Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

FPL

March 26, 2003

L-2003-080
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
Second Ten-Year Interval
Relief Request 29 Supplemental Response to Request for Additional Information

Pursuant to 10 CFR 50.55a (a)(3) on July 23, 2002, Florida Power and Light Company (FPL) requested approval of Relief Request 29, Risk Informed Inservice Inspection Program. On December 17, 2002, the NRC provided FPL a request for additional information (RAI) needed before the NRC could complete their review. On January 16, 2003, FPL provided a response to the NRC RAI by FPL letter L-2003-009.

By letter L-2002-142 dated July 23, 2002, FPL requested a change to the St. Lucie Unit 2 ISI Program plan for Class 1 piping only, through the use of a Risk-Informed Inservice Inspection (RI-ISI) Program. The risk-informed process used to prepare the submittal was described in Westinghouse Owners Group WCAP-14572, Revision 1-NP-A, *Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report*. As a risk-informed application, the submittal met the intent and principles of Regulatory Guide (RG) 1.174, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis*, and RG 1.178, *An Approach for Plant-Specific Risk-Informed Decision Making: Inservice Inspection of Piping*. In accordance with 10 CFR 50.55a (a)(3)(i), FPL determined that the proposed alternatives provided an acceptable level of quality and safety.

Attachment 1 supplements the original FPL response to the NRC RAI dated December 17, 2002 provided by L-2003-009 on January 16, 2003. Attachment 2 is Revision 3 of the Risk–Informed Inservice Inspection Program Plan for St. Lucie Unit 2, which is a complete replacement for Attachment 1 to Relief Request 29. FPL has modified the requested approval of Relief Request 29 to support its use during the spring 2003 St. Lucie Unit 2 refueling outage (SL2-14). Please contact George Madden at 772-467-7155, should there be any additional questions about this submittal.

Very truly yours,

Donald E. Jernigan
Vice President
St. Lucie Plant

DEJ/GRM

Attachments

A047

St. Lucie Unit 2
Supplemental Response to NRC Request for Additional Information (RAI)
Risk-Informed Inservice Inspection (RI-ISI) Relief Request 29

NRC Request 5:

On page 2 of the submittal dated July 23, 2002, FPL stated that the methodology used deviated from the methodology presented in Westinghouse Owners Group WCAP-14572, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report" (WCAP) for selecting elements from Region 1B and 2 of the Structural Element Selection Matrix shown in Figure 3.7-1 of the WCAP. FPL indicated the use of the process described in EPRI TR-112657 to select elements from these regions instead of the one described in the WCAP. On page 10 of the submittal (Section 3.8, Structural Element and NDE [nondestructive examination] Selection), FPL stated that for the 205 piping segments that were evaluated, Region 1B contains 9 segments, Region 2 contains 2 segments, no segments are contained in Region 3, and Region 4 contains 194 segments. Explain why there are no parts of any segments in Region 1A (the placement of segments in Region 1A does not rely on the Perdue method). What failure probability value was used to distinguish elements between Region 1 and Region 2?

FPL Response 5:

Placement in Region 1A is dependent on the presence of an active degradation mechanism. FPL did not identify any active degradation mechanisms.

An annual failure rate of 2.5E-05 was used to differentiate between Regions 1 and 2 simply for reporting purposes. Both Regions 1B and 2 were subject to the same element selection requirements; therefore, this segregation had no impact on the final selection.

NRC Requested Clarification to Response 5:

Saint Lucie in response to question 5, defines susceptible locations (Region 1A) as being "dependent on the presence of an active degradation mechanism." Page 168 of the WCAP defines susceptible locations (Region 1A) as those "being likely to be affected by a known or postulated failure mechanism." Discuss the parity between the two definitions.

FPL Clarification to Response 5:

In accordance with the WCAP, Subsection 3.7, Structural Element Selection, Paragraph 3.7.1, Structural Element Selection Matrix, page 166, a segment meeting the description of High Failure Importance, as determined by the engineering subpanel, "typically has either an active failure mechanism that is known to exist, which may be currently monitored as part of an existing augmented program, or alternatively may be analyzed as being highly susceptible to a failure mechanism, that could lead to leakage or rupture." The definition goes on to say, "Examples of failure mechanisms that would typically result in this classification are excessive thermal fatigue, corrosion cracking, primary water stress corrosion cracking, intergranular stress corrosion cracking, microbiologically influenced corrosion, erosion-cavitation, high vibratory loading on small diameter piping, and flow-accelerated corrosion."

These examples were considered representative of "active" failure mechanisms by FPL. The WinPRAISE failure rate calculations used by FPL incorporate the specific parameters indicative of the applicable mechanisms, including frequency and delta-T for thermal transients; however, none of the segments determined to be High Safety Significant were subject to any of the listed mechanisms, and as such were not placed in Region 1A.

NRC Request 9:

Under what conditions would the RI-ISI program be resubmitted to the Nuclear Regulatory Commission (NRC) prior to the end of any 10-year interval.

FPL Response 9:

FPL intends to comply with the standards developed by the industry and accepted by the NRC. Specifically, FPL will comply with the topical report currently drafted by NEI, upon endorsement by the NRC. The current proposal calls for NRC notification and approval for:

- Changing from one methodology to another
- Changing scope of application
- Plant-specific impact of revised methodology or safety evaluations
- ASME Section XI Ten-Year update
- Changes that impact the basis for NRC approval in the FPL St. Lucie Unit 2 specific safety evaluation

NRC Requested Clarification to Response 9:

FPL's response does not address resubmittal if there is industry experience or plant events that affect the outcome of the RI-ISI Program.

FPL Clarification to Response 9:

In addition to the above, the RI-ISI Program will be resubmitted to the NRC prior to the end of the 10-year interval if industry experience determines that there is a need for significant revision to the program as described in the original submittal for that interval.

NRC Request 11e:

An additional sensitivity analysis should have been performed regarding the probability of in-vessel recovery since the licensee assumed a very high probability of in-vessel recovery due to ex-vessel cooling.

FPL Response 11e:

For the Class 1 piping RI-ISI application, conservatism embedded in the IPE with respect to other dominant early containment failure mechanisms (e.g., direct containment heating, steam explosion, and the vessel acting like a rocket) outweigh the risk impact of variations in the probability used for in-vessel recovery. The revised Level

2 analysis, incorporating insights since the IPE submittal, indicates that the large early containment failure probability, assuming 25% for ex-vessel cooling, is less than 1%.

Revised FPL response 11e:

FPL's response is revised to read:

For the Class 1 piping RI-ISI application, conservatism embedded in the IPE with respect to other dominant early containment failure mechanisms (e.g., direct containment heating, steam explosion, and the vessel acting like a rocket) outweigh the risk impact of variations in the probability used for in-vessel recovery. The revised Level 2 analysis, incorporating insights since the IPE submittal, indicates that the large early containment failure probability is less than 1%.

NRC Request 15:

Section 3.8 of the licensee's submittal addresses additional examinations. It states, "The evaluation will include whether other elements on the segment or segments are subject to the same root cause and degradation mechanism. Additional examinations will be performed on these elements up to a number equivalent to the number of elements initially required to be inspected on the segment or segments. If unacceptable flaws or relevant conditions are again found similar to the initial problem, the remaining elements identified as susceptible will be examined. No additional examinations will be performed if there are no additional elements identified as being susceptible to the same service related root cause conditions or degradation mechanism."

ASME Code directs licensees to perform these sample expansions in the current outage that the flaws or relevant conditions were identified. Verify in what time frame the sample expansions will be completed.

FPL Response 15:

The FPL PSL RI-ISI program was developed in accordance with the Westinghouse Owners Group WCAP-14572. This technique has been incorporated into the ASME Code through Code Case N-577-1 for trial use. A non-mandatory appendix is currently under development for permanent incorporation in Section XI. Both the Code Case and the proposed non-mandatory appendix state that an evaluation shall be performed to establish when additional examinations are to be conducted. It is the intent of FPL to comply with the version of the Code that is approved incorporating the WCAP technique, including any conditions that may be imposed.

NRC Requested Clarification to Response 15:

FPL's response discusses future changes to the ASME Code that have not yet been developed or accepted by the NRC. Verify in what time frame the sample expansions will be completed, include in your response the current NRC approved Code in use and the time frame in which the samples will be performed.

FPL Clarification of Response 15:

WCAP-14572 Revision 1-NP-A, Section 4 Inspection Program Requirements, Subsection 4.5, Implementation and Program Monitoring, Paragraph 4.5.3, "Use of

Corrective Action Programs", states in part "Acceptable sampling schemes such as those required in ASME Section XI under IWB-2430 shall be used." The St. Lucie Unit 2 Risk Informed Inservice Inspection Program will follow the requirements of 1989 ASME Section XI Code with regard to additional examinations and will complete those sample expansions within the outage they were identified.

Florida Power and Light Company

St. Lucie Unit 2

Risk-Informed Inservice Inspection Piping Program Submittal

Using the Westinghouse Owners Group (WOG) Methodology

(WCAP-14572, Revision 1-NP-A, February 1999)

March 2003

RISK-INFORMED INSERVICE INSPECTION PROGRAM PLAN

Table of Contents

1. INTRODUCTION/RELATION TO NRC REGULATORY GUIDE RG-1.174

1.1 Introduction

Inservice inspections (ISI) are currently performed on piping to the requirements of the ASME Boiler and Pressure Vessel Code Section XI, 1989 Edition as required by 10CFR50.55a. St. Lucie Unit 2 is currently in the second inspection interval as defined by the Code for Program B.

The objective of this submittal is to request a change to the ISI Program plan for Class 1 piping only through the use of a Risk-Informed Inservice Inspection (RI-ISI) Program. The risk-informed process used in this submittal is described in Westinghouse Owners Group WCAP-14572, Revision 1-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," (referred to as "WCAP-14572, A-Version" for the remainder of this document).

As a risk-informed application, this submittal meets the intent and principles of Regulatory Guides 1.174 and 1.178. Further information is provided in Section 3.10 relative to defense-in-depth.

1.2 PRA Quality

The St. Lucie Unit 2 probabilistic safety assessment (PSA) baseline model was used to evaluate the consequences of pipe ruptures. The base core damage frequency (CDF) and the base large early release frequency (LERF) are 1.25E-05 and 6.00E-06, respectively.

The baseline model used for this RI-ISI evaluation was generated using the IPE model developed in response to Generic Letter (GL) 88-20, *Individual Plant Examination for Severe Accident Vulnerabilities*, and associated supplements. The original development work was classified and performed as "quality-related" under the FPL 10 CFR 50 Appendix B, Quality Assurance Program. The revision and applications of the PRA models and associated databases continue to be handled as quality-related. Administrative controls include written procedures, independent review of all model changes, data updates, and risk assessments performed using PSA methods and models. Risk assessments are performed by one PSA engineer, independently reviewed by another PSA engineer, and approved by the department head or designee. The PSA group falls under the FPL Engineering Quality Instructions (QI) with written procedures derived from those QIs. Procedures, risk assessment documentation, and associated records are controlled and retained as QA records.

Since the approval of the IPE, the FPL Reliability and Risk Assessment Group (RRAG) has maintained the PSA models consistent with the current plant configuration such that they are considered "living" models. The PSA models are updated for different reasons, including plant changes and modifications, procedure changes, accrual of new plant data, discovery of modeling errors, advances in PSA technology, and issuance of new industry PSA standards. The update process ensures that the applicable changes are implemented and documented timely so that risk analyses performed in support of plant operation reflect the plant configuration, operating philosophy, and transient and component failure history. The PSA maintenance and update process is described in FPL RRAG standard *PSA Update and Maintenance Procedure*. This standard defines two different types of periodic updates: 1) a data analysis update, and 2) a model update. The data analysis update is performed at least every five years. Model updates consisting of either single or multiple PSA changes are performed at a frequency dependent on the estimated impact of the accumulated changes. Guidelines to determine the need for a model update are provided in the standard. The Maintenance Rule Program developed to implement the requirements of 10CFR50.65 is also based on this PSA. The PSA model was also used to justify risk-informed evaluations to support technical specification change requests to extend the diesel generator and low-pressure safety injection allowed outage times (AOT).

The St. Lucie Unit 2 PSA model uses a large fault tree/small event tree method of quantification. Event tree models were developed to define the logic for core damage sequences. The event tree models were converted to equivalent fault tree logic and linked to the frontline and support system fault tree models. The core damage sequence gates were combined into a single-top core damage gate using "OR" logic. The single-top core damage gate was quantified to obtain core damage cutsets in terms of basic events. The core damage cutsets were used to obtain the CDF values. Each quantification involves post-process operations on the quantified "raw" cutsets. Cutsets containing pre-defined mutually exclusive event combinations were removed from the final cutset listing. Finally, recovery events were applied to selected cutsets based on pre-defined recovery rules. EPRI's Risk & Reliability Software Package and the NURELMCS code was used to perform the quantification of CDF values.

For this RI-ISI application, the impact of pipe breaks were simulated by defining surrogate basic events in the fault tree models and using the events to configure the fault tree models prior to the quantification process. If a pipe break did not result in an initiating event, the appropriate basic event(s) was set to a logical "TRUE" state prior to each fault tree quantification to simulate failure of a mitigation system or function due to the pipe break. If a pipe break resulted in an initiating event, the appropriate basic event(s) were set equal to the initiating event prior to each fault tree quantification to simulate the impact of the pipe break initiating event on mitigation systems or functions. Existing basic events in the model were used as the preferred method of simulating the postulated pipe break. New surrogate basic events were added to the model, as required, to properly simulate the impact of the postulated pipe break when existing events were not adequate.

The Level 2 evaluation determines that for Unit 2, LERF comprises 1% of CDF, except for those degradations that result in the inability to mitigate steam generator tube ruptures or interfacing systems LOCAs.

Since the St. Lucie Unit 2 PSA model has been used for Maintenance Rule risk ranking applications and risk-informed Technical Specification requests, it is concluded that, on a relative basis, the PSA method and model would yield meaningful rankings for RI-ISI evaluations when combined with deterministic insights.

2. PROPOSED ALTERNATIVE TO ISI PROGRAM

2.1 ASME Section XI

ASME Section XI Class 1 Categories B-F and B-J currently contain the requirements for examining (via non-destructive examination (NDE)) Class 1 piping components. This RI-ISI program applies to all ASME Class 1 piping, including piping currently exempt from requirements. The alternative RI-ISI program for piping is described in WCAP-14572, A-Version. The Class 1 RI-ISI program will be substituted for the current examination program on Class 1 piping in accordance with 10 CFR 50.55a(a)(3)(i) by alternatively providing an acceptable level of quality and safety. Other non-related portions of the ASME Section XI Code will be unaffected. WCAP-14572, A-Version, provides the requirements defining the relationship between the risk-informed examination program and the remaining unaffected portions of ASME Section XI.

2.2 Augmented Programs

There are no augmented inspection programs for the St. Lucie Unit 2 Class 1 piping systems.

3. RISK-INFORMED ISI PROCESSES

The processes used to develop the RI-ISI program are consistent with the methodology described in WCAP-14572, A-Version.

The process that is being applied involves the following steps:

- Scope Definition
- Segment Definition
- Consequence Evaluation
- Failure Assessment
- Risk Evaluation
- Expert Panel Categorization
- Element/NDE Selection
- Implement Program
- Feedback Loop

<u>Deviations</u>

There are two deviations to the process described in WCAP-14572, A-Version.

WCAP-14572 uses the Westinghouse Structural Reliability and Risk Assessment Model (SRRA) to calculate failure rates. Since SRRA is a Westinghouse product and St. Lucie is a CE plant, FPL uses WinPRAISE, a Microsoft Windows based version of the PRAISE code used as the benchmark for SRRA in WCAP-14572, Supplement 1.

In WCAP-14572, selection of elements in Regions 1B and 2 of the structural element selection matrix shown in Figure 3.7-1 of the WCAP is determined by a statistical evaluation process. Since the statistical model used in the WCAP is a proprietary Westinghouse product and St. Lucie is a CE plant, an alternative selection process was used. The alternative process selected 25% of the elements in each high safety significance segment. This alternative is based on the percentage designated in EPRI Topical Report TR-112657, Rev. B-A, approved in a safety evaluation report dated October 28, 1999 and on current ASME Section XI criteria. This selection process resulted in the selection for examination of 27.7% of the total population of elements in the high safety significance segments.

3.1 Scope of Program

The scope of this program is limited to all Class 1 piping, including piping exempt from current Section XI examination requirements. The Class 1 piping systems included in the risk-informed ISI program are provided in Table 3.1-1.

3.2 Segment Definitions

Once the scope of the program is determined, the piping for these systems is divided into segments as defined in WCAP-14572, Section 3.3.

The numbers of pipe segments defined for the Class 1 piping systems are summarized in Table 3.1-1. The as-operated piping and instrumentation diagrams were used to define the segments.

3.3 Consequence Evaluation

The consequences of pressure boundary failures are measured in terms of core damage and large early release frequency. The impact on these measures due to both direct and indirect effects was considered.

A review of the license basis of St. Lucie Unit 2, the Updated Final Safety Analysis Report Amendment No. 13, and the IPE Internal Events Methodology was performed to determine the potential impact of the indirect effects of pipe leak or rupture inside containment. As a result of the review, it was concluded that the containment structure and the safety-related components inside containment are adequately protected from pipe failures such that the effects of a failure are limited to direct effects. Table 3.3-1 summarizes the postulated consequences for each system.

3.4 Failure Assessment

Failure estimates were generated utilizing industry failure history, plant specific failure history, and other industry relevant information.

The engineering team that performed this evaluation used WinPRAISE, a Microsoft Windows based version of the PRAISE code used as the benchmark for SRRA in WCAP-14572, Supplement 1. The failure rate for each segment was based on an aggregate condition, utilizing a combination of the highest individual values of each parameter input to the calculation.

Table 3.4-1 summarizes the failure probability estimates for the dominant potential failure mechanism(s)/combination(s) by system. Table 3.4-1 also describes why the failure mechanisms could occur at various locations within the system. Full break cases are shown only when pipe whip is of concern.

No augmented inspections are performed for the Class 1 piping.

3.5 Risk Evaluation

Each piping segment within the scope of the program was evaluated to determine its CDF and LERF due to the postulated piping failure. Calculations were also performed with and without operator action.

Once this evaluation was completed, the total pressure boundary core damage frequency and large early release frequency were calculated by summing across the segments for each system. The results of these calculations are presented in Table 3.5-1. The expected value for core damage frequency due to piping failure without operator action is 9.365E-05/year, and with operator action is 9.364E-05/year. The expected value for large early release frequency due to piping failure without operator action is 9.365E-07/year, and with operator action is 9.364E-07/year. This evaluation also included a 5^{th} and 95^{th} percentile uncertainty analysis.

To assess safety significance, the risk reduction worth (RRW) and risk achievement worth (RAW) importance measures were calculated for each piping segment.

3.6 Expert Panel Categorization

The final safety determination (i.e., high and low safety significance) of each piping segment was made by the expert panel using both probabilistic and deterministic insights. The expert panel was comprised of personnel who have expertise in the following fields: probabilistic safety assessment, inservice examination, nondestructive examination, stress, material considerations, plant operations, plant and industry maintenance, repair, and failure history, system design and operation, and SRRA methods including uncertainty. Maintenance Rule expert panel members were used to ensure consistency with the other PSA applications.

The expert panel had the following positions represented during the expert panel meeting.

- Probabilistic Safety Assessment (PSA engineer)
- Maintenance Rule (Chairman)
- Operations (Senior Reactor Operator)
- Inservice Inspection (ISI&NDE)
- Plant & Industry Maintenance, Repair, and Failure History (System Engineer)
- Materials Engineer
- Stress Engineer

A minimum of four members filling the above positions constituted a quorum. This core team of panel members was supplemented by other experts, including a piping stress engineer, as required for the piping system under evaluation.

The System and Component Engineering Manager is the chairman of the expert panel. The Maintenance Rule administrator may act as alternate chairman.

Members received training and indoctrination in the risk-informed inservice inspection selection process. They were indoctrinated in the application of risk analysis techniques for ISI. These techniques included risk importance measures, threshold values, failure probability models, failure mode assessments, PSA modeling limitations, and the use of expert judgment. Training documentation is maintained with the expert panel's records.

Worksheets were provided to the panel containing information pertinent to the panel's selection process. This information, in conjunction with each panel member's own expertise and other documents, as appropriate, were used to determine the safety significance of each piping segment.

Meeting minute records were generated. The minutes included the names of members in attendance and whether a quorum was present. The minutes contained relevant discussion summaries and the results of membership voting.

3.7 Identification of High Safety Significant Segments

The number of high safety significant segments for each system, as determined by the expert panel, is shown in Table 3.7-1 along with a summary of the risk evaluation identification of high safety significant segments.

3.8 Structural Element and NDE Selection

The structural elements in the high safety significant piping segments were selected for inspection and appropriate non-destructive examination methods were defined.

The program being submitted addresses the high safety significant (HSS) piping components placed in Regions 1 and 2 of Figure 3.7-1 and described in Section 3.7.1 in

WCAP-14572, A-Version. Region 3 piping components, which are low safety significant, are to be considered in an owner defined program and is not considered part of the program requiring NRC approval. Region 1, 2, 3, and 4 piping components will continue to receive Code required pressure testing, as part of the current ASME Section XI program. For the 205 piping segments that were evaluated in the RI-ISI program, Region 1B contains 9 segments, Region 2 contains 2 segments, no segments are contained in Region 3, and Region 4 contains 194 segments.

The number of locations to be inspected in applicable HSS segments was determined using a selection process based on that described in EPRI Topical Report TR-112657 Rev. B-A, approved in a safety evaluation report dated October 28, 1999 and on current ASME Section XI criteria. The process selected 25% of the elements in each high safety significance segment. This resulted in the selection of 27.7% of the total population of elements in the high safety significance (HSS) segments.

Table 4.1-1 in WCAP-14752, A-Version, was used as guidance in determining the examination requirements for the HSS piping segments. VT-2 visual examinations are scheduled in accordance with the station's pressure test program, which remains unaffected by the risk-informed inspection program.

<u>Additional Examinations</u>

The risk-informed inspection program in all cases will determine, through an engineering evaluation, the root cause of any unacceptable flaw or relevant condition found during examination. The evaluation will include the applicable service conditions and degradation mechanisms to establish that the element(s) will still perform their intended safety function during subsequent operation. Elements not meeting this requirement will be repaired or replaced.

The evaluation will include whether other elements on the segment or segments are subject to the same root cause and degradation mechanism. Additional examinations will be performed on these elements up to a number equivalent to the number of elements initially required to be inspected on the segment or segments. If unacceptable flaws or relevant conditions are again found similar to the initial problem, the remaining elements identified as susceptible will be examined. No additional examinations will be performed if there are no additional elements identified as being susceptible to the same service related root cause conditions or degradation mechanism. Sample expansions will be completed within the outage that the flaw or relevant condition was identified.

3.9 Program Relief Requests

An attempt shall be made to provide a minimum of >90% coverage criteria (per ASME Code Case N-460) when performing an exam. Some limitations will not be known until the examination is performed, since some locations will be examined for the first time by the specified techniques.

In instances where it may be found at the time of the examination that a location does not meet >90% coverage, the process outlined in Section 4.0 (Inspection Program Requirements) of WCAP-14572, A-Version will be followed.

3.10 Change in Risk

The Risk-Informed ISI program has been done in accordance with Regulatory Guide 1.174, and the risk from implementation of this program is expected to remain constant when compared to that estimated from current requirements.

A comparison between the proposed RI-ISI program and the current ASME Section XI ISI program was made to evaluate the change in risk. The approach evaluated the change in risk with the inclusion of inservice inspections with a "good" probability of detection in the WinPRAISE model and followed the guidelines provided on page 213 of WCAP-14572.

The results from the risk comparison are shown in Table 3.10-1. As seen from the table, the overall RI-ISI program maintains the risk associated with piping CDF/LERF, with respect to the current Section XI program, while reducing the number of examinations. The primary basis for being able to maintain risk with a reduced number of examinations is that exams are now being placed on piping segments that are high safety significant, and in some cases elements are inspected that are not inspected by NDE in the current ASME Section XI ISI program.

Defense-In-Depth

The reactor coolant piping will continue to receive a system leakage test and visual VT-2 examination as currently required by the Code. Volumetric examinations will also continue on the main reactor coolant piping as part of the RI-ISI program (segments categorized HSS). These locations, which include main loop and pressurizer surge line piping welds determined by the RI-ISI program for St. Lucie Unit 2, assure that "defense-in-depth" is maintained. No additional inspection locations are required to meet "defense-in-depth."

4. IMPLEMENTATION AND MONITORING PROGRAM

Upon approval of the RI-ISI program, procedures that comply with the guidelines described in WCAP-14572, A-Version, will be prepared to implement and monitor the program. The new program will be integrated into the existing ASME Section XI interval. No changes to the Technical Specifications or the Updated Final Safety Analysis Report are necessary for program implementation.

The applicable aspects of the Code not affected by this change would be retained, such as inspection methods, acceptance guidelines, pressure testing, corrective measures, documentation requirements, and quality control requirements. Existing ASME Section XI program implementing procedures would be retained and would be modified to address the RI-ISI process, as appropriate. Additionally, the procedures will be modified to include the high safety significant locations in the program.

The proposed monitoring and corrective action program will contain the following elements:

A. Identify
B. Characterize
C. Evaluate
   (1) Evaluate, determine the cause and extent of the condition identified
   (2) Evaluate, develop a corrective action plan or plans
D. Decide
E. Implement
F. Monitor
G. Trend

The RI-ISI program is a living program requiring feedback of new relevant information to ensure the appropriate identification of high safety significant piping locations. As a minimum, risk ranking of piping segments will be reviewed and adjusted on an ASME Section XI inspection period basis. Significant changes may require more expedited adjustment as directed by NRC Bulletin or Generic Letter requirements, or by plant specific feedback.

5. PROPOSED ISI PROGRAM PLAN CHANGE

A comparison between the RI-ISI program and the current ASME Section XI program requirements for piping is given in Table 5-1. The plant will be performing examinations on elements not currently required to be examined by ASME Section XI. The current ASME Section XI program selects a prescribed percentage of examinations without regard to safety significance. The RI-ISI program focuses examinations on those high safety significant segments and subsequently examinations are required on inspection elements not currently scheduled for examination by the ASME Section XI program.

The program will be retroactively started in the third period of the second interval, starting in the outage scheduled to begin November 19, 2001. Currently, 68% of the exams in the Section XI program have been performed, meeting the 50% requirement for the end of the second inspection period of the current interval.

6. SUMMARY OF RESULTS AND CONCLUSIONS

A partial scope Class 1 risk-informed ISI application has been completed for Unit 2. Upon review of the proposed risk-informed ISI examination program given in Table 5-1, an appropriate number of examinations are proposed for the high safety significant segments across the Class 1 portions of the plant piping systems. Resources to perform examinations currently required by ASME Section XI in the Class 1 portions of the plant piping systems, though reduced, are distributed to address the greatest amount of risk within the scope. Thus, the change in risk principle of Regulatory Guide 1.174 is maintained. Additionally, the examinations performed will address specific damage mechanisms postulated for the selected locations through appropriate examination selection and increased volume of examination.

The construction permit for St. Lucie Unit 2 was issued May 1977. The plant is designed to ASME Section III for the Class 1 piping. The ASME Section III design provides an improved level of fatigue analysis and operating conditions scrutiny when compared to older vintage plants. This results in a larger percentage of the reactor coolant system piping constructed with butt welds as opposed to socket welds and more detailed information is available for input to the estimation of the failure probability.

From a risk perspective, the PRA dominant accident sequences include: small LOCA; loss of offsite power; and large LOCA.

For the RI-ISI program, appropriate sensitivity and uncertainty evaluations have been performed to address variations in piping failure probabilities and PRA consequence values along with consideration of deterministic insights to assure that all high safety significant piping segments have been identified.

As a risk-informed application, this submittal meets the intent and principles of Regulatory Guide 1.174.

7. REFERENCES/DOCUMENTATION

WCAP-14572,Revision 1-NP-A, , "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," February 1999

Calculation Number PSL-BFJR-98-004, Revision 2, "St. Lucie Units 1 & 2 Baseline EOOS Models."

St. Lucie Units 1 & 2 Individual Plant Examination Submittal, Revision 0, dated December 1993.

St. Lucie Unit 2 Probabilistic Safety Assessment Update Revision 0, 1996.

Procedure RRAG-GEN-002, "PSA Update and Maintenance Procedure," Revision 2, Dated July 25, 1996.

Calculation Number PSL-BFJR-96-007, Revision 4, "Documentation of St. Lucie Pre-Evaluated Maintenance Risk Assessments (PREMRA)"

Risk & Reliability Software developed for the Electric Power Industry under sponsorship of EPRI, the Electric Power Research Institute.

NURELMCS, SCIENTECH, Version 2.20, Revision 1.8

Supporting Onsite Documentation

The onsite documentation is contained within the following Engineering Evaluations:

PSL-ENG-SEOS-01-002, "St. Lucie Unit 2 Risk-Informed ISI Program Development Analysis"

PSL-ENG-SEOS-01-003, "St. Lucie Unit 2 Risk-Informed ISI Program – Failure Analysis"

PSL-ENG-SEOS-01-004, "St. Lucie Unit 2 Risk-Informed ISI Program – Consequence Quantification"

Table 3.1-1
System Selection and Segment Definition for Class 1 Piping

System Description	PRA	Section XI	Number of Segments
CH - Chemical & Volume Control	Yes	Yes	20
RC - Reactor Coolant[1]	Yes	Yes	126
SI - Safety Injection [1,2]	Yes	Yes	59
Total			205

Notes:

1. Includes shutdown cooling flowpaths.
2. Includes flow paths for high pressure safety injection, low pressure safety injection, and the passive accumulator in portions of SI.

Table 3.3-1
Summary of Postulated Consequences by System

System	Summary of Consequences
CH – Chemical & Volume Control	The direct consequences postulated from piping failures in this system are: loss of auxiliary pressurizer spray flow path; loss of one or more trains for charging; and small-small loss of coolant accident (LOCA).
RC – Reactor Coolant	The direct consequences associated with piping failures are: large, small, and/or small-small LOCAs; loss of safety injection tank flow path; loss of cold or hot leg injection flow path; loss of alternate injection flow path; loss of auxiliary pressurizer spray flow path; loss of one or more charging flow paths; and loss of identified instrumentation; loss of shutdown cooling flowpath.
SI – Safety Injection	The direct consequences associated with piping failures are: loss of safety injection tank flow path; loss of low pressure safety injection (LPSI) flowpath; loss of cold or hot leg injection flow path; loss of alternate injection flowpath; piping break outside primary containment; large and/or small-small LOCAs; loss of suction to LPSI pump; loss of identified instrumentation; loss of shutdown cooling flowpath..

Table 3.4-1
Failure Probability Estimates (Without ISI)

System	Dominant Potential Degradation Mechanism(s)/ Combination(s)	Failure Probability Range (Small Leak Probability @ 40 years, no ISI)	Comments
CH	-Fatigue	2.01E-12 – 6.80E-09	The charging path to the applicable RCS loop is potentially susceptible to thermal fatigue
RC	-Fatigue	1.66E-14 – 4.82E-06	Fatigue at instrument line connections to main loop.
	-Thermal Transients	5.67E-14 – 2.85E-03	Piping where large thermal transients could occur: pressurizer surge line and charging nozzles
	-Thermal and Vibratory Fatigue	1.4E-06 – 4.6E-05	The piping is located on the RCP pump or seal housing and is potentially subject to vibration.
SI	- Fatigue	1.85E-15 – 2.07E-11	Piping in flow path of alternate injection and SIT is potentially susceptible to thermal fatigue.
	- Thermal Transients	8.21E-15 – 5.83E-14	Potential piping locations where thermal transients could occur in injection lines.

Table 3.5-1
Number of Segments and Piping Risk Contribution by System (without ISI)

System	# of Segments	CDF Without Operator Action (/yr)	CDF With Operator Action (/yr)	LERF Without Operator Action (/yr)	LERF With Operator Action (/yr)
CH	20	4.041E-11	3.963E-11	4.041E-13	3.963E-13
RC	126	9.365E-05	9.364E-05	9.365E-07	9.364E-07
SI	59	1.954E-16	1.954E-16	1.954E-18	1.954E-18
TOTAL	205	9.365E-05	9.364E-05	9.365E-07	9.364E-07

Table 3.7-1
Summary of Risk Evaluation and Expert Panel Categorization Results

System	Number of segments with any RRW > 1.005	Number of segments with any RRW between 1.005 and 1.001	Number of segments with all RRW < 1.001	Number of segments with any RRW between 1.005 and 1.001 placed in HSS	Number of segments with all RRW < 1.001 selected for inspection	Total number of segments selected for inspection (HSS Segments)
CH	0	0	20	0	0	0
RC	9	2	115	2	0	11
SI	0	0	59	0	0	0
Total	9	2	194	2	0	11

Table 3.10-1
COMPARISON OF CDF/LERF FOR CURRENT SECTION XI AND RISK-INFORMED ISI PROGRAMS

Case	Current Section XI	Risk-Informed
CDF No Operator Action	8.03E-05	8.03E-05
• CH	2.46E-11	2.46E-11
• RC	8.03E-05	8.03E-05
• SI	1.60E-18	1.60E-18
CDF With Operator Action	8.03E-05	8.03E-05
• CH	2.39E-11	2.39E-11
• RC	8.03E-05	8.03E-05
• SI	1.60E-18	1.60E-18
LERF No Operator Action	8.03E-07	8.03E-07
• CH	2.46E-13	2.46E-13
• RC	8.03E-07	8.03E-07
• SI	1.60E-20	1.60E-20
LERF With Operator Action	8.03E-07	8.03E-07
• CH	2.39E-13	2.39E-13
• RC	8.03E-07	8.03E-07
• SI	1.60E-20	1.60E-20

Table 5-1
STRUCTURAL ELEMENT SELECTION
RESULTS AND COMPARISON TO ASME SECTION XI
1989 EDITION REQUIREMENTS

System	Number of HSS Segments (No. of HSS in Aug. Program / Total No. of Segments in Aug. Program)	Degradation Mechanism(s)	Class	ASME Code Category	Weld Count		ASME XI Examination Methods (Volumetric (Vol) and Surface (Sur))		RI-ISI	
					Butt	Socket	Vol & Sur	Sur Only	SES Matrix Region	Number of Exam Locations
CH	0	Thermal Fatigue	1	B-F	3	0	0	3	-	0
				B-J	30	115	0	81		
RC	11 (0/0)	Thermal Fatigue, Thermal Transients, Vibration Fatigue	1	B-F	20	0	12	8	1B, 2	3 volumetric
				B-J	202	20	50	24		21 volumetric
SI	0	Thermal Fatigue, Thermal Transients	1	B-F	6	0	6	0	-	0
				B-J	143	22	18	5		
TOTAL	11 (0/0)		CL. 1	B-F	29	0	18	11		3 NDE
				B-J	375	157	68	110		21 NDE
			TOTAL		404	157	86	121		24 NDE

Summary: Current ASME Section XI selects a total of 86 non-destructive exams (surface only exams not included), while the proposed RI-ISI program selects a total of 24 non-destructive exams. This results in a 73% reduction of non-destructive exams.

General Note:
System pressure test requirements and VT-2 visual examinations shall continue to be performed in ASME Class 1 systems.