion stresses are low and comparable to the primary bending stress levels (see Tables A3-3B through A3-5B) which explains the smaller difference in results for TIG/wrought material compared to SMAW/SAW material.

(2) For the 6 NPS pipe evaluated in Appendix A.12, there is also a very large expansion stress calculated for the line (16,083 psi in Table A12-6B). As discussed in (1) above, this is the reason for the large difference in the allowable lengths between TIG/wrought and SMAW/SAW materials.

NRC Question 13:

(1) Discuss the nondestructive examination requirements (inspection method and frequency) for the flaw(s) that will remain in service under the relief request.
(2) Discuss how the crack growth will be monitored during operation for the flaw that will remain in service.
(3) Discuss actions that will be taken if the actual crack growth exceeds the crack growth used in the flaw evaluation.

SCE Response:

(1) The NDE requirements for flaws that remain in service will be as described in Code Case N-513-2, paragraph 2.0(e). Specifically, periodic inspections will be performed at no more than 30 day intervals. It is SCE's intent to use

ultrasonic exams at the flaw location or physical measurement to satisfy this requirement.

(2) In accordance with Code Case N-513-2, the inspections described in item (1), above, will be used to determine if flaws are growing and to establish the time at which the detected flaw will reach the allowable size. In addition, for through-wall leaking flaws, leakage will be observed by daily walkdowns to confirm the analysis conditions used in the evaluation remain valid.

(3) The actions taken if actual crack growth exceeds that used in the flaw evaluation will be consistent with Code Case N-513-2. Specifically, a repair or replacement shall be performed no later than when the predicted flaw size from periodic inspection or flaw growth analysis exceeds the acceptance criteria, or the next scheduled outage, whichever occurs first.

NRC Question 14.

Based on the flaw evaluation in Attachment 1, it appears that the relief request applies to planar flaws. Discuss whether the relief request would be applicable to non-planar flaws due to wall thinning.

SCE Response:

The proposed alternative described in the relief request permits application of the methodology described in Code Case N-513-2 to evaluate planar flaws detected in ECCS Schedule 10s lines of the affected pipe diameters that may have maximum operating temperature that exceed 200^{o}F. Code Case N-513-2 does provide provisions where planar flaw analysis may be used to evaluate non-planar flaws under the requirements of 3(d)(1) or 3(f) of the case. This will allow the use of the relief request to evaluate non-planar flaws, such as localized pitting, or intergranular attack, if such degradation is detected.

NRC Question 15:

Clarify if the relief request (i.e., the allowable lengths for through wall circumferential and axial flaws) applies to flaws that are embedded (subsurface) in the pipe wall.

SCE Response:

Yes, the calculated allowable lengths apply to both surface and subsurface flaws. In the event that a part-through wall or an embedded flaw is detected, the allowable through-wall lengths will be conservative.