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EISENHUT,D.G. Division of Licensing

SUBJECT: Forwards response to Generic Ltr 81-14 re auxiliary feedwater sys seismic qualification, per NRC 810210 request. Plant & sys will function as designed & would enable plant to be brought to cold shutdown condition safely.

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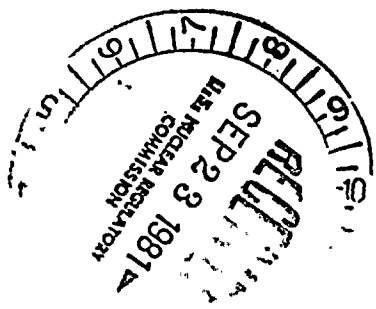

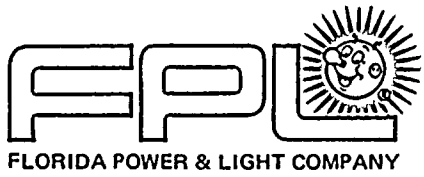

September 18, 1981
L-81-411

Office of Nuclear Reactor Regulation
Attention: Mr. Darrell G. Eisenhut, Director
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Eisenhut:

Re: St. Lucie Unit 1
Docket No. 50-335
NRC Generic Letter 81-14
Auxiliary Feedwater System Seismic Qualification

Please find attached our response to Generic Letter 81-14, as requested by your letter dated February 10, 1981.

Very truly yours,

J. a de Mastry
for

Robert E. Uhrig
Vice President
Advanced Systems and Technology

REU/JEM/mbd

Attachment

cc: Mr. James P. O'Reilly, Region II
Harold F. Reis, Esquire

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ATTACHMENT

RE: ST. LUCIE UNIT 1
DOCKET NO. 50-335
NRC GENERIC LETTER 81-14
AUXILIARY FEEDWATER SYSTEM SEISMIC QUALIFICATION

I. Summary

1) Although the NRC did not officially recognize the AFW system as an engineered safety feature until publication of the 1975 Standard Review Plans, the St Lucie Unit 1 FSAR (docketed March 1973) identifies this System as Safety Class 3 and Seismic Class I.

2) All mechanical, electrical and instrumentation/control components required for the proper operation of the Auxiliary Feedwater System are adequately designed to withstand earthquake induced loads. All essential components are located in Seismic Category I structures. The AFW system adheres to criteria stated in the FSAR and the system design is consistent with other safety grade systems in the plant.

3) As part of a supplemental review, FPL has established that all major Class 1E equipment (transformers, switchgear, batteries, inverters, cable tray and control/power panels) for the balance of safety system are adequately anchored and supported to withstand the SSE event.

4) One generic class of equipment where rigorous analytical proof of seismic adequacy is not available was miscellaneous electrical equipment supports including those for electrical conduit and some electrical boxes. As requested by Generic Letter 81-14 a field inspection and design evaluation of these items was performed. The results of this review indicate that the as-built support system has considerable seismic resistance, and in our best engineering judgement we believe that the sys-

I Summary (Cont'd)

4) tem would remain functional following a Safe Shutdown Earthquake. This item is discussed further below under Section III.

5) The AFW system was considered in the responses to NRC IE Bulletins 79-02, 79-04, 79-07, 79-14 and 80-11.

6) The primary source of water and supply paths for St Lucie Unit 1 are seismically qualified and therefore, the requirement for a qualified secondary water supply path is not applicable to St Lucie Unit 1.

II Methodology/Acceptance Criteria

The design conditions, design loading combinations and stress limits for major system components are detailed in Chapter 3 of the FSAR. Seismic analysis test reports and engineering evaluations to substantiate the seismic adequacy of the system are available in our files.

The following is a brief description of the methodologies and criteria used to qualify the AFW system compoments:

A) Pumps and Drives

All three AFW pumps (one turbine, two motor driven) and drivers were qualified by static analysis methods using acceleration factors of .25g horizontal and .175g vertical for the Operating Basis Earthquake (OBE), and .5g horizontal and .334g vertical for the Safe Shutdown Earthquake (SSE). The stresses due to the two acceleration directions were added absolutely and acceptance criteria is based on maintaining material stresses within allowables without loss of function.

B) Piping

All above ground piping from the Condensate Storage Tank to the ground was qualified by static analysis methods using acceleration factors of .32g horizontal and .24g vertical for the OBE, and .64g horizontal and .48g vertical for the SSE, applied simultaneously. The remainder of the condensate piping, the AFW system piping, and the Main Steam System piping supplying the turbine drives were analyzed by the modal response spectrum analysis method, based upon ½% damping, with the earthquake directions combined by the SRSS method. The allowable stresses for these systems were based upon B31.7 (1969) requirements.

C) Valves/Actuators

All valves and actuators were qualified for 3g horizontal and 2g vertical for SSE, except for the turbine driven pump steam inlet valve which was designed for 1.5g horizon-

II Methodology/Acceptance Criteria (Cont'd)

C) tal and .48g vertical. The large bore valves were qualified by static analysis; the small bore valves were qualified by engineering evaluation.

D) Power Supplies

All major electrical equipment has been seismically qualified. This was done through tests, using accelerations ranging from .15g to 4.8g. Cable trays were qualified by analysis, using acceleration factors from the appropriate response spectra.

E) Primary Water and Supply Path

The Condensate Storage Tank was analyzed for seismic (including hydrodynamic) and dead load, using acceleration factors of .29g (hor) and .19g (vert) for OBE and .58g (hor) and .39g (vert) for SSE. The stresses were combined by taking the absolute sum of the vertical and one horizontal acceleration component, the stresses were compared to 1.33 times the AWWA D-100 allowable stresses for OBE, and 90% of yield stress for SSE. The supply path (piping) is covered under (B) above.

F) Initiation and Control System

Most of the instrumentation devices have been qualified by subjecting them to tests at various input accelerations. Exceptions to this are as follows:

. local gauges not essential for safety system operation.

The control grade automatic initiation circuitry installed as a post-TMI modification will be upgraded to safety grade and seismic Category 1 during our current outage.

G) Structures Supporting or Housing AFW System Components

All pipe support/restraints were designed to Seismic Category I requirements to withstand the piping loads due to (Thermal + Weight + SSE). Cable tray supports and electrical equipment mounting details were qualified by analysis, using loads from the appropriate response spectra. Design load was (Weight + SSE) and resultant stresses were combined by taking the absolute sum of the vertical and one horizontal acceleration component. The conduit supports and mounting of certain electrical boxes were not qualified by rigorous analysis since the criteria at the time of installation was to install in accordance with the electrical industry standards. These items were inspected in the field as discussed below.

AUXILIARY FEEDWATER SYSTEM SEISMIC QUALIFICATION
NRC GENERIC LETTER 81-14

III Field Inspection/Evaluations

1.0 Auxiliary Feedwater System

A field inspection was conducted covering all system components that could not be readily qualified by existing documentation. These items consisted of miscellaneous conduit and electrical box supports. The inspection team consisted of personnel highly experienced with electrical equipment and support systems. The inspection verified that in general, the support systems have conservative support spans and were installed in accordance with National Electrical Code Standards using standard commercially available strut material, clamps, u-bolts, and various steel shapes, in conjunction with ANSI C80.1 rigid steel conduit. This level of design for miscellaneous electrical component supports is consistent with industry practice for plants of the St Lucie Unit 1 era. These support designs and materials are used universally throughout the nuclear and fossil power plant field as well as other industries and were considered to have adequate seismic resistance at the time of installation. Industry tests on cable tray/conduit support assemblies based on worst case models indicate that systems supported by commercial grade components similar to those used at St Lucie Unit 1 remain functional after being subjected to tests which simulate earthquake conditions.

In addition, when assessing the seismic resistance of the installed system, certain inherent conservatisms were considered. These include:

1) Margins between allowable stresses and ultimate material strengths.
2) Inherent ductility of materials.
3) Seismic resistance of non-structural elements in the system.
4) Ability of cable/conductor to suffer considerable deformation without affecting function.
5) Increased damping values, due to friction between the cable and the inside wall of the conduit.

Also, a substantial data base detailing the effects of actual earthquakes on large industrial facilities (including power plants) exists in the literature. Our review of these reports/observations provide evidence that installations built to commercial standards and local building codes exhibit a high degree of seismic resistance.

2.0 Anchorage/Support for all remaining Class 1E Electrical Equipment

Based on preliminary findings from the review of the Auxi-

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AUXILIARY FEEDWATER SYSTEM SEISMIC QUALIFICATION
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III Field Inspection/Evaluations

2.0 Anchorage/Support for all remaining Class 1E Electrical Equipment (Cont'd)

liary Feedwater System, FPL decided to extend the review of electrical equipment support/anchorage to include all major Class 1E components for the balance of safety related systems. IE Information Notice 80-21 provided the basis for this supplemental review which included the following electrical equipment: transformer, switchgear, control/power panels, batteries, inverters, cable tray, electrical boxes and conduit. Those components whose anchorage/support could not be verified by existing documentation were inspected concurrently with the Auxiliary Feedwater System inspections. The components examined included the conduit and electrical box supports in areas that are accessible during plant operation.

All major electrical equipment anchorages and cable tray supports were found to be satisfactory. Miscellaneous electrical equipment supports (conduit and boxes) were installed to NEC standards in existence at the time of installation. As in the case of the AFW system, the support systems possess a substantial amount of inherent seismic resistance and are considered adequate to withstand the Safe Shutdown Earthquake.

IV Conclusion

Design criteria and methods of seismic qualification for safety related equipment have changed significantly during the course of development of commercial nuclear power plants. Major system components for the St Lucie Unit 1 AFW system were rigorously designed to acceptable criteria and guidelines that existed for safety related systems during the plant design stage. Due to evolving criteria and changes in analysis methods since that time, the support systems for some miscellaneous electrical components may not be qualified when strictly compared to current acceptable criteria. However, based on our evaluation, we find that these components possess a reasonable level of inherent seismic resistance. We expect that a seismic event of the SSE level could result in some yielding of miscellaneous electrical support components. In our engineering judgement, however, we are confident that the AFW system and the plant electrical systems as a whole would function as designed and would enable the plant to be brought to cold shutdown conditions safely.