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JUN 7 1982

Docket No.: 50-389

Dr. Robert E. Uhrig
Vice President
Advanced Systems & Technology
Florida Power & Light Company
Post Office Box 529100
Miami, Florida 33152

Dear Dr. Uhrig:

Subject: St. Lucie Plant, Unit 2 FSAR - Request for Additional Information in Support of Confirmatory Issues Relating to CESSEC

Enclosed, please find additional request for information we require before completing our confirmatory reviews, as documented in our SER for St. Lucie 2.

Responses to the enclosed request should be submitted by August 1, 1982. If you cannot meet this date, please inform us within seven days after receipt of this letter of the date you plan to submit your responses.

Please contact Mr. Nerses (301/492-7318), St. Lucie 2 Project Manager, if you desire any discussion or clarification of the enclosed report.

Sincerely,

Original signed by:

Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosure:
As stated

cc: See next page

OFFICE	DL:LB#3	DL:LB#3	DL:AD:L				
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CONFIRMATORY QUESTIONS REGARDING CESEC*

Section 1.0

440.83 Describe in detail the relationship between CESEC-SAR, CESEC-ATWS, CESEC-SLB and CESEC-III with an emphasis on the differences.

440.84 There is no discussion of DNBR calculations. If the code does compute DNBR, provide details.

440.85 Describe the self-initialization procedure.

440.86 How is the closure head bubble modelled?

Section 2.0

440.87 Does assumption (1) of Appendix B, assuming pressure to be spatially uniform throughout the entire primary coolant system, imply that no differentiation is made between pressurizer pressure and system pressure in the derivation of the T/H equations, eq. (B-30) through eq (B-78)? Where and how is each pressure used?

Section 3

440.88 How are the crossflows, bypass flows, mixing flows, head flows and leak flows incorporated into eq. (3-1), the equation for the pump flow?

440.89 How does the inertia term in eq. (3-1) take account of the flow split for parallel pumps?

Section 4

440.90 Justify the use of the Semiscale degraded two phase pump data to model CE pumps.

*Note: Questions are organized in Sections, corresponding to CENPD-107, "CESEC."

Section 6.0

440.91 Describe how the level in the pressurizer is determined and how the external heat transfer/mass flow terms are divided between the steam region and the liquid region.

Section 7.0

440.92 Why does the gravity term in the surge line momentum equation, eq. (7.1) contain expressions for the pressurizer when the inertia term is written only for the surge line?

440.93 Show the table of f values used in eq. (7-1) when Re > 15000.

Section 8.0

440.94 Why is the pressurizer pressure time derivative and not the RCS pressure time derivative used in eq. (8-1)?

Section 9.0

440.95 Are the 13 nodes referred to in the wall heat transfer model radial nodes? Provide a figure for the model to illustrate it.

440.96 How is heat conduction through the steam generator tubes modelled?

440.97 Is eq. (9-2) for the shroud heat capacity solved simultaneously with the thermal hydraulic equations of Appendix B?

Section 10.0

440.98 For the Doppler and the moderator reactivity feedback calculation does the core have only one axial node? How is the split core accounted for?

440.99 How is the moderator temperature/density calculated for the reactivity feedback?

440.100 How is the fuel temperature for the Doppler feedback calculated?

440.101 Describe in detail the 3-D reactivity feedback model used for steam line breaks.

440.102 Explain the homogenization procedure for the third radial node of the fuel rod heat conduction model.

440.103 Is the heat transfer correlation, given by eq. (10-1), for the clad-coolant interface, actually used for all pressures and temperatures?

440.104 What is the difference between T_w and T_{w1} in Fig. 10-6?

440.105 Is Q_w in Fig. 10-6 the source term used in the thermal-hydraulic equations of Appendix B?

Section 11.0

440.106 Is the letdown fluid temperature at the heat exchanger user input as stated by §11.0 or calculated in accordance with eq. (F-3)?

440.107 In the iterative procedure described in Appendix F is the critical flow set equal to the D'Arcy flow? Why assume saturation at the RHX exit?

440.108 What is the database for the heat transfer correlation given by eq. (F-6)?

Section 13.0

440.109 (a) Why does the suppression factor S, given by eq. (13-9) not correspond with the formula given in Table 2 of the Hoeld† paper referenced?

(b) Provide references/explanation for the difference in functional dependence between Chen's suppression factor* $[f(Re_R F^{1.25})]$ and Hoeld's expression $[f(1 - x) \bar{Re}_R F^{-1.25}]$.

(c) Justify the choice of Hoeld's formula for the Reynold's number factor, F, eq. (13-8) over the original Chen values.

440.110 Justify the use of the Dittus-Boelter correlation, eq. (13-3) for film heat transfer.

440.111 (a) Justify the assumption of two phase flow with condensation in the steam generator primary for all cases of forward heat transfer.

(b) Explain why the extrapolation of the Akets, Deans, and Crosser correlation to the water system is valid.

440.112 (a) Present the database for CE's modification of the Rohsenow pool boiling correlation, eq. (13-10), and discuss the range of validity.

(b) Should the term (P - 800) be (P_{sec} - 800) in the second expression for K_R on page 13-5?

440.113 Justify the assumption of free convection in the steam generator secondary during reverse heat transfer.

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† A. Hoeld, "A Theoretical Model for the Calculation of Large Transients in Nuclear Natural Circulation U-Tube Steam Generators (Digital Code UTSG)," Nuclear Eng. and Design, 47, pp. 1-23, 1978.

* J. C. Chen, "Correlation for Boiling Heat Transfer to Saturated Fluids in Convective Flow," I&EC Process Design and Development, 5, pp. 322-329.

Section 15.0

440.114 Is flow through the valves of the steam system assumed to be choked even when the sink pressure is higher than the throat pressure?

440.115 Justify the expression for A_{TUB} in Fig. 15-1A.

440.116 Correct the equation for W_{gL} in Fig. 15-1A.

Section 16.0

440.117 Justify the use of CRITCO for steam discharge flow when the reference+ quoted in the CESEC report is for two phase mixtures.

440.118 Is an orifice coefficient used in eq. (16-4) only when the steam generator tube rupture option is selected?

Section 17.0

440.119 Show why the steam generator load dependency of the steam generator water level, required in the steady state situation, is not needed to determine level during transients.

Appendix B

440.120 Equations (B-31), (B-33), (B-35) and (B-54) should be corrected.

440.121 Is reverse flow allowed in the core?

440.122 Is $W_{25} = 2W_{25,7}$?

+ A. N.Nahavandi and M. Rashevsky, "Computer Program for Critical Flow Discharge of Two Phase Steam-Water Mixtures," CVNA-128, February, 1962.

440.123 Describe the algorithm CESEC uses to trace the state of the pressurizer and to maintain continuity as the state changes. Is there an automatic time step adjuster?

440.124 Justify the identification, in state 8, of W_B with the vapor portion of the critical flow through the pressurizer valve. How is this consistent with the absence of W_B in state 7?

440.125 Provide references for the two phase pressure drop correlations, eqs. (C-1) - (C-5) and a comparison with the Baroczy[+] or Chisholm[*] correlation.

440.126 Are the CEFLASH-4A water properties applicable to the supercritical region? Provide a copy of the report[‡]

Appendix D

440.127 Explain why eq. (D-12A) can be neglected.

440.128 (a) How is the reference exit temperature in the steam generator node calculated and how is it used?

(b) How is the exiting enthalpy computed?

Appendix E

440.129 Prove that eq. (E-4) converges.

+ C. J. Baroczy, "A System Correlation for Two Phase Pressure Drop," AIChE reprint #37. Paper presented at the 8th Nat. Heat Transfer Conf., Los Angeles, Aug. 1965.

* D. Chisholm, "The Influence of Mass Velocity on Frictional Pressure Gradients During Steam-Water Flow," Paper 35 presented at the 1968 Thermodynamics and Fluid Mechanics Convention, Bristol, 1968.

‡ CENPD-133, "CEFLASH-4A, A FORTRAN IV Digital Computer Program for Blowdown Analysis," August, 1974.

440.130 How is the moderator feedback divided between the void feedback and the density feedback?

440.131 (a) Provide additional information about the core coolant flow and temperature calculation as the connection between COREQ and LOOPEQ is not clear. Which moderator temperature and density is used for the reactivity feedback?

(b) What fraction of instantaneous core power is absorbed by the coolant?

440.132 Justify the reactivity flux weighting method (i.e., flux or flux**2).

440.133 Why does the void reactivity calculation employ static quality when the Martinelli-Nelson correlation+ referred to uses flowing quality?

440.134 (a) Is the quantity Q used in T_{eff} for the Doppler an input constant?

(b) How is it determined?

440.135 Justify the CESEC/PDQ-TH calibration scheme for weighting factors.

440.136 Explain why in the formulation of the T/H nodal equations the pressure p is used but in the determination of water properties the pressure $p + \Delta p_{surge}$ is utilized.

440.137 Present the derivation/assumptions used to reduce the T/H nodal equations to a 19 equation set.

+ N. C. Sher, "Review of Martinelli-Nelson Pressure Drop Correlation," Westinghouse Electric Corp. Report WAPD-TH-219 (July 1956).

440.138 In the T/H model is the instantaneous core power entirely absorbed by the coolant with no heating of the fuel?

440.139 Are the sprays 100% efficient?

440.140 Discuss the DNBR calculation in more detail; in particular the open/closed channel aspect.

440.141 Describe the modelling of the steam bubble. What effect does the assumption of a uniform RCS pressure have?

440.142 Is there only boiling heat transfer on the secondary side of the steam generator and only film heat transfer on the primary side?

440.143 (a) Explain the steam generator dryout heat transfer criterion and the calculation of UA.

(b) How is the steam flow calculated?

(c) How is tube heat transfer area related to the mass inventory, the recirculation flow, and the quality calculation?

(d) How is quality calculated?

440.144 Is it correct that the heat transfer in the steam generator is

$$Q = \begin{cases} \dfrac{UA(T_i - T_s)}{\ln\dfrac{(T_i - T_s)}{(T_o - T_s)}} & \begin{array}{l} UA = 1.0 \text{ UA forward transfer} \\ \quad = \text{input reverse transfer} \end{array} \\[2em] UA\left(\dfrac{T_i + T_o}{2} - T_s\right) & \begin{array}{l} \text{when } T_i > T_s \text{ and } T_o < T_s \\ \text{with } UA = 0.8 \text{ UA of} \\ \text{previous timestep} \end{array} \end{cases}$$

where UA = overall heat transfer coefficient

T_i = primary side inlet temperature

T_o = primary side outlet temperature

T_s = secondary side temperature

440.145 (a) Does the code use the cold edge temperature or the cold leg temperature for the moderator feedback?

(b) How is the cold edge temperature calculated?

440.146 Is there an iteration between the pump flow calculation and the energy/mass balance calculations?

440.147 (a) How is the input flow fraction for the outlet plenum to closure head flow determined?

(b) Are the plena crossflows or the bypass flows user specified? If so what is the basis for the input values?

440.148 How is the UA parameter used in the steam generator heat transfer determined at the minimum mass inventory?

440.149

It is our intent that CESEC-III be used for future analyses instead of CESEC-I or CESEC-II. Please demonstrate that CESEC-III is capable of performing the required analyses by submitting an analysis of the following transients for the CESSAR design using CESEC-III:

(a) steamline break,

(b) feedwater line break,

(c) loss of feedwater ATWS, and

(d) steam generator tube rupture.

The results obtained with CESEC-III should be overlaid with the results obtained with CESEC-I and CESEC-II.

440.150

In general, it is our impression that the data[1] presented by Fla. P.&L. is insufficient to support a general mixing model since only one flow condition was measured. Furthermore, the particular flow condition chosen has a Reynolds number nearly one full order of magnitude below operating conditions.

The experiment represented each core assembly by a single flow tube and used air as its simulant fluid. SO_2 was injected into the air flow of one (of 4) reactor vessel inlet nozzles on a roughly 1/4 scale model. The SO_2 concentration was measured at the exit of each of the "core tubes" and in each of the two reactor vessel outlet nozzles. Although the method appears reasonable for obtaining information on reactor vessel outlet flow, unfortunately, data is presented for only one operating condition. Furthermore, we are concerned about the impact of constraining the core flow in tubes when substantial cross flow is to be expected.

Thus it is our general opinion that this single data point is not an adequate basis upon which to build a computer code model intended to model a wide range of flow conditions. The following specific questions should be addressed by the applicant.

(a) This data is only for one Re number, representing only one operating condition. Upon what grounds does CE utilize this data for other flow conditions such as pump coastdown or loss of one pump.

(b) How was this data implemented in the CESEC computer codes, justify and explain in depth.

(c) Discuss the impact of having done these experiments in a geometry which prohibits cross flow between assemblies. How is the cross flow expected to impact the flow split in the exit nozzles.

(1) "Test Report on Fluid Mixing in a Scaled Reactor Vessel Flow Model," CEN-169(L)-P, July, 1981, Combustion Engineering.

Furthermore, how does this lack of cross flow impact the accuracy of simulation of core moderator temperature during a return to power?

(d) Discuss accuracy of the experiments - what are the fractional errors in the % of flow through the various "core tubes"?

The total % of flow going into the two outlet nozzles is 38% + 14% = 52% - why is it not 50%? What were the experimental errors?