September 20, 2005

Mr. Dale E. Young, Vice President
Crystal River Nuclear Plant (NA1B)
ATTN: Supervisor, Licensing & Regulatory Programs
15760 West Power Line Street
Crystal River, FL 34428-6708

SUBJECT: CRYSTAL RIVER UNIT 3 - SAFETY EVALUATION FOR RELIEF REQUEST REGARDING THE RISK-INFORMED INSERVICE INSPECTION PROGRAM (TAC NO. MC5085)

Dear Mr. Young:

By letter dated November 10, 2004, as supplemented by letters dated July 1 and July 14, 2005, Florida Power Corporation (the licensee), doing business as Progress Energy Florida, Inc., requested relief to implement a risk-informed inservice inspection (RI-ISI) program as an alternative to the 1989 Edition, ASME Code, Section XI inservice inspection program for Class 1, Code Category B-J and B-F piping welds at Crystal River, Unit 3 (CR-3). The proposed RI-ISI program was developed in accordance with the methodology contained in the NRC approved Electric Power Research Institute (EPRI) topical report (TR) EPRI TR-112657, Revision B-A. The results of our review indicate that the licensee's proposed RI-ISI program is an acceptable alternative to the requirements of the ASME Code, Section XI for inservice inspection of Class 1 piping, Examination Categories B-F and B-J welds. Therefore, the licensee's request for relief is authorized for the current inspection interval at CR-3 pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provides an acceptable level of quality and safety.

The enclosed Safety Evaluation authorizes implementation of the proposed RI-ISI program starting with the Refueling Outage14 of the 2nd inspection period of the third 10-year inservice inspection interval.

Sincerely,

/RA by Douglas V. Pickett for/
Michael L. Marshall, Jr., Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-302

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RISK-INFORMED INSERVICE INSPECTION PROGRAM

FLORIDA POWER CORPORATION

CRYSTAL RIVER NUCLEAR PLANT, UNIT 3

DOCKET NO. 50-302

1.0 INTRODUCTION

By letter dated November 10, 2004, as supplemented by letters dated July 1 and July 14, 2005, Florida Power Corporation (the licensee) doing business as Progress Energy Florida, Inc., submitted a request for relief proposing a risk-informed inservice inspection (RI-ISI) program as an alternative to portions of its current inservice inspection (ISI) program at Crystal River, Unit 3 (CR-3). The scope of the RI-ISI program is only limited to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Class 1 piping, Examination Categories B-F and B-J welds.

The licensee's RI-ISI program was developed in accordance with the methodology contained in the Electric Power Research Institute (EPRI) topical report (TR) EPRI TR-112657, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," dated December 1999, that was previously reviewed and approved by the Nuclear Regulatory Commission (NRC). The licensee proposed the RI-ISI program as an alternative to the requirements in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i). The licensee requests implementation of this alternative starting with the second period of the third 10-year ISI interval at CR-3.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements set forth in the Code to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations of 10 CFR 50.55a(g) also state that ISI of the ASME Code, Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable addenda, except where specific written relief has been granted by the NRC. The objective of the ISI program as described in Section XI of the ASME Code and applicable addenda is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary of these components that may impact plant safety.

The regulations also require that, during the first 10-year ISI interval and during subsequent intervals, the licensee's ISI program complies with the requirements in the latest edition and

addenda of Section XI of the ASME Code incorporated by reference into 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The CR-3 began its third 10-year interval on August 14, 1998, using the 1989 Edition of Section XI of the ASME Code with no addenda.

According to 10 CFR 50.55a(a)(3), the NRC may authorize alternatives to the requirements of 10 CFR 50.55a(g), if an applicant demonstrates that the proposed alternatives would provide an acceptable level of quality and safety, or that the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis," defines the safety principles for an acceptable RI-ISI program as follows:

(1) The proposed change meets current regulations unless it is explicitly related to a requested exemption.

(2) The proposed change is consistent with the defense-in-depth philosophy.

(3) The proposed change maintains sufficient safety margins.

(4) When proposed changes result in an increase in risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

(5) The impact of the proposed change should be monitored using performance measurement strategies.

In addition, RG 1.178, "An Approach For Plant-Specific Risk-Informed Decisionmaking - Inservice Inspection of Piping," describes methods acceptable to the NRC staff for integrating insights from probabilistic risk assessment (PRA) techniques with traditional engineering analyses into ISI programs for piping, and addresses risk-informed approaches that are consistent with the basic elements identified in RG 1.174.

The licensee has proposed to use an RI-ISI program for ASME Class 1 piping (Examination Categories B-F and B-J welds) as an alternative to the ASME Code, Section XI requirements. The licensee states that this proposed program was developed using RI-ISI methodology described in EPRI TR-112657. The NRC staff's safety evaluation (SE) of October 28, 1999, approving the methodology described in the TR, concluded that the methodology conforms to guidance provided in RGs 1.174 and 1.178, and that no significant risk increase should be expected from the changes to the ISI program resulting from applying the methodology. The transmittal letter for this SE also stated that an RI-ISI program as described in the TR utilizes a sound technical approach and will provide an acceptable level of quality and safety. It also stated that, pursuant to 10 CFR 50.55a, any RI-ISI program meeting the requirements of the TR provides an acceptable alternative to the piping ISI requirements with regard to (1) the number of locations, (2) the locations of inspections, and (3) the methods of inspection.

3.0 TECHNICAL EVALUATION

Pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff has reviewed and evaluated the licensee's proposed RI-ISI program based on guidance and acceptance criteria provided in the following documents:

- RGs 1.174 and 1.178
- NRC NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 3.9.8
- EPRI TR-112657 and its NRC SE

3.1 Proposed Changes to the ISI Program

The scope of the licensee's proposed changes to the licensee's ISI program is limited to ASME Code Class 1 piping welds for the Examination Categories: B-F for pressure retaining dissimilar metal welds in piping, and B-J for pressure retaining welds in piping. The RI-ISI program is proposed as an alternative to the existing ISI requirements of the ASME Code, Section XI, 1989 Edition.

The program changes would result in the number and locations of non-destructive examination (NDE) inspections based on ASME Code, Section XI requirements being replaced by the number and locations of these inspections based on RI-ISI guidelines. The ASME Code requires, in part, that for each successive 10-year ISI interval, 100 percent of Category B-F welds and 25 percent of Category B-J welds for the Code Class 1 non-exempt piping be selected for volumetric and/or surface examination based on existing stress analyses and cumulative usage factors. The proposed RI-ISI program for CR-3 selects 56 of 539 Class 1 piping welds for NDE and will be implemented during the second period of the third 10-year ISI interval beginning with plant's Refueling Outage 14. Thus far, the licensee has completed 35.4 percent of the piping weld examinations required by the ASME Code, Section XI, Subsection IWB-2412 (Inspection Program B) in Examination Categories B-F and B-J. Therefore, the remaining 64.6 percent of the inspection locations will be examined in accordance with the proposed RI-ISI program during the remainder of the third 10-year ISI interval. The surface examinations required by the ASME Code, Section XI, will be discontinued while system pressure tests and VT-2 visual examinations shall continue. The licensee states that none of the augmented piping inspection programs at CR-3 will change as a result of the proposed RI-ISI program.

These results are consistent with the concept that, by focusing inspections on the most safety significant welds, the number of inspections can be reduced while at the same time maintaining protection of public health and safety.

3.2 Engineering Analysis

In accordance with the guidance provided in RGs 1.174 and 1.178, the licensee provided the results of an engineering analysis of the proposed changes, using a combination of traditional engineering analysis and supporting insights from the PRA. The licensee performed an evaluation to determine the susceptibility of components (i.e., a piping weld) to a particular degradation mechanism that may be a precursor to leak or rupture, and then performed an independent assessment of the consequence of a failure at that location. The results of this

analysis assure that the proposed changes are consistent with the principles of defense-in-depth because EPRI TR-112657 methodology requires that the population of welds with high consequences following failure will always have some weld locations inspected regardless of the failure potential. No changes to the evaluation of design-basis accidents in the Updated Final Safety Analysis Report are being made by the RI-ISI program. Therefore, sufficient safety margins will be maintained.

3.2.1 Failure Potential

Piping systems within the scope of the RI-ISI program are divided into piping segments. Pipe segments are defined as lengths of pipe whose failure (anywhere within the pipe segment) would lead to the same consequence and that are exposed to the same degradation mechanisms, i.e., some lengths of pipe whose failure would lead to the same consequence may be split into two or more segments when two or more regions are exposed to different degradation mechanisms. The licensee states that the failure potential assessment, summarized in Table 3.3 of the November 10, 2004, submittal, was accomplished utilizing industry failure history, plant-specific failure history, and other relevant information using the guidance provided in the TR.

The NRC staff concludes that the licensee has met the Standard Review Plan (SRP) 3.9.8 guidelines to confirm that a systematic process was used to identify the component's (i.e., pipe segments) susceptibility to common degradation mechanisms, and to categorize these degradation mechanisms into the appropriate degradation categories with respect to their potential to result in a postulated leak or rupture.

3.2.2 Consequence Analysis

The licensee states that the consequences of pressure boundary failures were evaluated and ranked based on their impact on core damage and containment performance (isolation, bypass, and large early release). Also, the licensee indicated that impact on the above measures due to both direct and indirect effects was considered. The licensee reports no deviations from the approved consequence evaluation guidance provided in the TR. Therefore, the NRC staff considers the consequence analysis performed by the licensee for this application to be acceptable.

3.2.3 PRA

The original CR-3 individual plant examination (IPE) was submitted to the NRC on March 9, 1993. The NRC's evaluation of the IPE, dated June 30, 1998, did not identify any significant weaknesses in the IPE, and concluded that it met the intent of Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities." The licensee stated in its November 10, 2004, submittal, that it used the "CR-3 PSA Model of Record - MOR02" (CR-3 PSA) for evaluation of the consequences of pipe ruptures. The licensee stated that numerous plant design changes and PRA model improvements have been made to the PRA since the IPE. The CR-3 PSA includes both Level 1 and Level 2 evaluations and estimates the core damage frequency (CDF) and the large early release frequency (LERF) to be 6.83E-6/year and 3.59E-7/year, respectively.

The industry peer certification review was conducted in September 2001. The review generated specific recommendations for model changes, guidance for improvements to process and methodologies, and enhancements to the documentation and administrative procedures used for model updates. The licensee's July 14, 2005, submittal provided a list of the significant (level A and B) facts and observations from the peer review. The licensee had resolved or justified all the observations, and incorporated, as needed, the resolution into the CR-3 PSA used for the evaluation of the consequence of pipe ruptures. The NRC staff reviewed the list of significant observations and the licensee's resolution of each observation. Based on this review, the NRC staff concludes that the licensee has addressed all the issues raised in the peer certification review to the extent needed to support this relief request.

In the licensee's November 10, 2004, submittal, and in response to several of the peer review observations, the licensee describes its current PRA maintenance and update process. Administrative controls dictate the review of all model changes, data updates, and risk assessments performed using PRA methods and models. The licensee stated that subsequent to the completion of the RI-ISI effort at CR-3, but prior to the November 10, 2004, submittal, an update of the CR-3 PRA had been conducted. The licensee evaluated the impact of the CR-3 PRA update on the RI-ISI program and there was no impact from the update on the proposed program.

The NRC staff did not review the PRA models to assess the accuracy of their quantitative estimates. The NRC staff recognizes that the quantitative results of the PRA model are used as order of magnitude estimates to support the assignment of segments into three broad consequence categories. Inaccuracies in the models or in assumptions large enough to invalidate the broad categorizations developed to support the RI-ISI should have been identified during the NRC staff's review of the IPE, and by the licensee's model update control program that included peer review/certification of the PRA model. Minor errors or inappropriate assumptions will affect only the consequence categorization of a few segments and will not invalidate the general results or conclusions.

As required by Section 3.7 of EPRI TR-112657, the licensee has evaluated the change in risk expected from replacing the current Section XI, ISI program with the RI-ISI program. The analysis estimates the net change in risk due to the positive or negative influence of adding or removing locations from the inspection program. The expected change in risk is quantitatively evaluated using the "Simplified Risk Quantification Method" described in Section 3.7 of EPRI TR-112657 and is shown in the table below.

Unit Number	Change in Risk ([a]CDF)		Change in Risk ([a]LERF)	
	With increased POD	Without increased POD	With increased POD	Without increased POD
Unit 3	-5.8E-8	-1.8E-8	-2.9E-11	-1.0E-11

POD = probability of detection

The NRC staff finds the licensee's process to evaluate and bound the potential change in risk reasonable because it accounts for the change in the number and location of elements inspected, recognizes the difference in degradation mechanism related to failure likelihood, and

considers the effects of enhanced inspection. All system level and aggregate estimates of the changes in CDF and LERF are less than the corresponding guideline values in EPRI TR-112657. The NRC staff finds that redistributing the welds to be inspected with consideration of the safety-significance of the segments provides assurance that segments whose failure has a significant impact on plant risk receive an acceptable and often improved level of inspection. Therefore, the NRC staff concludes that the implementation of the RI-ISI program as described in the licensee's application will have an impact on risk consistent with the guidelines of RG 1.174, and thus, will not cause the NRC safety goals to be exceeded. The NRC staff finds that the change in risk estimate is appropriate and the results provide assurance that the fourth key principle in RG 1.178 (any risk increase in CDF or risk should be small and consistent with the intent of the Commission's Safety Goal Policy Statement) is met.

3.2.4 Integrated Decisionmaking

The licensee used an integrated approach in defining the proposed RI-ISI program by considering in concert the traditional engineering analysis, the risk evaluation, the implementation of the RI-ISI program, and performance monitoring of piping degradation. This is consistent with the guidelines given in RG 1.178 and is, therefore, acceptable.

3.2.4.1 Risk Characterization

The licensee states in its November 10, 2004, submittal that pipe segments (and ultimately the elements within, which are defined as all having the same degradation susceptibility) are ranked in accordance with definitions given in the TR and is, therefore, acceptable.

3.2.4.2 Selection of Element Population for Inspection

By indicating that EPRI TR-112657 requires that 25 percent of the locations in high risk regions and that 10 percent of the locations in medium risk regions must be selected for NDE, the licensee has opted to use the element selection guidance provided in EPRI TR-112657 under Section 3.6.4.2 "ASME Code Case –578." The NRC staff notes that the specific requirement in the TR requires that at least 25 percent of the locations in each high risk category and that at least 10 percent of the locations in each medium risk category must be selected for NDE.

The licensee provides detailed information on the results of the evaluation in the following tables of its submittal:

- Table 3.1 identifies on a per system basis, the number of segments and number of elements (welds) for CR-3.

- Table 3.3 provides the degradation mechanism assessment summary for CR-3.

- Table 3.4 identifies on a per system basis, the number of segments by risk category for CR-3.

- Table 3.5 identifies on a per system basis, the number of elements selected for inspection by risk category excluding the impact of flow accelerated corrosion.

- Table 3.6 provides the risk impact analysis results for each system, as well as a summary comparing the number of inspections required under the 1989 ASME Code, Section XI, ISI program with that of the alternative RI-ISI program.

- Table 5-1 provides a comparison of selection of inspection locations between the ASME Code, Section XI and the EPRI TR-112657 by risk region.

- Table 5-2 provides a comparison of selection of inspection locations between the ASME Code, Section XI and the EPRI TR-112657 by risk category.

In reviewing the tables above, the NRC staff concludes that EPRI TR-112657's requirement that at least 25 percent of the locations in each high risk category, and that at least 10 percent of the locations in each medium risk category must be selected for NDE has been met.

In its November 10, 2004, submittal, the licensee reported that 10.4 percent of Class 1 piping welds were selected for RI-ISI NDEs. Section 3.6.4.2 of EPRI TR-112657 states that if the percentage of Class 1 piping locations selected for examination falls substantially below 10 percent, then the basis for selection needs to be investigated. The licensee has met this expectation of the TR, and no investigation is required.

Based on the NRC staff's review of the above tables (containing the results of element selection), the NRC staff concludes that the element selection results are consistent with the described process and with EPRI TR-112657 guidelines. Hence, the licensee's selection of element locations, which includes consideration of degradation mechanisms in addition to those covered by augmented inspection programs, is judged to be acceptable.

3.2.4.3 Examination Methods

As noted in Section 2.0 of this SE, the objective of ISI is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary that may impact plant safety. To meet this objective, the RI-ISI location selection process, per EPRI TR-112657, employs an "inspection for cause" approach. To address this approach, Section 4 of the same TR provides guidelines for the areas and/or volumes to be inspected, as well as the examination method, acceptance standard, and evaluation standard for each degradation mechanism. Based on its review and acceptance of the TR, the NRC staff concluded that these examination methods are appropriate since they are selected based on specific degradation mechanisms, pipe sizes, and materials of concern. The licensee states that Section 4 of the TR was used as guidance in determining the examination methods and requirements for these locations.

Based on these considerations, the NRC staff concludes that the licensee's determination of examination methods is acceptable.

3.2.4.4 Relief Requests for Examination Locations and Methods

As required by Section 6.4 of EPRI TR-112657, the licensee has completed an evaluation of existing relief requests to determine if any should be withdrawn or modified due to changes that occur from implementing the RI-ISI program. In response to NRC staff's request for additional

information, the licensee revised its submittal to reflect that no relief requests were required to be withdrawn.

The licensee states that any examination location where greater than 90 percent volumetric coverage cannot be obtained, the process outlined in EPRI TR-112657 will be followed. The NRC staff finds that the licensee's proposed treatment of existing relief requests to be acceptable.

3.2.5 Implementation and Monitoring

Implementation and performance monitoring strategies require careful consideration by the licensee and are addressed in Element 3 of RG 1.178 and the SRP 3.9.8. The objective of Element 3 is to assess performance of the affected piping systems under the proposed RI-ISI program by utilizing monitoring strategies that confirm the assumptions and analyses used in the development of the RI-ISI program. Pursuant to 10 CFR 50.55a(a)(3)(i), a proposed alternative, in this case the implementation of the RI-ISI program, including inspection scope, examination methods, and methods of evaluation of examination results, must provide an acceptable level of quality and safety.

The licensee states that upon approval of the RI-ISI program, procedures that comply with EPRI TR-112657 guidelines will be prepared to implement and monitor the RI-ISI program. The licensee states in its submittal that the applicable aspects of the ASME Code not affected by the proposed RI-ISI program would be retained.

The licensee indicates in Section 4 of the November 10, 2004, submittal that the RI-ISI program is a living program and its implementation will require feedback of new relevant information to ensure the appropriate identification of safety significant piping locations. The licensee also states that, as a minimum, risk ranking of piping segments will be reviewed and adjusted on an ASME period basis and that significant changes may require more frequent adjustment as directed by NRC Bulletin or Generic Letter requirements, or by industry and plant-specific feedback. This periodic review and adjustment of the risk-ranking of segments ensure that changes to the PRA that the licensee will make to incorporate the peer review results will also be incorporated into the RI-ISI program as necessary.

The licensee addresses additional examinations in Section 3.5.1 of the November 10, 2004, submittal, which states that examinations performed that reveal flaws or relevant conditions exceeding the applicable acceptance standards shall be extended to include additional examinations. These additional examinations shall include piping structural elements with the same root cause conditions or degradation mechanisms. The additional examinations will include high risk significant elements and medium risk significant elements, if needed, up to a number equivalent to the number of elements initially required to be inspected on the segment or segments during the current outage. If unacceptable flaws or relevant conditions are again found similar to the initial problem, the remaining elements identified as susceptible will be examined during the current outage. No additional examinations will be performed if there are no additional elements identified as being susceptible to the same root cause conditions. The NRC staff finds the licensee's approach acceptable since the additional examinations, if required, will be performed during the outage that the indications or relevant conditions are identified.

The NRC staff finds that the proposed process for RI-ISI program implementation, monitoring, feedback, and update meets the guidelines of RG 1.174 which states that risk-informed applications should include performance monitoring and feedback provisions. Hence, the licensee's proposed process for program implementation, monitoring, feedback, and update is judged to be acceptable.

4.0 CONCLUSIONS

Pursuant to 10 CFR 50.55a(a)(3)(i), alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if the licensee demonstrates that the proposed alternatives will provide an acceptable level of quality and safety. In this case, the licensee has proposed an alternative to use the risk-informed process described in NRC-approved EPRI TR-112657.

RG 1.174 establishes requirements for risk-informed decisions involving a change to a plant's licensing basis. RG 1.178 establishes requirements for risk-informed decisions involving alternatives to the requirements of 10 CFR 50.55a(g) (ISI program requirements), and its directive to follow the requirements of the ASME Code, Section XI. These two RGs, taken together, define the elements of an integrated decisionmaking process that assesses the level of quality and safety embodied in a proposed change to the ISI program. RI-ISI methodology in EPRI TR-112567 contains the necessary details for implementing this process. This methodology provides for a systematic identification of safety-significant pipe segments, for a determination of where inspections should occur within these segments (i.e., identification of locations), and for a determination how these locations will be inspected. Such segments/locations are characterized as having active degradation mechanisms, and/or whose failure would be expected to result in a significant challenge to safety (either immediately by initiating an event or later on in response to an unrelated event).

The methodology in EPRI TR-112657 also provides for implementation and performance monitoring strategies to ensure a proper transition from the current ISI program, and to assure that changes in plant performance, and new information from the industry and/or from the NRC, is incorporated into the licensee's ISI program as needed.

Other aspects of the licensee's ISI program, such as system pressure tests and visual examination of piping structural elements will continue to be performed on all Class 1, 2, and 3 systems in accordance with ASME Code, Section XI. This provides a measure of continued monitoring of areas that are being eliminated from the NDE portion of the ISI program. As required by EPRI TR-112657 methodology, the existing ASME Code performance measurement strategies will remain in place. In addition, EPRI TR-112657 methodology provides for increased inspection volumes for those locations that are included in the NDE portion of the program.

The NRC staff concludes that the licensee's development of its RI-ISI program is consistent with the methodology described in the TR. Hence, the NRC staff concludes that the licensee's proposed program which is consistent with the methodology as described in the TR, will provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i) for the proposed alternative to the piping ISI requirements with regard to (1) the number of locations, (2) the locations of inspections, and (3) the methods of inspection.

The NRC staff concludes that the licensee's proposed RI-ISI program is an acceptable alternative to the current ISI program for Class 1 piping welds at CR-3. Therefore, the proposed RI-ISI program is authorized for the third 10-year ISI interval pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that this alternative will provide an acceptable level of quality and safety. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributors: P. Patnaik
S. Malik

Date: September 20, 2005

cc:
Mr. R. Alexander Glenn
Associate General Counsel (MAC-BT15A)
Florida Power Corporation
P.O. Box 14042
St. Petersburg, Florida 33733-4042

Mr. Jon A. Franke
Plant General Manager
Crystal River Nuclear Plant (NA2C)
15760 W. Power Line Street
Crystal River, Florida 34428-6708

Mr. Jim Mallay
Framatome ANP
1911 North Ft. Myer Drive, Suite 705
Rosslyn, Virginia 22209

Mr. William A. Passetti, Chief
Department of Health
Bureau of Radiation Control
2020 Capital Circle, SE, Bin #C21
Tallahassee, Florida 32399-1741

Attorney General
Department of Legal Affairs
The Capitol
Tallahassee, Florida 32304

Mr. Craig Fugate, Director
Division of Emergency Preparedness
Department of Community Affairs
2740 Centerview Drive
Tallahassee, Florida 32399-2100

Chairman
Board of County Commissioners
Citrus County
110 North Apopka Avenue
Inverness, Florida 34450-4245

Mr. Michael J. Annacone
Engineering Manager
Crystal River Nuclear Plant (NA2C)
15760 W. Power Line Street
Crystal River, Florida 34428-6708

Mr. Daniel L. Roderick
Director Site Operations
Crystal River Nuclear Plant (NA2C)
15760 W. Power Line Street
Crystal River, Florida 34428-6708

Senior Resident Inspector
Crystal River Unit 3
U.S. Nuclear Regulatory Commission
6745 N. Tallahassee Road
Crystal River, Florida 34428

Mr. Richard L. Warden
Manager Nuclear Assessment
Crystal River Nuclear Plant (NA2C)
15760 W. Power Line Street
Crystal River, Florida 34428-6708

David T. Conley
Associate General Counsel II - Legal Dept.
Progress Energy Service Company, LLC
Post Office Box 1551
Raleigh, North Carolina 27602-1551