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September 30, 1983

Mr. Jack Guttmann
Reactor Systems Branch
Division of Systems Integration
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Review of PTSPWR2 Under Task I.A of FIN A2311

Dear Mr. Guttmann:

Enclosed are first round questions on the Exxon plant transient code PTSPWR2 based on our review of the following Exxon draft report:

1. XN-74-5 (P) Revision 2, "Description of the Exxon Nuclear Plant Transient Simulation Model for Pressurized Water Reactors (PTS-PWR)," D. M. Turner, et al. (received June, 1983).

It should be noted that although typographical errors were encountered the emphasis has only been on those which could lead to significant ambiguities.

The following additional supplement has recently been received from Exxon:

XN-74-5 (P) Revision 2, Supplement 1, "PTSPWR2 Modifications for St. Lucie Unit 1," W. T. Nutt, et al. (Received September 23, 1983).

It is unclear to ANL how this supplement should be treated in the generic review of the code models under FIN A2311. Please advise us.

Furthermore we have not yet received the qualification material, the methodology report or the description of code model modifications for CE plants and four loop W plants which Exxon agreed to submit by September 1 at the June 16 ANL meeting. This delay may impact the FIN A2311 schedules accordingly.

If further clarification is required, please contact us.

Sincerely,

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Enclosure

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-PTSPWR2: FIRST ROUND QUESTIONS

The applicant is requested to verify that the errors identified as typographical errors are indeed typographical errors and were not carried further into the program statements.

Section 1.0

1) How is metal heat transfer modelled?

2) Is there a boron transport model? If so, provide a discussion of the model.

3) For the fixed nodalization used (as shown in Fig. 1.1) justify

   (a) the connection of the pressurizer to the upper plenum.

   (b) the absence of resistance in the surge line.

4) Detail the steam separator model used.

5) Provide a summary of the numerical scheme employed and the time step selection algorithms available.

Section 2.1

6) Show how the prompt term in the power equation is consistent with the prompt term in the precursor equation of the point kinetics equation set, eq. (2-1).

7) Present the derivation for the prompt jump approximation equation, eq. (2-3).

Section 2.2

8) Correct the typographical error for R_{f3}.

9) Demonstrate that the one axial node approximation for the core has insignificant effects for the core heat transfer and the reactivity feedback.

Section 2.2.2

10) Justify the quasistatic approach for the coolant enthalpy distribution.

Section 2.3

11) Define f used in the pump equation and provide justification for its functional form.

12) Provide derivations for the gravity heads in eqs. (2-26e), (2-27), and (2-28).

13) How are the friction coefficients K determined?

14) (a) Define FDECAY { } used in eq. (2-32) for the hot leg.

(b) Detail the model for the cold leg.

15) Present the derivation for eq. (2-37).

Section 2.3.3

16) Show the control volume for which the mass balance eq. (2-38) is written and identify the different flow terms.

Section 2.4

17) Define h_f used in eq. (2-5) for the case of pressurizer outsurge.

18) Regarding the pressurizer insurge analysis:

(a) Explain why, while the analytical equations give an indeterminate answer the numerical algorithm described gives a unique solution.

(b) Justify the neglection of bulk condensation interregion mass transfer in the mass equations, eqs. (2-1) and (2-2).

19) Discuss the pressurizer outsurge model in more detail; in particular, the calculation of the flashing rate.

20) Provide the equations for the empty pressurizer model.

Section 3.0

21) List the criterion used to differentiate between the steam, boiling and nonboiling regions of the steam generator model.

Section 3.1

22) Clarify and summarize the primary side equations used for the steam generator model in the case of reverse flow (Eqs. (3-3), (3-5), (3-7), (3-9), (3-11) . . .).

23) (a) Show how the expression for $(\Delta TM1)_{i1}$ used in Eq. (3-2) is arrived at.

(b) Justify the quasistatic approach which neglects the steam generator tube heat capacity.

24) Give a physical interpretation of eq. (3-6) for the U-bend region.

25) Discuss the modelling when one or more regions disappears or reappears.

26) Is U_{steam} always set to zero?

27) Define the temperature used in Eq. (3-13).

28) On the secondary side of the steam generator model,

(a) Explain why the specific volume in eq. (3-14) is evaluated at subcooled conditions when the nonboiling region is assumed to be at saturation.

(b) Justify the modulus signs in eq. (3-14) for the nonboiling length.

29) (a) Present the derivation for eq. (3-19) for the steam region.

(b) Justify the expression used for V_{lsST}.

(c) Define CF_{sglT}

30) (a) Define A_{cs} used in eq. (3-18).

(b) Define A_{mt} used in eq. (3-21).

31) Justify the numerical value used for the fouling factor f.

Section 3.2

32) Provide derivations for the gravity head terms in Eq. (3-32) and (3-36) and state which of the two equations is actually used.

33) How is W_{uptdl} determined?

34) Justify the use of eq. (3-52) for the top of the downcomer when the level changes.

35) Present the derivation for eq. (3-55) which determines the pressure at the bottom of the downcomer.

36) Provide the functional form of FDECAY.

Section 4.0

37) Correct the typographical errors in Eqs. (4-3) and (4-4).

38) Justify the modulus signs in

(a) eq. (4-6) for the recoverable acceleration head

(b) the flow acceleration term in eq. (4-21).

39) Does the steam line model only apply for saturation conditions?

Section 5.1

40) Correct the typographical error in Eq. (5-1).

Section 5.2

41) Compare the valve flow model against the Murdock and Bauman correlation for single phase steam flow and agains the Moody correlation for two phase mixture flow.

42) Present justification for the valve flow modifier, eq. (5.3).

Section 5.8

43) Describe the model which converts rod speed into reactivity insertion/deletion.

Section 6.0

44) Correct the typographical error in the W-3 correlation, eq. (6-8).

Section 8.0

45) Give references for the thermodynamic and transport water properties used and compare against steam table data (or an equivalent reference).

46) Give references for the default pump curve.

47) Submit a copy of reference 3 and compare the decay heat model described therein with the ANS standards.

Section 8.2

48) Provide a reference for the default delayed neutron parameters used and compare against the RELAP5 set.

Section 8.3

49) Detail the initialization procedure used in the steam line and the pressurizer.