ATTACHMENT TO L-2000-010

FLORIDA POWER AND LIGHT

TURKEY POINT UNIT 3

Risk-Informed Inservice Inspection Program Using the Westinghouse Owners Group (WOG) Methodology (WCAP-14572, Revision 1-NP-A, February 1999)

December 1999

RISK-INFORMED INSERVICE INSPECTION PROGRAM PLAN

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

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. Turkey Point Unit 3 is currently in the third 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," and WCAP-14572, Revision 1-NP-A, Supplement 1, "Westinghouse Structural Reliability and Risk Assessment (SRRA) Model for Piping Risk-Informed Inservice Inspection," (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.

PRA Quality

The Turkey Point Level 1 and Level 2 Probabilistic Safety Assessment (PSA) model, 1997 update, was used to evaluate the consequences of pipe ruptures during operation in Modes 1 and 2. The base core damage frequency (CDF) and base large, early release frequency (LERF) from this version of the PSA model are 6.09E-05/yr and 1.00E-05/yr, respectively.

The Turkey Point PSA model is an updated version of the original Turkey Point Individual Plant Examination (IPE) submittal. Prior to the IPE being submitted to the U.S. Nuclear Regulatory Commission (NRC), a peer review was conducted by an outside contractor. All review findings were addressed prior to the IPE submittal to NRC on June 25, 1991. Following the submittal, the NRC chose to apply a "Step 1" and a "Step 2" review of the IPE. The "Step 2" portion consisted of a more detailed review, including an on-site visit by an NRC review team. After resolving the findings of this review, a revised IPE was submitted to NRC in March 1992. The NRC safety evaluation report (SER) for the IPE was issued thereafter in October 1992. The SER and the associated technical report were very positive in their assessment of the Turkey Point IPE. The few comments on the submittal were minor and were addressed by Florida Power and Light (FPL) and closed out.

Since the IPE, the FPL Reliability and Risk Assessment Group (RRAG) has maintained the Turkey Point PSA model consistent with the plant configuration as it has evolved. The PSA computer models are updated on an as-needed basis for various reasons, such as plant changes and modifications, procedure changes, accrual of new plant data, modeling improvements, advances in PSA technology, and issuance of new industry PSA standards. These changes are implemented and documented in a timely manner to ensure that risk analyses performed in support of plant operation reflect the current plant configuration, operating philosophy, transient history, system and component performance.

The PSA maintenance and update process is governed by the RRAG PSA procedures. Updates to the Turkey Point PSA model are documented and reviewed via engineering calculations and evaluations in accordance with the FPL Engineering Department's Quality Instructions and RRAG procedures. As further verification for this application, the RI-ISI evaluation included a determination that the PSA model and supporting documentation accurately reflects the current Turkey Point plant configuration.

2. PROPOSED ALTERNATIVE TO ISI PROGRAM

2.1 ASME Section XI

ASME Section XI Class 1 Categories B-F, B-J, etc. currently contain the requirements for examining (via non-destructive examination (NDE) Class 1 piping components. This current program is limited to 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 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 Turkey Point Unit 3 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

There are no deviations to the process described in WCAP-14572, A-Version.

3.1 Scope of Program

The scope of this program is limited to the Class 1 piping, including piping exempt from current requirements. The Class 1 piping systems included in the risk-informed ISI program are provided in Table 3.1-1. For Turkey Point Unit 3, because of the vintage of the plant, the Class 1 piping boundaries include from the reactor coolant system up to, in most cases, the second isolation valve. This includes piping through the excess letdown and regenerative heat exchangers in the chemical and volume control system.

3.2 Segment Definitions

Once the scope of the program is determined, the piping for these systems is divided into segments.

The number 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. The simplified drawings showing the piping segments are provided in the Turkey Point Engineering Evaluation PTN-ENG-SEOS-99-0152.

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 Turkey Point (Turkey Point Units 3 and 4 Updated Final Safety Analysis Report and supporting documents) 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.

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 the Westinghouse structural reliability and risk assessment (SRRA) software program (described in WCAP-14572, Revision 1-NP-A, Supplement 1) to aid in the process. Generally, the SRRA code was used to estimate where the possible ranges of failure probability would fall. The final probability selected was determined by the team members using the relevant information and industry experience.

Table 3.4-1 summarizes the failure probability estimates by failure mechanism and also identifies the systems susceptible to these mechanisms.

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 3.69E-05/year, and with operator action is 3.60E-05/year. The expected value for large early release frequency due to piping failure without operator action is 2.62E-06/year, and with operator action is 2.56E-06/year.

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 and 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 meetings.

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

The expert panel chairperson was appointed by the Turkey Point Engineering Manager. The chairperson conducted the meeting.

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 on each system for each piping segment, 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.

A consensus process was used by the expert panel. Consensus is defined as unanimous during first consideration and 2/3 (rounding conservatively) of members or alternates present in the second or subsequent considerations. The chairperson allowed appropriate time duration between considerations for deliberation.

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 5-1.

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 initial 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 201 piping segments that were evaluated in the RI-ISI program, Region 1 contains 18 segments, Region 2 contains 12 segments, no segments are contained in Region 3, and Region 4 contains 171 segments.

The number of locations to be inspected in applicable HSS segments was determined using a Westinghouse statistical (Perdue) model as described in section 3.7 of WCAP-14572, A-Version. The 12 HSS piping segments in Region 2, including the RCS primary loop piping, were evaluated using this model. The welds in several of the HSS segments in Region 1 are socket welds where neither surface nor volumetric examinations are possible. The pressurizer surge line included thermal stratification as a primary degradation mechanism. For these segments, where the Perdue Model is not applicable, the guidance in Section 3.7.3 of WCAP-14572, A-Version was followed to identify appropriate exam locations. At this time, all 7 locations (welds) in the surge line will be examined as part of the RI-ISI program.

The segments categorized as HSS by the plant expert panel which include socket welds consist of piping with a nominal diameter of 2 inches or less. The socket welds in these segments cannot be individually examined by any currently available NDE methods that are appropriate for the degradation mechanism of intent. Therefore, for these segments a focused visual VT-2 exam will be performed during the system pressure test each refueling outage with emphasis on a specific and potentially limiting location within each segment.

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.

Additional Examinations

Since the risk-informed inspection program will require examinations on a large number of elements constructed to lesser pre-service inspection requirements, the 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 required to be initially 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.

3.9 Program Relief Requests

Alternate methods are specified to ensure structural integrity in cases where examination methods cannot be applied due to limitations such as inaccessibility or radiation exposure hazard.

An attempt has been made to provide a minimum of >90% coverage (per Code Case N-460) for all of the risk-informed examinations. However, 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 a location may be found at the time of the examination that it 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 slightly decrease 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 the probability of detection as determined by the SRRA model. This evaluation resulted in the identification of 7 piping segments for which examinations will continue to be performed.

The results from the risk comparison are shown in Table 3.10-1. As seen from the table, the overall RI-ISI program slightly reduces or maintains the risk associated with piping CDF/LERF, with respect to the current Section XI program, while reducing the number of examinations. Table 3.10-1 also includes the systems that are the significant contributors to the overall risk for both the current program and the RI-ISI program. The primary basis for being able to slightly reduce (or 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 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. Surface and volumetric examinations will also continue on the main reactor coolant piping and main safety injection lines (downstream of first check valve) as part of the RI-ISI program (segments categorized HSS). These locations, which include reactor vessel, steam generator, and pressurizer dissimilar metal welds determined by the RI-ISI program for Turkey Point Unit 3, 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 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. (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 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. An example of these additional examinations is that several elements (segments) currently classified as exempt from examination as NPS 1 and smaller shall be included into the program plan, for Class 1 only.

The initial program will be started in the third period of the third interval. For example, the second inspection period of the third inspection interval for Unit 3 ends on February 21, 2001. Currently, 55% 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. Therefore, exams initially planned during the upcoming Turkey Point Unit 3 outage in February 28, 2000 will be delayed anticipating approval and implementation of the RI-ISI program during the third period.

6.0 REFERENCES/DOCUMENTATION

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

WCAP-14572, Revision 1-NP-A, Supplement 1, "Westinghouse Structural Reliability and Risk Assessment (SRRA) Model for Piping Risk-Informed Inservice inspection," February 1999

Supporting Onsite Documentation

The onsite documentation is contained within the Engineering Evaluation PTN-ENG-SEOS-99-0152 and the following calculations.

CN-RRA-99-15 Revision 0, "Turkey Point Unit 3 Risk Ranking Analysis," December 1999. (Westinghouse Proprietary)

CN-RRA-99-17 Revision 0, "Turkey Point Unit 3 Risk-Informed ISI Program – Segment Definition," December 1999. (Westinghouse Proprietary)

CN-RRA-99-35, "Turkey Point Unit 3 Risk-Informed ISI Program – Expert Panel Worksheets and MS Access Database," December 1999. (Westinghouse Proprietary)

CN-RRA-99-38 Revision 0, "Turkey Point Unit 3 Perdue Model Calculations for Risk-Informed ISI Pilot Program," December 1999. (Westinghouse Proprietary)

CN-RRA-99-40, "Turkey Point Unit 3 Revised Failure Probability Calculations with WinSRRA Version 1.1.0," December 1999. (Westinghouse Proprietary)

CN-RRA-99-41, "Turkey Point Unit 3 RI-ISI Program - Delta-Risk Calculation," December 1999. (Westinghouse Proprietary)

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	70
RC - Reactor Coolant	Yes	Yes	102
SI - Safety Injection	Yes	Yes	29
Total			201

Table 3.4-1 Failure Probability Estimates (without ISI)		
Failure Mechanism	Failure Probability Range (Small Leak Probability @ 40 years, no ISI)	Susceptible Systems
Corrosion	N/A	None
Fatigue	1.0E-08 to 1.4E-04	RC, SI, CH
Stress Corrosion Cracking	N/A	None
Striping/Stratification	4.0E-04	Pressurizer surge line
Vibratory Fatigue (Low/Moderate)	1.7E-08 to 5.9E-5	RC, SI, CH
Wastage	N/A	None

Table 3.5-1

Number of Segments and Piping Risk Contribution by System (without ISI)
(Values shown are expected values)

System	# of Segments	CDF without Operator Action (/yr)	CDF with Operator Action (/yr)	LERF without Operator Action (/yr)	LERF with Operator Action (/yr)
CH	70	2.52E-05	2.44E-05	1.51E-06	1.47E-06
RC	102	1.17E-05	1.16E-05	1.10E-06	1.10E-06
SI	29	7.02E-10	7.02E-10	5.52E-11	5.52E-11
TOTAL	201	3.69E-05	3.60E-05	2.62E-06	2.56E-06

Table 3.10-1

COMPARISON OF CDF/LERF FOR CURRENT SECTION XI AND RISK-INFORMED ISI PROGRAMS AND THE SYSTEMS WHICH CONTRIBUTED SIGNIFICANTLY TO THE CHANGE

Case (Systems Contributing to Change)	Piping CDF/LERF Current Section XI	Piping CDF/LERF Risk-Informed
CDF No Operator Action (RC, CH)	1.66E-05	1.65E-05
CDF with Operator Action (RC, CH)	1.66E-05	1.65E-05
LERF No Operator Action (RC, CH)	1.02E-06	1.01E-06
LERF with Operator Action (RC, CH)	1.01E-06	1.01E-06

Note: CDF/LERF values include credit for leak detection also.

Table 5-1 **STRUCTURAL ELEMENT SELECTION RESULTS AND COMPARISON TO ASME SECTION XI 1989 EDITION REQUIREMENTS**					
System	Number of High Safety-Significant Segments (No. in Augmented Program)	RI-ISI Program High Safety-Significant Structural Elements[a]	ASME Section XI ISI Program 1989 Edition Examination Category Weld Selections		Total Number of Segments Credited in Augmented Programs
		CLASS 1	B-F	B-J	
CH	16 (0)	16[b]	0	57	0
RC	14 (0)	19 + 1[b] + 7[c]	18	86	0
SI	0 (0)	0	0	63	0
Total	30 (0)	19 + 17[b] + 7[c]	18	206	0

Summary: Current ASME Section XI selects a total of 224 non-destructive exam locations while the proposed RI-ISI program selects a total of 26 exam locations (43 - 17 visual exam locations), which results in an 88% reduction.

Notes for Table 5-1

a. System pressure test requirements and VT-2 visual examinations shall continue to be performed in all ASME Code Class 1, 2, and 3 systems.
b. VT-2 area exam at specific location.
c. Examinations added for change in risk considerations.