FPL

FEB 28 2003

L-2003-052

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington D. C. 20555

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Response to Request for Additional Information Regarding the Relaxation Request for US NRC Order EA-03-009

By letter L-2003-045, dated February 25, 2003, Florida Power & Light (FPL) submitted a Relaxation Request to implement an alternative to the requirements specified in Section IV, paragraph C.(1)(b)(i) or Section IV, paragraph C.(1)(b)(ii) for the Reactor Vessel Level Monitoring System (RVLMS) Penetrations # 59 and # 60. The U.S. Nuclear Regulatory Commission Staff requested additional information regarding the above referenced FPL submittal during a telephone conference on February 27, 2003.

The response to the NRC's request for additional information is provided in Attachment 1.

Enclosure 1 contains proprietary and non-proprietary versions of the Westinghouse letter report STD-DA-03-05, dated February 21, 2003. This report is referenced in FPL's letter L-2003-045 in page 6 of the Attachment to the letter as footnote #6. The affidavit required by 10 CFR 2.790 is also attached to the proprietary version of the report. FPL requests that the proprietary version be withheld from public viewing.

If you have any questions on this request, please contact Walter Parker at (305) 246-6632.

Sincerely,

William Jefferson, Jr.
Vice President
Turkey Point Plant

SM

Attachments
Enclosure

cc: Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point

A101

NRC Question #1: It is stated that the risk evaluation approach is (in part) "based on a simple statistical evaluation of the assumed sample inspection results of no flaws found in the inspected penetrations." How is this assumption incorporated in the analysis? Given this basis, why don't the relaxation withdrawal criteria have a trigger of any flaws found in any penetration?

FPL Response to Question 1: The assumption of no flaws found is incorporated into the calculation of the 95% upper confidence bound probability of any one penetration having a leak. The risk evaluation was intended to be backward looking based on the actual results of theTurkey Point Unit 3 (PTN-3) inspection. To request relaxation from the Order, FPL prepared the risk argument making a no defect assumption. However, several conservative assumptions were made that support the basis that inspections of the RVLMS penetrations are only required should repairable service induced defects be identified, including the following:

- For the analysis, flaws are assumed to exist in the 2 RVLMS penetrations with an average length of 3 inches (~90°) and 100% through wall, with an exponential distribution in circumferential extent.
- There is a 95% confidence that these flaws will not grow to a critical flaw size within 7.5 EFPY. This is a factor of 5 greater than the 1.5 EFPY period of the relaxation request.
- The critical circumferential flaw size of 11.6 inches is the controlling flaw.
- The analysis uses a 95 % upper confidence bound on the probability. The R.G. 1.174 guidline is intended to use a mean confidence adding a 3 to 4 times higher probability of occurance.
- The analysis makes no assumption about the integrity of the welds, however, FPL is proposing a surface weld examination of the two RVLMS penetrations.
- The analysis uses the larger conditional core damage propability (CCDP) of a small break LOCA (2-6 inches) but the RVLMS penetrations have a welded alignment cover plate that makes the effective break size equal to a 1.61 inch diameter opening, which is a small-small LOCA (3/8-2 inches).

Deterministically, if the 64 RPV penetration base material examinations identify no service induced circumferential flaws of any size, no leaks, and no repairable axial flaws, then the inspection has yielded results that support the conclusion that no one flaw will exceed the pertinent critical flaw size during the desired time interval of the relaxation of 1.5 EFPY.

Should cracks of any size be found, they will be evaluated within the plant corrective action program. As part of this evaluation,the risk model will be rerun to verify that the risk conclusions remain valid to support not inspecting the RVLMS.

NRC Question #2: Any service-induced cracking in a nozzle from a specific heat may indicate that the heat has an elevated susceptibility to cracking. Given this assumption, provide a basis for not withdrawing the relaxation request if service-induced cracking is identified in any of the other 10 nozzles of heat #NX5940.

FPL Response to Question 2: If any service induced cracking is identified in the base material of the 10 nozzles of heat NX5940 during the PTN 3, March 2003 inspection, the relaxation request will be withdrawn, and the two RVLMS penetrations will be ultrasonically inspected.

NRC Question #3: Identify any other plants that have heat #NX5940 in their nozzles. What are the inspection results for this heat at other plants (if applicable)? Provide a basis for not considering these inspection results as being relevant to Turkey Point.

FPL Response to Question 3: A search of the database for all RPV head nozzle heats of material made available to the NRC [1] was performed. Three plants are identified from the 489 individual material heat entries, that have heat NX5940 used in the construction of their RPV heads. These include PTN-3, PTN-4 and Surry Unit 1. PTN-3 has 12 penetrations of this heat including the 2 RVLMS locations. PTN-4 has 7 penetrations of this heat including the 2 RVLMS locations. Surry Unit 1 has a total of 10 different heats used for its 65 RPV penetrations (not counting the vent), but no information was available about how many of the penetrations used heat NX5940.

The inspections performed to date at both PTN-3 and 4 have been visual with no indication of leakage from heat NX5940. In the fall of 2001 (Event #38435), Surry Unit 1 plant identified RPV leakage that eventually resulted in 6 pentrations that required repair, however since the utility did not have heat location data it was not known if heat NX5940 was involved.

A further look at the Surry Unit 1 heat data and the PTN data indicated that the Surry Unit 1 heat of NX5940 may have been heat treated in a different lot from the PTN-3 and 4 heat of NX5940. The Surry Unit 1 heat has a higher reported tensile test result yield strength/tensile strength of 39 ksi/83 ksi, as compared to 31.5 ksi/83.5 ksi for the PTN-3 and 4 heats. Therefore, the Surry heat of NX 5940 may not be as directly representative as the 10 examples that are being inspected in the PTN-3 head and the 5 in the PTN-4 head.

NRC Question #4: The identification of repairable cracking at a unit may indicate that there are plant-specific parameters that make the VHP nozzles in that plant more susceptible to cracking. Provide a basis for not withdrawing the relaxation request if repairable cracking is identified in any of the other 64 nozzles at Turkey Point.

FPL Response to Question 4: If service induced cracking, that requires repair, is identified in the base material of any of the 64 inspected nozzles during the PTN-3, March 2003 inspection, the relaxation request will be withdrawn, and the two RVLMS penetrations will be ultrasonically inspected.

NRC Question #5: Page 6 of the request states that "if a defect is identified during the inspection, the issue will be addressed within the plant corrective action program." What types of findings will be classified as "defects" and hence trigger this consideration?

FPL Response to Question 5: The types of findings classified as defects include any indications identified during the ultrasonic inspections, any J-groove weld and adjacent nozzle surface examination observable indications, or any leakage detected during the visual examinations.

[1] EPRI MRP Letter 2002-112 dated December 19, 2002, "Alloy 600 RPV Head Nozzle Heats of Material," Christine King (EPRI-MRP) to Alex Marion (NEI), forwarded via e-mail from Alex Marion to Richard Barrett (NRC) on January 3, 2003.

NRC Question #6: What is your current total core damage frequency (CDF) including internal and external events. What fraction of the total CDF is internal and what fraction is external?

FPL Response to Question 6: The total core damage frequency (CDF), including internal and external events is 2.1E-05 per year. The internal events contribution is 1.0E-05 per year, or 48%, and the external events contribution is 1.1E-05 per year, or 52%.

NRC Question #7: What is the principal use of the leakage detection system? How frequently is the system used to assess the leakage rate in the reactor pressure vessel (RPV) head area? What triggers nonroutine use of the system and what is the sensitivity?

FPL Response to Question 7: The head leak detection system monitors the relative differences between normal containment atmosphere and the exhaust of the Reactor Area CRDM ventilation ductwork. The CRDM ductwork pulls air up around the reactor pressure vessel and head for cooling. The head leak detector is principally used for diagnostics of suspected leakage conditions inside containment.

This system monitors each of the two source locations through motor operated valves. The valves are on an automatic timer, which switches the sources of sample flow on an approximate 5-hour interval. The system is used to monitor the differences between the two sources to determine if release activity is occurring from the reactor pressure vessel area. When the system is placed in service, it is run for at least 10 to 12 hours to assure adequate sampling and sufficient sample time from both sources.

The system is run on a bi-weekly basis per procedure. Non-scheduled operation of the system is performed whenever there is a suspect leakage condition in containment. This would be identified in several ways, as follows:

- Daily RCS leak rate calculation
- Containment gaseous and particulate radiation monitors are monitored on a shiftly basis by the control room operators as a part of their daily logs
- Shift Technical Advisor reports on a daily basis into the management plan of the day meeting and daily logs.
- Nominally, the gaseous detector ranges in the mid to high 10^{-9} microcurries/cc range. Consistent unexplained daily upward trending results in a "run" of the head leak detector system.

No specific surveillances are performed to verify the sensitivity of the system. However, the head leak detector installation was designed for a monitor sensitivity of 0.01gpm.

NRC Question #8: Will your repair criteria deviate from the guidance provided in Jack Strosnider's letter issued in 2001 referenced in the February 11th Order? Address both axial and circumferential cracking. If the repair criteria will deviate, discuss the differences.

FPL Response to Question 8: The repair criteria will follow the newly approved ASME Code Section XI IWB-3660. This section was approved at the ASME Code meeting in San Fransico on February 27, 2003. The methodology is identified in WCAP-16027-P [2]. The primary difference in this approach from the Strosnider letter[3] is that the crack growth rate is determined using MRP-55 [4].

NRC Question #9a: If one of the RVLIS nozzles ejected and created a LOCA, would that affect the ability of the other RVLIS train to properly indicate RV water level?

FPL Response to Question 9a: The RVLMS channel pressure housings are located approximately 90 degrees apart in the outer row of penetrations in the reactor head. The connections are located on top of the upper structure, and the cables are routed through the seismic plate elevation, then in opposite directions to the West end of the refueling cavity. The East channel (probe) is routed in a clockwise direction from the penetration to the bulk head/tray connection and the North channel (probe) is routed in a counter clockwise direction. If either housing were ejected from the reactor head, the RVLMS column would move upward, lifting the connectors and cabling. This displacement would most likely cause the MI cable to deform and be damaged in the area where they are routed through the seismic plates. The remainder of the MI cables would remain in place and not cause any collateral damage of the other channel of RVLMS.

NRC Question #9b: Would erroneous indication of RV water level occur in the RVLIS train connected to the ejected nozzle?

FPL Response to Question 9b: With the expected damage to the ejected RVLMS channel cables and connectors, the input to Qualified Safety Parameter Display System (QSPDS) would not fall into the expected ranges that is built into the software. With this input, the QSPDS display would show the indication as failed with question marks in the display, and would not give an erroneous indication that could be mistaken for an actual level. Additionally, each probe has two heater circuits (odd thermocouples on one heater circuit, and even thermocouples on the other). These circuits would also be damaged and provide further skewing of values. If the probe is not immersed in water, there is a 200-degree difference in heated verses non-heated thermocouples. If immersed in water, the difference drops to 90 degrees. Comparison of the two channels would provide obvious differences.

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[2] "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operations: Turkey Point Units 3&4," Westinghouse Electric Company LLC WCAP 16027-P, Rev. 0, Draft, February 2003.

[3] NRC Letter, "Flaw Evaluation Criteria," Jack Strosnider, NRC, to Alex Marion, NEI, November 21, 2001.

[4] "Material Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick Wall Alloy 600 Material (MRP-55), Revision 1," Electric Power Research Institute (EPRI), Palo Alto, CA: 2002. 1006695.

NRC Question #9c: If there is potential for erroneous RVLIS indication (one or both trains), how would that change the human error probabilities that are involved in the conditional core damage probability (CCDP) for the LOCA, and what is the resulting change in the CCDP?

FPL Response to Question 9c: As discussed in the above responses, a RVLMS ejection would only result in damage to one of the redundent RLVMS trains. The affected RVLMS train would most likely display question marks on the QSPDS, indicating an input error. If it did display erroneous values, the failure would be apparent when compared to other plant parameters and the operable train of RVLMS (e.g. RVLMS indicating full with the core superheated and other train indicating core uncovery, or indicating empty with the core subcooled, level in the pressurizer, and the other train indicating vessel full). Once the failed train was identified, operators can use the unaffected train for indication. Accordingly, there is no effect on human error probabilities and no change in the CCDP for the LOCA event.

Enclosure 1 contains proprietary and non-proprietary versions of the Westinghouse letter report STD-DA-03-05, dated February 21, 2003. This report is referenced in FPL's letter L-2003-045 dated February 25, 2003, in page 6 of the Attachment, footnote #6.

The affidavit required by 10 CFR 2.790 is also attached to the proprietary version of the report.

Westinghouse

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Nuclear Services
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Attention: Mr. Samuel J. Collins

Our ref: CAW-03-1602

February 24, 2003

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: Transmittal of STD-DA-03-05, "Probabilistic Analysis of the Safety Risk Associated with Turkey point Units 3 and 4's Unexamined CRDM Penetrations – with Addendum for Inspection of One Unit Only", Westinghouse Letter, February 2003 (Proprietary).

Dear Mr. Collins:

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-03-1602 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.790 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by Florida Power and Light Company.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-03-1602 and should be addressed to the undersigned.

Very truly yours,

J. Galembush, Acting Manager
Regulatory and Licensing Engineering

Enclosures

cc: T. Carter/NRC (5E7)

INFORMATION TO INCLUDE IN THE TRANSMITTAL LETTER TO THE NRC

The following paragraphs should be included in your letter to the NRC:

Enclosed are:

1. Probabilistic Analysis of the Safety Risk Associated with Turkey point Units 3 and 4's Unexamined CRDM Penetrations – with Addendum for Inspection of One Unit Only, Westinghouse Letter, STD-DA-03-05, February 2003 (Proprietary).

2. Probabilistic Analysis of the Safety Risk Associated with Turkey point Units 3 and 4's Unexamined CRDM Penetrations – with Addendum for Inspection of One Unit Only, Westinghouse Letter, STD-DA-03-06, February 2003 (Non-Proprietary).

Also enclosed is a Westinghouse Application For Withholding letter CAW-03-1602, an accompanying affidavit, a Proprietary Information Notice, and a Copyright Notice.

As Item 1 contains information proprietary to Westinghouse Electric Company, it is supported by an affidavit signed by Westinghouse, the owner of the information The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b) (4) of Section 2.790 of the Commission's' regulations.

Accordingly, it is respectfully requested that the information that is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting Westinghouse Affidavit should reference CAW-03-1602, and should be addressed to H. A. Sepp, Manager of Regulatory and Licensing Engineering, Westinghouse Electric Company, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.790 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) contained within parentheses located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.790(b)(1).

COPYRIGHT NOTICE

CAW-03-1602

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared J. Galembush, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC ("Westinghouse"), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

J. Galembush

J. Galembush, Acting Manager
Regulatory and Licensing Engineering

Sworn to and subscribed
before me this 24th day
of February, 2003

Lorraine M. Piplica

Notary Public

LORRAINE M. PIPLICA
COMMONWEALTH OF PENNSYLVANIA
NOTARY PUBLIC

Notarial Seal
Lorraine M Piplica, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Dec. 14, 2003
Member, Pennsylvania Association of Notaries

(1) I am Acting Manager, Regulatory and Licensing Engineering, in Nuclear Services, Westinghouse Electric Company LLC ("Westinghouse"), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Electric Company LLC.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Electric Company LLC in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in brackets, STD-DA-03-05, "Probabilistic Analysis of the Safety Risk Associated with Turkey Point Units 3 and 4's Unexamined CRDM Penetrations – with Addendum for Inspection of One Unit Only" (Proprietary), dated February 2003 for Turkey Point Units 3 and 4, being transmitted by Florida Power and Light Company and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk, Attention Mr. Samuel J. Collins. The proprietary information as submitted for use by Westinghouse Electric Company LLC for Turkey Point Units 3 and 4 is expected to be applicable for other licensee submittals in response to certain NRC requirements for justification of a risk-informed basis for delayed inspection of the 4 part-length CRDM penetrations.

This information is part of that which will enable Westinghouse to:

(a) Provide documentation of the risk-informed approach used in the evaluation of delayed inspection of the 4 part-length CRDM penetrations.

(b) Justify the deferral of CRDM penetration inspection.

(c) Assist the customer to obtain NRC approval.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of supporting alternatives to meeting NRC requirements for licensing documentation.

(b) The information requested to be withheld reveals the distinguishing aspects of the methodology.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar licensing support documentation and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

BNFL

Westinghouse

Westinghouse
Electric Company

Science & Technology Department
Bldg 401-2X27D
1340 Beulah Road
Pittsburgh, Pennsylvania 15235-5082

Memo: STD-DA-03-06

To: Steve Collard
Florida Power & Light

From: Robert K. Perdue

CC: Christopher Ng (Westinghouse)

Date: 21 February 2003

Re: Probabilistic Analysis of the Safety Risk Associated with Turkey Point Units 3 & 4's Unexamined CRDM Penetrations – with Addendum for Inspection of One Unit Only (***Non-Proprietary Version***)

In its upcoming spring 2003 outage, Florida Power & Light (FP&L) intends to inspect the Alloy 600 vent tube and 63 of 65 of the Alloy 600 control rod drive mechanism (CRDM) penetrations at Turkey Point Nuclear Power Unit 3 and the same number of penetrations at Turkey Point Unit 4. In both cases, the two penetrations not inspected are part-length CRDMS. Assuming that no cracks or leaks are found in the inspected tubes, FP&L would like to delay the inspection of the 4 part-length CRDMs until the next scheduled outage. The recent Nuclear Regulatory Commission Order (EA-03-009) concerning inspections of Alloy 600 reactor vessel head penetrations for primary water stress corrosion cracking (PWSCC) makes it necessary for FP&L to seek permission for the less-than-100% inspections before going into the outage. The purpose of the work documented in this letter report is to provide a risk-informed basis for the delayed inspection of the 4 part length CRDM penetrations under the assumption that no cracking or leaks will be observed in the inspected penetrations. An addendum evaluates how the results change if the analysis is done on a single unit basis.

<u>Summary of Approach:</u> The approach is to first establish the maximum number of axial and circumferential flaws that may be left in the base metal of the tubing for the (2 x 64 =) 128 inspected reactor vessel head penetrations in Units 3 and 4 with 95% confidence that no one flaw will exceed the pertinent critical flaw size during the desired time interval. This calculation uses a probabilistic model derived from extreme value theory, with values for inputs (critical sizes and crack growth rates) taken from a recently-completed structural integrity study for Turkey Point Units 3 and 4 (WCAP-16027-P). The maximum allowable number is then compared with the upper 95% confidence value on flaws projected to currently be in the two units' unexamined penetrations based on a simple statistical evaluation of the assumed sample inspection results of no flaws found in 128 examinations. If the maximum allowable flaw number exceeds the upper confidence limit number, then it can be claimed with at least 95% confidence that the units can operate for the contemplated interval of 1.5 effective full power years (EFPY) without one or more of the four subject penetrations progressing to its critical size. This analysis is augmented with a Regulatory Guide 1.174 analysis to evaluate whether the incremental core damage risk associated with the delayed inspections is within regulatory guidelines.

<u>Summary of Results:</u> The analysis concludes that if inspections at the two units find no cracks or leaks, then it may be stated with at least 95% confidence that the 4 unexamined penetrations of interest will not produce an axial or circ flaw that will exceed the assumed critical sizes over the contemplated 1.5

additional EFPY. Further, the incremental core damage risk of waiting until the next refueling outage to examine the four penetrations is well within regulatory guidelines. This conclusion is based on conservative assumptions as to average crack size, to stresses influencing crack growth, circ crack growth rate and to the statistical implications of the assumed inspection results performed. It should be noted, however, that no welds are to be inspected and no inferences are made here about weld integrity. Further, it is implicitly assumed that the 100% visual inspection of the reactor vessel head surface and 100% UT of the sample tubes will have a negligibly small probability of non-detection. Results are similar when the analysis is conducted for a single unit involving inspection of 64 of 66 penetrations.

Description of the Work Performed

+a,c

+a,c

Results: Confidence That the Un-inspected Penetrations Will Not Reach Critical Size

Equation (2) is used to calculate the probability of the ith flaw reaching full critical length (Table 2) within operating intervals ranging from 1 to 8 effective full power years for axial and circ flaws. Equation (5) uses the probabilities in Table 2 and the target reliabilities of 95% to calculate the allowable number of flaws in the 4 penetrations for operating intervals out to 8 additional ("Target") EFPY as shown in Table 3. Comparing Table 3 to the upper confidence number of 1 calculated above, the circ cracks limit the number of additional EFPY that the units can go without inspecting the 4 subject penetrations to 7.5 EFPY. That is, at 7.5 additional EFPY the number of allowable leaks just matches the number of circ flaws that we are 95% confident will not be exceeded. We can thus say with at least 95% confidence that the 4 unexamined penetrations will not generate a critical axial or circ flaw over the 1.5 additional EFPY of interest here.

Table 2: Probability ith Flaw > Critical Length Before Target EFPY		
Target EFPY	Axial	Circ
1	1.14E-04	3.68E-03
1.5	1.74E-04	5.76E-03
2	2 37E-04	8.00E-03
2.5	3.03E-04	1.04E-02
3	3.72E-04	1.31E-02
3.5	4 44E-04	1.59E-02
4	5.19E-04	1.90E-02
4.5	5 97E-04	2.23E-02
5	6.78E-04	2.60E-02
5.5	7.64E-04	2.99E-02
6	8.52E-04	3.41E-02
6.5	9.45E-04	3.87E-02
7	1.04E-03	4.37E-02
7.5	1.14E-03	4.90E-02
8	1.25E-03	5.49E-02

Table 3: Allowable Number of Flaws @ 100% Critical Size (4 Tubes)		
Target EFPY	Axial	Circ
1	4.0	4.0
1.5	4.0	4.0
2	4.0	4.0
2.5	4.0	4.0
3	4.0	3.9
3 5	4.0	3.2
4	4.0	2.7
4.5	4.0	2.3
5	4.0	2.0
5.5	4.0	1.7
6	4.0	1.5
6.5	4.0	1.3
7	4.0	1.1
7.5	4.0	1.0
8	4.0	0.9

Results: A Regulatory Guide 1.174 Analysis

Regulatory Guide 1.174 suggests that a contribution to plant risk is "small" if the contribution to plant core damage frequency (CDF) is no more than 1E-6. By implication, the incremental plant risk, (equivalently, incremental probability of core damage), of extending the inspection interval for the four penetrations by 1.5 EFPY should not exceed 1.5 x 1E-6. The probabilities in Table 2 cannot be used in to support a Regulatory Guide 1.174 risk analysis without first accounting for the likelihood that at least one tube will currently actually have a leak RG 1 174's guideline is clearly intended to be compared to a "best estimate" (i.e., mean or median-based) value of incremental risk. We nevertheless conservatively use the previously estimated upper 95th confidence bound estimate of 2.3% as the estimated binomial probability that the ith of the 4 tubes will have a leak now (given that no leaks are found in the inspected 128 penetrations). Substituting p = .023 and n = 4 into a cumulative binomial distribution,[2] the probability of 1 or more leaks in the 4 penetrations is estimated to be 8 94E-2 or 8.9%. Thus, PCF = the unconditional probability of a critical flaw over the contemplated 1.5 EFPY for the 4 subject penetrations is

(6) PCF = 8 94E-2 * the probability ith circ flaw > critical length for 1.5 EFPY from Table 2 = 8.94E-2 * 5 76E-3 = 5 15E-4

Assume that a critical circ flaw is associated with an immediate small LOCA. The contribution to core damage (Birnbaum) probability (CCDP) for Turkey Point units is (Boggs) 9.57E-4. The resulting increase in plant risk for postponing the inspection of the 4 part-length CRDM penetrations is thus estimated to be

(7) ΔRisk = PCF * CCDP = 5.15E-4 * 9.57E-4 = 4.93E-7.

The conservatively estimated increase in risk of 4.9E-7 is substantially smaller than the guideline of (1E-6 times number of EFPY =) 1.5E-6.

[2] In Excel, the calculation is 1-Binomial(0, 4, .023, true) = .0894. This result is about 3 times higher than that obtained using the mean estimate of p (and 4 X the result obtained using the median p).

Addendum for Inspecting One Unit Only

For inspecting 64 out of 66 in just one unit the incremental risk is as follows. Assuming an exponential flaw size distribution for the 2 penetrations in the unit with an AVERAGE flaw size of 3" along with the aforementioned growth rate and the assumption that no flaws are found during the inspection of the unit, we could (still) say with 95% confidence that the two unexamined penetrations would not produce a critical circ flaw before 7.5 EFPY. Hence, if the inspections in the single Turkey Point unit find no cracks or leaks, then it can be stated with at least 95% confidence that the 2 (proposed) unexamined penetrations will not produce a flaw that will exceed critical size over the contemplated 1.5 additional EFPY. Further, the probability of one or more of the two unexamined penetrations having a leak now is (using the above described calculation based on 64 inspections with no flaws found) equal to 17.1 percent. Note that the (95^{th} percentile) probability of a flaw now went up because we have less evidence (64 rather than 128 observations) on which to calculate the probability of 1 or more leaks in the two unexamined penetrations. The incremental core damage risk of waiting until the next refueling outage to examine the four penetrations is (.171*5.76e-3*9.57e-4=) 9.4e-7, which is still well within regulatory guidelines.

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