FPL

November 3, 2014

L-2014-339
10 CFR 50.4
10 CFR 50.55a

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Re: St. Lucie Unit 2
Docket No. 50-389
Inservice Inspection Plan
RAI Reply - Third Ten-Year Interval Unit 2 Relief Request No. 14

References:

1. FPL Letter L-2014-206 dated June 30, 2014, "Inservice Inspection Plan Third Ten-Year Interval Unit 2 Relief Request No. 14," ADAMS Accession No. ML14203A046
2. NRR E-mail Capture dated August 27, 2014, "Request for Additional Information (RAI) re. St. Lucie 2 - 3rd Interval Relief Request 14 (TAC MF4341)," ADAMS Accession No. ML14239A693

In Reference 1, Florida Power & Light (FPL) requested relief from the examination requirements of the ASME Code, Section XI, 1998 Edition with Addenda through 2000, for the subject CEDM welds. The NRC provided a request for additional information (RAI) on the relief request in Reference 2. The attachment to this letter provides FPL's response to the RAI.

Please contact Ken Frehafer at (772) 467-7748 if there are any questions about this submittal.

Sincerely,

Steve Catron
Licensing Manager
St. Lucie Plant

Attachment

CS/KWF

cc: NRC Region II Administrator
NRC Site Resident Inspector

A047
NRR

Florida Power & Light Company

6501 S. Ocean Drive, Jensen Beach, FL 34957

St. Lucie Unit 2
THIRD INSPECTION INTERVAL
RAI REPLY RELIEF REQUEST NUMBER 14, REVISION 0

RAI 1

Page 1 of the submittal stated that performing ASME Code required examinations for the control element drive mechanism (CEDM) housing welds will expose personnel significant radiation. The licensee did not provide specific radiation dose. Provide the radiation dose.

FPL Response:
An estimate of the time required for disassembly, examination, and re-assembly of the CEDM for the performance of the examinations is estimated to result in 3.7 rem for the performance of the examination of 1 CEDM, welds 1 thorough 4.

RAI 2

The second to the last paragraph on Page 8 of the submittal states that "...Because the replacement head was installed during the 2nd period of the 3rd ISI interval, FPL performed examinations of the lower weld (CEDM [weld No.] 5) on the 2 accessible periphery CRD [control rod drive] housings during the 3rd period to satisfy the IWB-2412(b)(2) requirement..."

(a) Table IWB-2500-1, Examination Category B-O, Item No. B14.10, requires volumetric or surface examination of the welds in 10 percent peripheral CRD housing. Page 9 of the submittal stated that the periphery consists of thirty-two (32) CEDM housings. As such, a total of 16 welds (5 welds / housing x 32 housing x 10 percent = 16 welds) would be in the population per Table IWB-2500-1. The licensee invoked IWB-2412(b)(2) which requires that when items or welds are added during the second period of an interval, at least 25% of the examinations required by the applicable Examination Category and Item Number for the added items or welds shall be performed during the third period of the interval. It appears that based on the 25 percent requirement the total required welds to be examined would be 4 (16 welds x 25 percent). However, the NRC staff questions why IWB-2412(b)(2) is applicable in this case because the replacement CEDM housing is not "added" to the population of the original CEDM housing but a replacement. Please provide the exact number of welds that are required to be examined in accordance with the ASME Code, Section XI, and provide justification why IWB-2412(b)(2) is applicable.

FPL Response:
The 1998 Edition with Addenda through 2000 of ASME Section XI, IWB-2412(b), states "If items or welds are added to the Inspection Program, during the service lifetime of a plant, examinations shall be scheduled as follows;" IWB-2412(b)(2) states that "when items or welds are added during the second period of an interval, at least 25% of the examinations required by the applicable Examination Category and Item Number for the added items or welds shall be performed during the third period of that interval."

The replacement reactor head was installed during the 2nd period of the 3rd ISI interval. The replacement CEDMs contain all new welds and weld numbers that were added to the ISI program. Therefore, the requirements of IWB-2412(b)(2) are applied to the replacement component welds that were installed during the 2nd period.

ASME Section XI, Table IWB-2500-1, Examination Category B-O, states "10% of the peripheral CRD housings" be examined during each interval. The replacement reactor head contains thirty-two (32) periphery CEDMs. 10% of the periphery CEDMS would equal 3.2 CEDMS (FPL chose to round up to 4 CEDMs). In accordance with IWB-2412(b)(2), 25% (1 CEDM) of the total population (4 CEDMS for the interval) would have required examination during the 3rd period of the 3rd ISI interval.

FPL was only required to perform examinations of one CEDM containing 5 welds during the 3rd period. However, during the outage, FPL inadvertently examined the #5 welds on 2 CEDMS. Only 1 CEDM consisting of all 5 welds required examination. This relief states that the other 4 welds are inaccessible for examinations.

(b) Discuss how the examination of two CEDM weld No, 5 welds can demonstrate the condition of the rest of welds in the CEDM housing that are not inspected by surface or volumetric examinations.

FPL Response:
CEDM Weld No. 5 is the butt weld closest to the RV head and as a result, this weld experiences the highest temperature of any of the remaining CEDM butt welds. By comparison, temperatures just below CEDM Weld No. 1 have recently been measured to be less than 135°F for an entire 18 month cycle. Weld No. 5 is also subjected to the highest bending stresses from the CEDM due to the longest moment arm.

(c) Provide the month and year during the third period that the surface examination was performed on the two CEDM weld No, 5 welds.

FPL Response:
Surface examinations of the two CEDM weld No. 5 welds were performed in September of 2012.

<u>RAI 3</u>

The last paragraph on page 8 of the submittal states that "...For the remaining welds in each CEDM assembly, the configuration completely precluded accessibility for examination..." Clarify that the inaccessibility is referring to the surface examination, not the VT-2 examination, of the subject CEDM housing welds.

FPL Response:
The inaccessibility is applicable to the surface examination. FPL performs the required VT-2 examination after head re-assembly at RCS NOP/NOT conditions.

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RAI 4

Page 9 of the submittal states that "...FPL replaced the complete Reactor Vessel Head (RVH) assembly including CEDMs during the SL2-17 (2007) refueling outage. The replacement occurred during the 2nd period of the 3rd ISI interval for PSL-2. The PSL-2 replacement reactor vessel head contains ninety-one (91) control element drive (CEDM) mechanisms. The periphery consists of thirty-two (32) CEDMs. Prior to assembly, preservice surface examinations of all 5 welds on the thirty-two (32) periphery CEDMs were performed. In addition a volumetric preservice examination was performed of the CEDM welds prior to the assembly..."

(a) If surface examinations were performed for all 5 welds on the 32 periphery CEDM housings in 2007, discuss whether welds on the remaining 59 CEDM housings (91 - 32 = 59) were surface examined in 2007. If not, provide justification. Discuss the surface examination technique performed in 2007.

FPL Response:
All welds of all 91 CEDM housings had a surface (liquid penetrant) examination performed prior to being placed into operation in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components, Div. 1, Class 1, 1989 Edition, No Addenda.

(b) Discuss whether the pre-operational volumetric examination was performed for all 455 welds in 2007. If not, discuss which welds were volumetrically examined and justify why all 455 welds were not volumetrically examined.

FPL Response:
Pre-operational volumetric (radiography) examination was performed for all 455 welds at the completion of fabrication.

(c) Discuss the volumetric examination techniques (e.g., ultrasonic or radiographic) and associated qualifications (i.e., cite the subarticles in the ASME Code, Section III to which the technique was qualified) that were used in the 2007 pre-operational examination.

FPL Response:
Radiography (RT) was performed as the required volumetric examination of the pressure retaining welds identified as CEDM-1, CEDM-2, CEDM-3, CEDM-4, CEDM-5 on FPL's replacement CEDMs at the completion of fabrication (pre-operational) in accordance with ASME Section III, Subsection NB, Article NB-5000, Subarticle NB-5111(a). The radiographic examination of the welds have been performed with film, and in accordance with ASME Section V, Article 2 as allowed, and modified by Article NB-5000 for the geometric unsharpness (Ug) and penetrameter (IQI) selection, and the radiographic acceptance standards of NB-5320 have been used to evaluate the RT film image in accordance with Subarticle NB-5111(c)

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RAI 5

The licensee stated that most of the CEDM housing welds cannot be surface or volumetrically examined because of hardship. In light of that, the NRC staff would like to explore the potential for degradation of these welds and requests the following information:

(a) Page 3 of the relief request identified the two base metals that were joined with CEDM housing weld No. 1. However, the base metals for some welds were not clearly identified. Provide the material specification (e.g., SA-276 F403) of base metals that were joined with CEDM weld numbers 2, 3, 4 and 5. Provide the material specification of the filler metal used in each of the CEDM housing welds. Discuss the base metal and weld metal used that would minimize the potential for degradation.

FPL Response:
The weld metal and the adjoining base metals for the CEDM welds are listed in the table below:

CEDM Weld #	Component /Spec	Component/Spec	Weld material	Comment
1	Upper Pressure Housing (UPH) Upper End Fitting, SA479-Tp316	UPH-Tube, SA-213 Tp316	IN316L & ER316L	GTAW process, Consumable insert & bare wire
2	UPH-Tube, SA-213 Tp316	UPH Lower End Fitting, SA479-Tp316	IN316L & ER316L	GTAW process, Consumable insert & bare wire
3	Motor Housing Upper End Fitting, SA182-F348	Motor Housing, SA182-F403 Mod with CC N-2	ERNiCrFe-7A (UNS N06054)	GTAW process, bare wire
4	Motor Housing. SA182-F403 Mod with CC N-2	Motor Housing Lower End Fitting, SB166-Alloy N06690	ERNiCrFe-7A (UNS N06054)	GTAW process, bare wire
5	Reactor Vessel Head Penetration Adapter, (SB166-Alloy N06690)	Reactor Vessel Head Penetration Tube, (SB167-Alloy N06690)	ERNiCrFe-7 (UNS N06052) or ENiCrFe-7 (UNS W86152)	GTAW process or SMAW process

The CEDM upper pressure housing sub-components and welds 1 and 2 are 316/316L austenitic stainless and are the same grade as previously used at St. Lucie Unit 2 without any service related degradation. The CEDM motor housing is similar to the original CEDM motor housing except the alloy 600 material and weld material has been replaced with alloy 690 and its compatible alloy 52/152 weld material which has superior resistance to PWSCC degradation.

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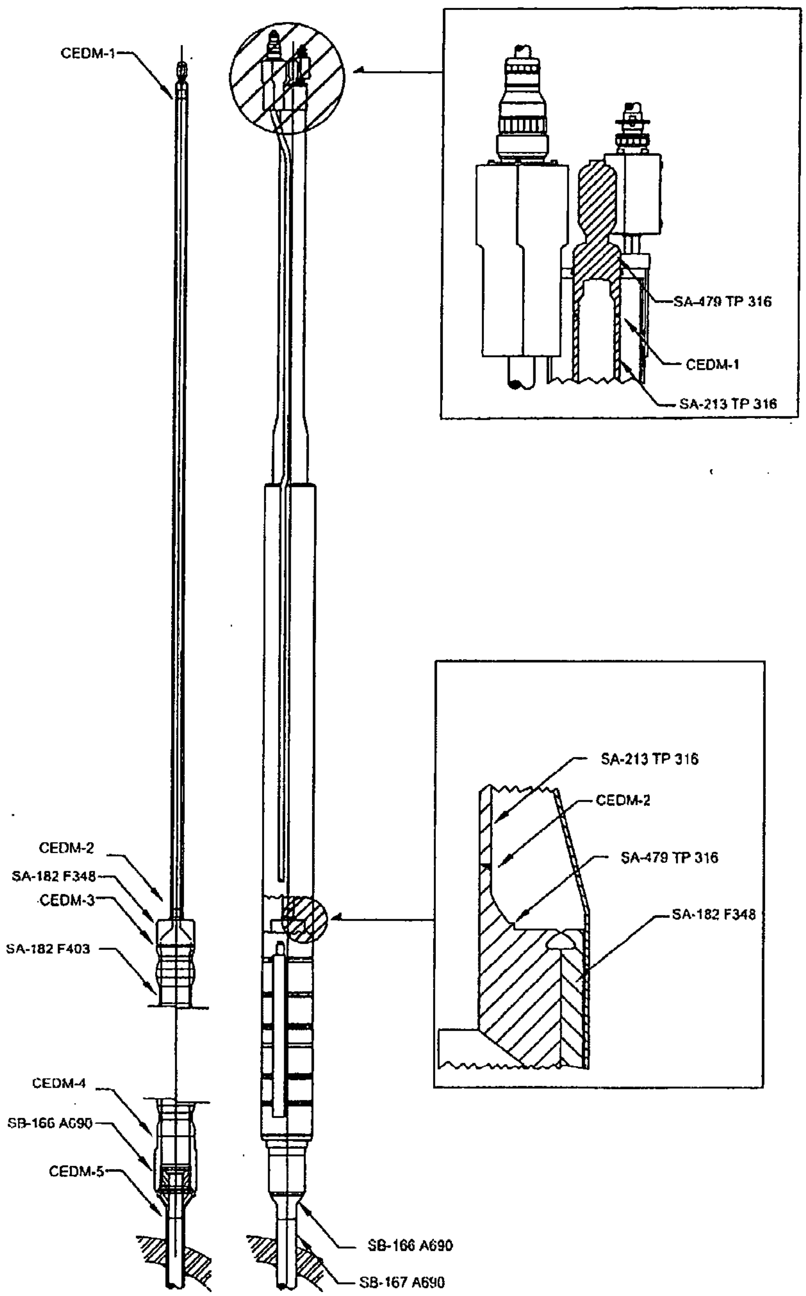
The figure of the CEDM assembly has been revised below to show the location of each material.



(b) Discuss the welding technique used to make the subject welds. Discuss the ASME Code requirements for the welding process and installation procedures such as post-weld heat treatment that would minimize fabrication defects.

FPL Response:
The welding process for the all the CEDM housings was the gas tungsten arc welding (GTAW) process. All welds were V-groove welds made from the component outside diameter. The SA182-F403 motor housing had a ERNiCrFe-7A weld build up or butter on each end followed by a post weld heat treatment (PWHT) that meets ASME Section III NB-4622.1-1 as well as Code Case N-2 from the original Construction Code. The weld buttered ends of the motor housing received a liquid penetrant test (PT) inspection before the end fittings were attached. No welding to the F403 material was allowed after PWHT. The reactor vessel head penetration to head adapter weld # 5 is also made primarily with the GTAW process but the option to use the SMAW process was available. The specific weld and base materials are listed in the table above in the response to RAI 5a. All pressure boundary housing welds received the required PT and radiography (RT) inspections. All weld procedures were qualified in accordance with the ASME Section IX Code.

(c) Discuss any operating experience of these welds in the CEDM housing in the industry fleet (any degradation of these welds?).

FPL Response:
There have been no reported CEDM/CRDM housing pressure boundary weld failures above the reactor vessel head of the same type of welded mag jack CEDM/CRDM assemblies. There is operating experience with the large diameter rotating motor type design CEDM at two plants. One plant has developed repeated cracking in the CEDM large diameter motor housings that have resulted in complete replacement of the bolted and flanged CEDMs multiple times. Another unit with the same type of large diameter CEDMs has only 2 failures of spare CEDM housings associated with an internal weld overlay and welded orifice flow restrictor to limit heat loss. The high rate of cracking at the one unit with large diameter rotating motor type design CEDMs and the near absence of degradation on other PWR units, suggests that the plant with multiple failures is an outlier to the PWR industry.

<u>RAI 6</u>

Last paragraph on Page 9 of the submittal states that "...FPL performed examinations of the accessible welds. Personnel and system engineers perform walk downs of the reactor head after shutdown and during startup looking for leakage or other abnormal conditions..."

(a) Confirm that in the ISI examinations performed during third period of the third ISI interval, only CEDM weld No. 5 on 2 accessible CEDM housing were surface examined and the remaining welds were examined by VT-2 visual examination during walkdowns. Discuss the type of surface examination that were performed during the third period and cite the specific ASME Code requirement for which the surface examination is qualified.

FPL Response:
Two CEDM Number 5 welds were examined during the 3rd period of the 3rd ISI interval. The surface examinations (liquid penetrant) were performed utilizing the solvent removable visible dye technique utilizing the acceptance criteria of ASME Section XI, IWB-3523.

The required VT-2 examination is performed of all CEDMs from the 62' containment elevation and looking down from the platform above the CEDM housings since there is no permanent ladder down into the upper cavity and the temporary access for the outage is removed during upper head re-assembly and outage de-mob for mode change with the Reactor Coolant System at NOP/NOT with a 4 hour hold at conditions prior to beginning the examination following reactor vessel re-assembly. The examination is performed by VT-2 qualified personnel.

(b) Discuss exactly how the VT-2 examination is performed during walkdowns because almost all of the CEDM housing welds are inaccessible for visual examinations. How a leak from a weld can be properly identified during a walkdown when there are 5 welds in each of 91 housings?

FPL Response:
FPL performs a visual examination at the beginning of each outage, prior to reactor vessel head disassembly. This examination is performed from the upper cavity elevation utilizing the inspection ports surrounding the vessel head. The inspection is also performed from the incore instrument (ICI) column access doors inside the reactor vessel head shroud during disassembly for evidence of leakage as well as all the accessible CEDMs. In addition to general recording requirements, the procedure requires "evidence of leakage or indeterminate inspections shall be indicated with an asterisk and recorded." Any evidence of leakage is required to be entered in the corrective action program and dispositioned. While this examination does not require VT-2 qualified personnel, typically the personnel utilized are VT-2 qualified.

The class 1 system leakage test VT-2 examination is performed every outage of all CEDMs from the 62' containment elevation and looking down from the platform above the CEDM housings since there is no permanent ladder down into the upper cavity and the temporary access for the outage is removed during upper head re-assembly and outage de-mob for mode change with the Reactor Coolant System at NOP/NOT with a 4 hour hold at conditions prior to beginning the examination following reactor vessel re-assembly. The examination is performed by VT-2 qualified personnel. Pressure boundary through wall leakage is unacceptable and shall be corrected prior to returning the system to service. The source of leakage shall be determined and quantified, if possible, and entered into the corrective action program.

Additionally, during the third refueling outage after installation of the replacement reactor vessel head (August 2012), FPL performed bare metal visual inspection in accordance with the requirements of ASME Code Case N-729-1 as modified by 10CFR50.55a of the entire head surface and the CEDM to reactor vessel head interface for evidence of leakage. No evidence of leakage was observed.

(c) Discuss whether CEDM welds No. 2, 3, 4, and 5 are in contact with coolant and CEDM weld No. 1 weld is not in contact with coolant. Through-wall cracks in welds that are in contact with coolant can be detected based on leakage. Discuss how a through-wall crack can be detected in the weld (CEDM weld No. 1) that is not in contact with coolant and is inaccessible for any examinations.

FPL Response:
CEDM weld No.1 is the only weld potentially not in contact with coolant during operation. As the RCS pressure increases during start-up, the trapped volume of air is squeezed until the remaining volume is reduced to a fraction of its original volume. Further, during start up there is control rod drop testing which results in a rapid exchange of RCS coolant with the coolant in the CEDM column to further reduce the air volume. Eventually, the gas pocket would be expected to nearly disappear during plant operations as the gas was forced into solution and exchanged with the bulk RCS coolant.

If a postulated through wall crack were to occur in an area of the CEDM upper pressure housing (CEDM Weld No. 1) that is air filled, the less dense air would escape more easily than RCS, removing the gas volume and bringing the through wall crack in contact with RCS coolant. Although these welds are inaccessible for PT, there are VT-2 examinations in the area of the RV head and CEDMs as identified in RAI 6(b) above.

(d) Discuss the potential of a guillotine break (a 360 degree circumferential break) of a CEDM housing weld (e.g., weld No. 4 or 5). Discuss consequence of such a guillotine break should it develops. Discuss whether the operator can detect such a large crack early so that corrective actions can be initiated.

FPL Response:
CEDM Welds Nos. 1 and 2 are austenitic stainless steel weld material and CEDM Welds Nos. 3, 4, and 5 are alloy 690 weld material as listed in the table in the RAI 5(a) response. These materials are resistant to stress corrosion cracking (SCC) mechanisms in the controlled RCS environment.

For SCC to occur in the CEDM housing welds, the following three conditions must exist simultaneously: high tensile stresses, susceptible material, and a corrosive environment. While residual stresses are always present as a result of welding, the ID stresses are minimized since all welding is performed from the component outside diameter and the small diameter precludes the possibility for inside diameter repairs. The alloy 690 weld material used in CEDM Weld Nos. 3, 4 and 5 are highly resistant to SCC mechanisms based on years of replacement steam generator and replacement reactor vessel head penetration performance with the alloy 690 weld and base metals. The 316L austenitic stainless steel weld material in CEDM Weld Nos.1 and 2 are also resistant to SCC in controlled RCS conditions based on the years of operating experience without SCC in primary loop piping welds. The RCS chemistry is controlled to reduce oxygen to < 5 ppb during normal operation. Contaminants known to increase the susceptibility of austenitic stainless steels are also strictly controlled in the RCS environment by Technical Specifications. The low temperature of the CEDM column also tends to decrease the susceptibility to SCC mechanisms (i.e., The CEDM Weld No. 1 has been measured to be below 135°F during operation).

Since SCC is a time dependent degradation mechanism, if a postulated through wall CEDM housing leak were to occur in these ductile materials, there would be time for detection prior to a 360° circumferential break to occur. St. Lucie unit 2 has several methods for early detection of RCS leakage by operators such that detection would occur prior to a guillotine break. Therefore the consequence of a guillotine break is a highly unlikely event.

The primary method for quantifying and characterizing RCS identified and unidentified leakage is by means of a reactor coolant water inventory balance. The inventory balance is performed as required by St. Lucie Unit 2 Technical Specification (TS 4.4.6.2.1 c) at least once every 72 hours except when operating in the shutdown cooling mode (not required to be performed until 12 hours after establishment of steady state operation). However, the St. Lucie surveillance procedure requires the inventory balance be performed once every 24 hrs since it provides the best and earliest trend of an increase in RCS leakage. The procedure methods use the recommendations and guidance in WCAP-16423-NP (Adams ML070310084) and WCAP-16465-NP (Adams ML070310082). The leak rate calculated using water balance inventory method is the most sensitive of the methods available with the leak rate calculated to the nearest 0.01 gallons-per-minute (gpm).

St. Lucie Unit 2 RCS Inventory Balance procedure ensures that RCS leakage is within Technical specification 3.4.6.2. The procedure also provides early detection of negative trends based on statistical analysis. The inventory balance leak rate calculation is performed more frequently (at a 24 hour rather than 72 hour interval) than required by Technical Specification.

Action levels on the absolute value of Unidentified RCS Inventory Balance (from surveillance data) are as follows:

Action Level 1

- An adverse trend over time is observed
- Seven day rolling average of UNIDENTIFIED Leak Rate is greater than 0.1 gpm.
- Nine consecutive RCS UNIDENTIFIED Leak Rates greater than the baseline mean (μ) value.

Action Level 2

- Two consecutive UNIDENTIFIED Leak Rates greater than 0.15 gpm.
- Two of three consecutive UNIDENTIFIED Leak Rates greater than the baseline mean plus two times the standard deviation ($\mu + 2\sigma$).

Action Level 3

- One UNIDENTIFIED Leak Rate greater than 0.30 gpm
- One UNIDENTIFIED Leak Rates greater than the base line mean value plus three times the standard deviation ($\mu + 3\sigma$).

These Action Levels trigger condition report initiation, various investigations of leakage up to and including containment entry to identify the source of the leakage.

RCS leak detection at St. Lucie Unit 2 is also provided by 3 separate monitoring systems: 1) reactor cavity (containment) sump inlet flow monitoring system; 2) containment atmosphere radiation gas monitoring system; 3) and containment atmosphere radiation particulate monitoring system. These systems have high level and alert status alarms in the control room. These systems also have Tech Spec required monitoring (TS 3.4.6.1 a. & b) at least once every 12 hours. The sensitivity of the containment atmosphere radiation monitoring system depends on the amount of radioactivity in the primary coolant system which is dependent on the percentage of failed fuel. Calculation results conclude that the containment atmosphere radiation monitors are capable of detecting a change of 1 gpm in the leak rate within one hour using design basis reactor water activity assuming 0.1% failed fuel.

The containment sump alarm response is also highly variable based on the location of the leak, how much vapor condenses and where it condenses. All drains entering the sump are routed first to a measurement tank. When the water level corresponding to 1 gpm or more into the tank is reached, a sump level alarm is actuated in the control room. The combination of Tech Spec required inventory balance, reactor cavity sump monitoring, gas and particulate monitoring systems provide diverse measurement means for acceptable monitoring of RCS leakage.

In addition, the St. Lucie Unit 2 Technical Specification was revised to the extent practical to meet the improvements of NRC approved revision 3 to Technical Specification Task Force (TSTF) Standard Technical Specification (STS) Change Traveler-513 to define new time limit for restoring inoperable RCS leakage detection instrumentation to operable status and to establish alternate methods of monitoring RCS leakage when one or more required systems are inoperable (Ref. St. Lucie Letter L-2011-073 dated March 11, 2011, ADAMS ML11087128).

The NRC concluded in the safety evaluation that the changes to the St. Lucie Unit 2 Technical Specifications were acceptable and that "The proposed actions for inoperable RCS leakage detection instrumentation maintain sufficient continuity, redundancy, and diversity of leakage detection capability that an extremely low probability of undetected leakage leading to pipe rupture is maintained. This extremely low probability of pipe rupture continues to satisfy the basis for acceptability of LBB in GDC 4." (NRC Issuance of Amendments regarding TSTF-513 Revision 3, dated 3-30-2012, ML12052A22).

RAI 7

Confirm that the proposed alternative in Relief Request 14 for the third ISI interval was to perform a surface examination of CEDM weld No. 5 on 2 accessible CEDM housing and a VT-2 visual examination of all remaining CEDM housing welds as required by the ASME Code, Section XI.

FPL Response:
FPL confirms that the alternative proposed in relief request 14 for the third ISI interval was to perform a surface examination of CEDM weld No. 5 on 2 accessible CEDM housings, a bare metal visual of the entire RPV surface and head to penetration interface for evidence of leakage, and a VT-2 visual examination of all remaining CEDM housings as required by the ASME Code Section XI.