SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO RELIEF FROM CERTAIN REQUIREMENTS OF SECTION XI OF THE ASME CODE FLORIDA POWER AND LIGHT COMPANY ST. LUCIE UNIT 1 DOCKET NO. 50-335

1.0 INTRODUCTION

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The regulations require that the Inservice Inspection (ISI) of ASME Code Class 1, 2, and 3 components shall be performed in accordance with Section XI of ASME Code and applicable Addenda except where specific written relief has been granted by the Commission. Since some plants were designed in conformance to early editions of this Code, consequently certain requirements of later editions and addenda of Section XI are impractical to perform because of the plant's design, geometry, and materials of construction of the components. Paragraph 10 CFR 50.55a(g)(6)(i) authorizes the Commission to grant relief from those requirements upon making the necessary findings.

In a letter dated October 29, 1986, the Florida Power and Light Company (FP&L), the licensee, identified specific ASME Code requirements that FP&L determined to be impractical to perform. A number of issues were identified by the licensee in the subject letter. FP&L requested that the staff evaluate the requirements for the reactor coolant pump (RCP) casing first because this issue had the most significant impact-on refueling outage planning. The licensee provided additional supporting information on this subject (Relief Request No. 8) in a letter dated January 21, 1987. The first 10-year inspection interval is scheduled to end February 11, 1988.

2.0 EVALUATION OF RELIEF REQUEST NO. 8

A. 64

The staff reviewed the information provided by the licensee's letters as related to the design, geometry, and materials of construction of the components pursuant to 10° CFR 50.55a(g)(6)(i).

A. Code Requirements:

ASME Section XI, 1974 Edition including Addenda through Summer 1975 requires the following:

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Examination	
Category	Item No.
B-L-1	B5.6

A volumetric examination is required of 100% of pressure retaining welds of one pump in each group of pumps performing similar functions in a system. The examinations shall be performed during each inspection interval, and may be performed at or near the end of the inspection interval.

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Examination Category	Item No.	
B-L-2	B5.7	A visual examination is required of the internal pressure boundary surface on one pump in each of the group of pumps performing similar functions in the system during each inspection interval. The examinations may be performed at or near the end of the inspection interval.

B. <u>Code Relief Request</u>

The licensee requested relief from the ASME Code required examinations for the following:

- 100% volumetric examination of the reactor coolant pump casing welds.
- 100% visual examination of the reactor coolant pump interior pressure boundary surface.

In a letter dated January 21, 1987 the licensee proposed the following alternatives: *

- If a pump is disassembled for maintenance, a radiographic examination of that pump will be performed. The extent of the examination will depend upon access and geometry limitations.
- 2. Part of one weld on one pump at St. Lucie Unit 2 will be ultrasonically examined during the refueling outage scheduled for Fall 1987. This examination will be performed using the best current technique as determined by FP&L to determine the feasibility of performing future examinations.

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C. Basis For Relief Request

St. Lucie Nuclear Power Plant, Unit 1, has reactor coolant pumps which were manufactured prior to the initial issuance of the ASME Section XI and the design did not provide for the disassembly and removal of fixed internals. The pumps were designed to provide reliable service for the plant lifetime without internal maintenance or inspection. The impracticality of performing these examinations is not unique to St. Lucie. The industry has performed generic studies to evaluate the need for the inspection and to develop specific examination techniques. To date, no technique has been qualified and proven practical for performing inservice inspections of the Type E pump design without pump disassembly.

Disassembly and Reassembly

The disassembly and reassembly of the pumps is extremely difficult given the interference and/or tight fits which need to be addressed. Without painstaking care, the disassembly/reassembly process could degrade the pump internals from an operational standpoint.

There is a very low probability, based upon experience, to disassemble pump(s) solely for maintenance purposes. The pump

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manufacturer, Byron Jackson, has no requirement to disassemble the pump(s) as part of normal maintenance or inspection. Accordingly, FP&L's procedures do not require disassembly of the pump(s) for maintenance or inspection purposes.

Material Considerations

The material of construction is CF8M which is a casting grade of 316 stainless steel which has seen extensive service in pressurized water reactor systems. This material has a typical ferrite content of 15% which imparts high resistance to stress corrosion cracking.

A generic analysis of Type E pumps was performed by Nutech Engineers, Inc., under EPRI project 2057. Two modes of degradation were considered; low cycle fatigue loading from events such as heatup and cooldown, operating transients and seismic events; and thermal aging of austenitic castings.

Fatigue crack growth analysis showed that both maximum Code-allowable shrinkage flaws and postulated surface cracks, grow to less than 20% of the wall thickness after 20 years of operating life even assuming worst case residual stress patterns. Fracture will not initiate for cracks less than 30% of wall thickness.

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J-integral elastic plastic analysis indicated additional margin against instability in tearing. This analysis used lower bound data from aged test specimens to simulate service time at temperature degraded properties.

This study concluded that:

- Based on the generic pump casing analysis, there is justifications for the extension of the pump-casing examination up to 15 years.
- 2. Plant-unique analysis will show greater margins of safety.
- 3. The tearing modulus analysis shows that large, final flaw sizes can be tolerated in the pump casing before fracture is predicted.
- 4. The recent 10-year Inservice Inspection of several pump casing (Type F) indicates no detectable flaw growth from baseline inspections, which corroborates the above analytical conclusion.

There have been no reported failures in these pump casings with this model pump.

Nondestructive Examination

The licensee evaluated the use of conventional radiography and the miniature linear accelerator. The licensee concluded that radiography would not be effective without disassembly of the pump. Based on actual data compiled from the radiographic examination of the Turkey Point Unit 3 reactor coolant pumps casing welds and the visual examination of the internal pressure boundary surface on one pump, in excess of 5900 manhours and 46 man-rem exposure was expended in the disassembly, examinations and reassembly of the pump. This data does not include engineering time or pre-outage job planning, nor does it include radiation protection personnel that required direct coverage and the postponement of work activities in other areas of the containment building due to the amounts of radiation being produced during the conduct of the radiography exposures of the casing welds.

The licensee does not consider ultrasonic examination to be feasible due to the material of construction of the pump casing. The material is essentially a cast-type 316 stainless steel. The coarse grain structure inherent in thick stainless steel castings preclude the use of conventional ultrasonic examinations. Future developments in ultrasonic examination techniques may provide a method to examine thick stainless steel castings. When and if a major breakthrough in

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ultrasonic examination techniques is made that satisfies the examination requirements of the ASME Code, FP&L will comply with the intent of the Code.

FP&L considered using the liquid penetrant method of examination as an alternative to the volumetric examination but rejected this method because of the porous condition of the casting surface of the weld zones. Considerable surface smoothing will be required in order to enable meaningful examination and interpretation of the results. Such weld surface finishing operations, if not performed prior to the preservice inspection, will be extremely difficult at the time of the inservice inspection.

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The recommended method of penetrant is the water-washable type. Using this method would require a sufficient water supply, a method of containing the water and disposal of the runoff after removal of the penetrant. This has the potential to cause'a contamination problem. The solvent-removable type penetrant method was rejected due to the large size of the pump and the surface roughness which would entrap the penetrant thereby precluding meaningful examination and valid interpretation of the results. Using this method would also require excessive manhours and man-rem.

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FP&L concludes that adequate safety margins are inherent in the basic design. The structural integrity afforded by the existing pump casing material will not significantly degrade over its lifetime. Pump casings are generally overdesigned because of added wall thickness to provide stability under operating load. Operating stresses in the pump casings are well below the levels associated with vessels, therefore, with lower operating stresses, fatigue life is significantly improved.

As an alternative, the licensee proposes the following:

- 100% visual examination of the pump interior to the extent practical (recognizing the interference by the vanes) should the pump be disassembled for maintenance.
- 2. The reactor coolant pump shall be hydrostatically tested, per the requirements of the ASME Boiler & Pressure Vessel Code, Section XI, 1980 Edition.

D. Staff Evaluation

The staff has completed the evaluation of the licensee's letters dated October 29, 1986 and January 21, 1987 pursuant to 10 CFR 50.55a(g)(6)(i). The staff determined that the disassembly of a reactor coolant pump for the sole purpose of performing a volumetric and visual examination of the casing is impractical. This licensee has performed a radiographic examination at another plant site that resulted in personnel exposure in excess of 46 man-rem and 5900 manhours of work. The staff recognizes that the industry experience with RCP casings has been good. The volumetric examinations performed at other plant sites have not detected significant inservice degradation or flaws that affect the structural integrity of the casing.

The licensee has evaluated the nondestructive examination methods available to perform the Code-requirement and potential alternative examinations. The staff agrees with the licensee that with radiography with the pump disassembled is the only proven method of meeting the Code requirement.

The staff also recognizes the difficulty of performing an ultrasonic test on relatively thick cast stainless steel weldments. The major tasks associated with scheduling an ultrasonic examination is removal of insulation and surface preparation, if necessary, of the weld and adjacent base material. The licensee has committed to determine the technical feasibility of performing an ultrasonic test on a similar RCP pump casing during the planned replacement of insulation at St. Lucie Unit 2. The staff finds this proposal

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acceptable for the demonstration of a potential examination method for Unit 1. If the licensee documents the Unit 2 activity as a Section XI inservice inspection, the staff will consider the examination results applicable to the Code requirement for Unit 2. The licensee will not be required to perform weld surface preparation as part of the Unit 2 demonstration. In the event that the licensee determines during the course of the Unit 2 examination that the resulting data cannot be interpreted because of the design configuration or materials of construction, the staff will consider the documented ISI of 20% of the total length of weld as a representative sample for the weld subject to examination. The licensee should also document the radiation exposure and manhours required to remove and replace the insulation. Considering the licensee's commitment to perform this ultrasonic test, the staff will not require an external surface examination on either Unit 1 or 2 pursuant to 10 CFR 50.55a(g)(6)(i).

The staff determined that the volumetric and visual examination of the reactor coolant pump casing is impractical unless the pump is disassembled. The staff finds that the licensee has proposed an acceptable alternative to the Code-required examination consisting of the following:

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- A commitment to perform radiography and visual examination in the event that a pump is disassembled for maintenance or repair at St. Lucie Unit 1.
- 2. A demonstration of the feasibility of performing ultrasonic testing on part of one pump casing weld at Unit 2.

The staff finds that this alternative program and the Code-required hydrostatic and pressure tests will provide an acceptable level of quality and safety.

3.0 CONCLUSION

The staff concludes that the licensee's proposals related to the volumetric and visual examination of the reactor coolant pump casing at St. Lucie Unit 1 are an acceptable alternative and relief from the Code requirements may be granted pursuant to 10 CFR 50.55a(g)(6)(i).

Since the inspection interval is scheduled to end in February 1988, the first volumetric and visual examination performed at St. Lucie Unit 1 will represent the Code requirement for the first inspection interval.

			PD22 Rdg. w/o encl.	
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