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ACCESSION NBR:8711100388 DOC.DATE: 87/11/06 NOTARIZED: NO DOCKET #
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50-389 St. Lucie Plant, Unit 2, Florida Power & Light Co. 05000389
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SUBJECT: Responds to NRC 870610 request for addl info re TMI Item II.D I of NUREG-0737, "Performance Testing of Relief & Safety Valves." Remaining questions will be addressed by 880205.

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L-87-448

NOVEMBER 0 6 1987

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

Gentlemen:

Re: St. Lucie Unit Nos. 1 and 2
Docket Nos. 50-335 and 50-389
TMI Action Item II.D.1
Request for Additional Information

By letter dated June 10, 1987 (E. G. Tourigny to C. O. Woody), the NRC identified additional information the staff required to continue its review of TMI Item II.D.1 of NUREG - 0737, "Performance Testing of Relief and Safety Valves". By letter L-87-339 dated August 14, 1987, Florida Power & Light Company (FPL) provided a completion date of November 6, 1987 for response to St. Lucie Unit 1 questions 1., 2.A., 2.B., 4.A. and 5., and St. Lucie Unit 2 questions 1.A., 1.B., 2.A., 2.B.1., 2.B.2. and 2.B.4. The purpose of this letter is to submit the response to these questions.

As stated in FPL letter L-87-339, the remaining St. Lucie Unit 1 and Unit 2 questions will be addressed by February 5, 1988.

If there should be any questions regarding this subject, please contact us.

Very truly yours,

J K Hays for
C. O. Woody
Group Vice President
Nuclear Energy Department

COW/MSD/gc

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

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# ADDITIONAL QUESTIONS ON ST. LUCIE 1 SUBMITTAL

1. What is the torque setting (value and ft-lbs) used for the plant Limitorque block valve operators?

Response

The St. Lucie Unit 1 motor-operated valve torque switch setting document specifies a nominal torque switch setting of 1.25 and a maximum setting of 2.75 for the PORV block valves. According to Limitorque, these torque switch settings correspond to a torque value of 47.5 ft-lbs and 98 ft-lbs, respectively.

2. Insufficient detail was received on the key parameters used in the RELAP5/MOD1 thermal-hydraulic analyses. Additional information is needed on the following items:

   A. Node Size: In Reference 1 the control volume size recommended is 0.5 to 1.0 ft. to adequately predict the fluid-hydraulic transient using RELAP5/MOD1. What control volume sizes were used in the St. Lucie 1 analysis? If larger than recommended in Reference 1, verify that the model used predicts accurate or conservative loads.

   B. Time Step Size: What calculational time step size was used in the analysis? Reference 1 (page 2-6) states that the time step recommended was determined by dividing the shortest downstream control volume length by the estimated shock wave velocity based on an instantaneous valve opening. The maximum shock wave velocity was assumed to be 2500 ft/sec (Reference 1, page C-23). If a larger time step was used verify that its use produces accurate or conservative results.

Response

2A. The pipe components immediately following the SRVs are component 5, component 9 and component 17. Component 5 consists of 18 volumes; component 9, 10 volumes and component 17, 15 volumes.

The following table lists the length of each volume in these 3 components:

| Component 5 | | Component 9 | | Component 17 | |
|---|---|---|---|---|---|
| Vol. No. | Length (ft) | Vol. No. | Length (ft) | Vol. No. | Length (ft) |
| 1 | 1.1 | 1 | 1.0 | 1 | 1.0 |
| 2 | 1.1 | 2 | 1.0 | 2 | 1.0 |
| 3 | 1.25 | 3 | 1.0 | 3 | 1.0 |
| 4 | 1.25 | 4 | 1.0 | 4 | 1.0 |
| 5 | 1.375 | 5 | 0.65 | 5 | 1.0 |
| 6 | 1.375 | 6 | 1.0 | 6 | 1.0 |
| 7 | 1.0 | 7 | 1.0 | 7 | 0.72 |
| 8 | 1.0 | 8 | 1.0 | 8 | 0.8 |
| 9 | 1.0 | 9 | 1.0 | 9 | 0.8 |

**Component 5**

| Vol. No. | Length (ft) |
|---|---|
| 10 | 1.0 |
| 11 | 1.0 |
| 12 | 0.91 |
| 13 | 0.75 |
| 14 | 0.58 |
| 15 | 1.0 |
| 16 | 1.0 |
| 17 | 1.0 |
| 18 | 1.0 |

**Component 9**

| Vol. No. | Length (ft) |
|---|---|
| 10 | 1.0 |

**Component 17**

| Vol. No. | Length (ft) |
|---|---|
| 10 | 0.9 |
| 11 | 1.0 |
| 12 | 1.0 |
| 13 | 1.0 |
| 14 | 1.0 |
| 15 | 1.0 |

The pipe components immediately following the PORVs are component 32 and 35. The sizes of control volumes in these 2 components are listed as follows:

**Component 32**

| Vol. No. | Length (ft) |
|---|---|
| 1 | 1.5 |
| 2 | 1.53 |
| 3 | 3.67 |
| 4 | 4.25 |
| 5 | 5.0 |
| 6 | 5.0 |
| 7 | 6.49 |
| 8 | 2.58 |
| 9 | 1.79 |
| 10 | 0.46 |
| 11 | 0.75 |
| 12 | 1.28 |

**Component 35**

| Vol. No. | Length (ft) |
|---|---|
| 1 | 1.56 |
| 2 | 4.83 |
| 3 | 4.25 |
| 4 | 5.5 |
| 5 | 5.75 |
| 6 | 5.01 |
| 7 | 2.58 |
| 8 | 2.07 |
| 9 | 0.46 |

The volume sizes in the SRV lines are in general consistent with the EPRI guidelines. The volume sizes in the PORV lines are larger than the recommended 1 ft. length. However, the PORV opening time of 0.11 sec. is much slower than the SRV opening time (0.006 sec). The PORV actuation transient is therefore less severe than the SRV actuation transient. Consequently, the longer volume length in the PORV lines is tolerable and the overall RELAP5 model is still adequate.

Please note that the RELAP5 analysis for St. Lucie 1 was performed prior to the issuance of Ref. 1 by EPRI. It is inevitable that a slight deviation from the EPRI guidelines could be found in the model.

2B. The time steps specified in the analysis range from $1.0 \times 10^{-7}$ sec. to $2.0 \times 10^{-4}$ sec. The maximum time step recommended in Ref. 1 (page C-23) is $2.0 \times 10^{-4}$ sec. Therefore, the time steps used in the RELAP5 analysis are adequate.

4. Provide the following information on the design analyses used to determine pipe stresses and support loads are within allowables:

   A. What code or standard was the pipe stresses and support loads compared against to verify acceptability? (ASME Section III, USAS B31.1 or ?) If not clearly defined by the code used, what allowable stresses were used to compare with the predicted pipe stresses and support loads? Show a comparison of the highest stressed and loaded areas with the allowable values.

<u>Response</u>

4A. The portion of pipe from the pressurizer nozzles up to and including the safety and relief valves was analyzed in accordance with USAS B31.7 Class I, 1969 Code. Although the remainder of the pipe up to the quench tank is classified as non-safety, it was included in the USAS B31.7 Class I piping model. However, this piping was analyzed in accordance with ANSI B31.1, 1973 Code. Safety related standard component supports were designed per USAS B31.7 Code and non-safety related standard component supports were designed in accordance with the ANSI B31.1 Code.

The codes used clearly specify the allowable stresses. These allowable stresses were used to compare with the predicted pipe stresses and support loads.

5. The Combustion Engineering (CE) inlet conditions report listed the FSAR transients and accidents for each plant which result in a peak pressure greater than the safety valve setpoint. For some plants this list included the feedwater line break (FWLB), but for other plants the FWLB was not included. St. Lucie 1 was a plant that did not include the FWLB in its list of transients and accidents that challenge the safety valves. From the CE report it was not clear whether the FWLB was missing because the accident did not challenge the safety valves or because St. Lucie 1 was licensed prior to the issuance of Regulatory Guide 1.70, Rev. 2 and, therefore, the FWLB was not analyzed as part of St. Lucie design basis. Discuss why the FWLB was not listed for St. Lucie 1. If the FWLB was not listed because of the second reason discussed above, it is the staff position the St. Lucie 1 submittal is incomplete. Item II.D.1 in NUREG-0737 specifically requires that PORVs and safety valves be qualified for fluid conditions resulting from transients and accidents referenced in Regulatory Guide 1.70, Rev 2. The FWLB is specifically defined in Regulatory Guide 1.70, Rev. 2. Additionally, from the staff review of other plant-specific response to Item II.D.1, it is clear that for many plants the FWLB accident is the limiting case for providing high pressure liquid to the safety valves, a fluid for which they were not specifically designed originally. This is exactly the type of concern that NUREG-0737, Item II.D.1 was established to address. In accordance with the requirements of the NUREG, we require that information be provided to demonstrate that the PORVs and safety valves will function as required to assist in safe shutdown of the plant and will not experience any degradation that would inhibit safe plant shutdown if exposed to the FWLB.

Response

The feedwater line break (FWLB) event had been previously evaluated in Section 15.2.8 of the St. Lucie Unit 1 FSAR. Based on the evaluation assumptions presented in the FSAR, the FWLB event is a cooldown event in the licensing basis for St. Lucie Unit 1. Standard Review Plan 15.2.8, Rev. 1 "Feedwater System Pipe Breaks Inside and Outside Containment (PWR)" states that, depending on the plant initial conditions and assumptions, the FWLB could cause either a reactor coolant system cooldown or heatup. For St. Lucie Unit 1, the FWLB event has been determined to be bounded by the limiting cooldown event, the main steam line break (MSLB) since the area for flow in the FWLB event is less than that assumed in the MSLB event. As such, the pressurizer safety valves and PORV's would not be subjected to high pressure liquid discharge during this transient.

The Loss of Load event is still the most limiting plant heatup, or RCS pressurization event. During this transient, the pressurizer safety valves and PORV's are limited to steam discharge.

## ADDITIONAL QUESTIONS ON ST. LUCIE UNIT 2 SUBMITTAL

1. Insufficient detail was received on the key parameters used in the RELAP5/MOD1 thermal-hydraulic analyses. Additional information is needed on the following items:

   A. <u>Node Size:</u> In Reference 1 the control volume size recommended is 0.5 to 1.0 ft. to adequately predict the fluid-hydraulic transient using RELAP5/MOD1. What control volume sizes were used in the St. Lucie 2 analysis? If larger than recommended in Reference 1 verify that the model used predicts accurate or conservative loads.

   B. <u>Time Step Size:</u> What calculational time step size was used in the analysis? Reference 1 (page 2-6) states that the time step recommended was determined by dividing the shortest down-stream control volume length by the estimated shock wave velocity based on an instantaneous valve opening. The maximum shock wave velocity was assumed to be 2500 ft./sec. (Reference 1, page C-23). If a larger time step was used verify that its use produces accurate or conservative results.

<u>Response</u>

1A. The pipe components immediately downstream of the SRV's are component 5, component 12 and component 19. The sizes of all the control volumes in these three components are ranged from 0.58 ft. to 1.0 ft.

The pipe components immediately downstream of the PORV's are component 33 and component 37. The volume sizes in these two components are ranged from 0.9 ft. to 1.0 ft.

Therefore, the volume sizes for piping downstream of the SRV's and PORV's are all consistent with the recommendations of Reference 1.

1B. The time-step control specified in the RELAP5 analysis is described as follows:

| Time (Sec) | Minimum Time Step (Sec) | Max. Time Step (Sec) |
|---|---|---|
| 0 to 0.20 | $1.0 \times 10^{-7}$ | $2.0 \times 10^{-4}$ |
| 0.20 to 0.40 | $1.0 \times 10^{-7}$ | $5.0 \times 10^{-4}$ |
| 0.40 x 1.20 | $1.0 \times 10^{-6}$ | $1.0 \times 10^{-3}$ |

The RELAP5 program would try to use the maximum time step specified. If the solution does not converge with the assigned time step, the program would automatically reduce the time step in half and repeat the calculation until the solution converges or until the minimum time step is used. If the solution does not converge with the minimum time step, the program would stop the execution. During the SRV/PORV actuation, the most severe transient generally occurs prior to 0.20 sec., therefore the time step control used in the RELAP5 analysis for St. Lucie Unit 2 is adequate and consistent with the recommendation of Reference 1.

2. Provide the following information on the PIPESTRESS 2010 analyses used to determine pipe stresses and support loads are within allowables:

   A. What code or standard was the pipe stresses and supports loads compared to show adequacy? (ASME Section III, USAS B31.1 or ?). If not clearly defined by the code used, what allowable stresses were used to compare with the predicted pipe stresses and support loads? Show a comparison of the highest stressed and loaded areas with the allowable values.

   B. The dynamic piping model used affects the accuracy of the predicted stresses and loads. Provide the following information on the mode used: (The figures provided were not adequate or legible).

      1. Maximum and minimum lumped mass spacing used.
      2. Calculation time step used.
      4. What damping factor was used in the analysis? Typically 1% for upset and 2% for emergency conditions are the maximum allowed; if greater than these values were used, justification is requested.

<u>Response</u>

2A. The portion of pipe from the pressurizer nozzle up to and including the safety and relief valves was analyzed in accordance with Article NB-3600 of ASME Boiler and Pressure Vessel Code Section III, 1971 Edition, including Summer 1973 Addenda. Although the remainder of the piping up to the quench tank is classified as non-safety, it was analyzed using the Class 2 requirements of Article NC-3600 of ASME Section III, 1971 Edition including Summer 1973 Addenda. This piping was upgraded to Safety Class 2 since it was included in the ASME Section III, Class 1 piping model. Safety related standard component supports were designed per the requirements of ASME Section III, 1971 Edition, including Summer 1973 Addendum and non-safety related standard component supports were designed in accordance with the ANSI B31.1 Code.

The codes used clearly specify the allowable stresses. These allowable stresses were used to compare with the predicted pipe stresses and support loads.

2B1. The maximum and minimum lumped mass spacing used in the analysis is as follows:

| PIPE SIZE | MASS POINT SPACING MAXIMUM | MINIMUM |
|---|---|---|
| 3" Sch. 160 | 2.333 ft. | 0.333 ft. |
| 4" Sch. 160 | 2.229 ft. | 0.154 ft. |
| 6" Sch. 40 | 4.537 ft. | 0.322 ft. |
| 8" Sch. 40 | 5.292 ft. | 0.145 ft. |
| 10" Sch. 40 | 4.685 ft. | 0.167 ft. |

2B2. The calculational time step used in the dynamic analysis of piping utilizing the PIPESTRESS 2010 program are the same as those used for the other RELAP5/MOD1 thermal-hydraulic analyses as given in Response 1B.

2B4. The damping factor used for the upset condition was 1% and for the emergency condition was 2%.

REFERENCES

1. "Application of RELAP5/MOD1 for Calculation of Safety and Relief Valve Discharge Piping Hydrodynamic Loads", EPRI-2479, December 1982.