February 25, 1997

APPLICANT: Westinghouse Electric Corporation

PROJECT: AP600

SUBJECT: SUMMARY OF AP600 TELEPHONE CONFERENCE (TELECON) TO DISCUSS QUESTIONS ON THE STAFF'S COMPARISON OF SCDAP/RELAP AND MAAP ANALYSES

On February 10, 1997, members of the Nuclear Regulatory Commission (NRC) staff, its contractor at Idaho National Engineering and Environmental Laboratory (INEEL), and Westinghouse conducted a telecon concerning the staff's comparison of a SCDAP/RELAP analysis with MAAP results for the AP600 3BE core damage sequence. NRC questions on the comparison effort where sent in advance to Westinghouse via NRC letter dated January 28, 1997. Westinghouse provided responses to the questions during the telecon which are summarized in Attachment 1.

During the telecon, Westinghouse noted that the 3BE.TAB file would be helpful in the INEEL comparison effort. Westinghouse committed to provide the staff a copy of this file if the staff did not already have it. The staff subsequently informed Westinghouse that it did not have this file and Westinghouse stated that it would send the NRC a copy.

Software used to analyze ex-vessel reactor cooling (EVRC) was discussed during the telecon. The staff stated it was interested in obtaining a copy of the software to perform some sensitivity studies. Attachment 2 is a matrix of some of the sensitivities the staff would like to analyze. Westinghouse stated that it would look into obtaining a copy of the EVRC software for NRC use.

original signed by:

William C. Huffman, Project Manager
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Docket No. 52-003

Attachments: As stated

cc w/attachments:
See next page

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DOCUMENT NAME: A:SCDAP.MAP

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Westinghouse Electric Corporation

Docket No. 52-003

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Date: February 10, 1997

Subject: Phone conversation between INEEL, NRC, and Westinghouse.

Attendees:

INEEL:
Scott Ghan, Ed Harvego, Darrell Knudson,

NRC:
Bill Huffman, Bob Palla

Westinghouse:
Cindy Haag, Jim Scobel

The following questions were presented to Westinghouse by the NRC in a fax prior to this conversation.

1. Q: Could we get a copy of the current documentation for the MAAP code?

   A: NRC has a copy and it is about 12 inches thick. NRC will get us the information if we can specify which sections we need.

2. Q: Could we get a copy of version 5 of the input model?

   A: WCAP-14729, pg 123 contains a copy of the parameter file and input file.

3. Q: Could you please provide a diagram or explanation of relationships of the nodes in the core and the core barrel?

   A: The reactor vessel wall consists of 10 axial nodes: 5 for the lower head and 5 for the cylinder. See subroutine PSHS. The core barrel and the core have 17 axial nodes.

4. Q: How does TCBL indexing correlate with TRV indexing? See question 3.

   A: For radiation heat transfer from the core barrel to the vessel wall, a core barrel node sees the nearest reactor vessel node. See subroutine PSHS. A view factor of one is assumed. Emissivity from the core barrel is given as input.

   MAAP contains no reflector modeling. The core is assumed to instantaneously relocate.

   MAAP calculations are used to estimate source terms and for insight regarding hydrogen generation and migration.

The NRC wishes to use this MAAP/SCDAP comparison to establish a level of confidence with other MAAP calculations.

5. Q: Could you please provide a diagram or description that tells the locations of the rows and columns in the model?

   A: There are 17 axial nodes and 7 radial channels. For the following variables, see documentation for the subroutine HEATUP.

   ICOLAP = Axial node that contains the top of the slumped core.
   ICRUST = Axial node that contains the uppermost layer of the bottom crust.
   ITOPCR = Axial node that contains the uppermost layer of the top crust.
   ILOWMX = The depth to which natural circulation can penetrate; i.e., the height of core above the top crust.

6. Q: What does XTRVII(i) and SIGW(i,j) represent?

   A: XTRVII(i) = the thickness of the RV wall at node i after melting.
   SIGW(i,j) = wall stress in radial node i, at the jth mesh point. j = 1 is the inside of the vessel. See subroutine CREEP.

7. Q: What does "CCI" represent?

   A: Corium Concrete Interaction.

8. Q: In variables MFPRB(x,y,z), x apparently represents the species and z apparently represents the compartment number. Is this true? What does y represent?

   A: MFPRB(x,y,z) = mass of fission products in containment nodes.
   x = fission product group
   y = deposition state - 1 = airborne gas, 2 = airborne aerosol, 3 = deposited aerosol.
   z = compartment index.

The remaining questions were asked, but they were not sent to Westinghouse prior to the telephone conversation.

1. Q: Primary pressure falls rapidly without plateau at secondary pressure. Please explain briefly.

   A: ADS opens and decouples the secondary and primary systems.

2. Q: Are ADS stages 1-4 assumed to open simultaneously at 60 s?

   A: We are not absolutely certain, but we believe the ADS actuation timer is assumed to begin at 60 s. The ADS stages then open sequentially according to the timer. We would have to check the LOG file, which records "actions" such as ADS actuation in the calculation.

3. Q: ZWCPS = RCS collapsed liquid level. ZWV = RCS mixture level. What is included in these level calculations? ZWV is sometime less than ZWCPS. Why?

   A: We usually don't consider ZWV when looking at system inventory. ZWCPS includes the reactor vessel, hot legs, cold legs, and steam generator tubes. It does not consider the accumulators, CMTs, or pressurizer.

4. Q: MCMTPS = mass of debris + metal layer. Does this include frozen and molten parts?

   A: Yes, it includes everything, including the crust. The subroutine name to look for begins with "lp."

5. Q: MCRUMT = mass of debris excluding metal
   MSSPS = mass of metal layer
   MXPSU = mass of upper crust
   MXPSL(i) = mass of lower crust in node i.
   Please verify our understanding of these variables. If we add these variables together we do not arrive at MCMTPS. Why?

   A: Yes, those are the correct variables. We don't know why they wouldn't add to MCMTPS.

6. Q: Is there a way to separate the components of the debris and crust?

   A: No. When a relocation occurs, the mass is deposited into a debris mass bin, and the energy is deposited into a debris energy bin. The components are treated as a mixture in the lower head.

7. Q: For fission product heating, the following variables are available:
   QFPHSF(i), and QQFPPS(j), which represents the power of the deposited and suspended fission products. If I add these together, will I arrive at the total power of the fission products released from the fuel?

   A: No. Some of the fission products escape through the break. The output file (which INEEL does not have) states the locations and masses of the fission products. NRC should send us a request for information, and we will send the output file (.tab).

8. Q: Is there a variable that states the power density of the debris bed?

   A: No. It is necessary to manipulate other variables to calculate the power density.

case: (1) input parameters set individually to values specified in column 2 below (15 cases), and (2) input parameters set simultaneously to values specified in column 3 below (1 case).

Parameter	Value	
	Individual Sensitivity Cases	Combined Case
Vessel Wall Melting Temperature (K)	1200 1900	1600
Pool Power Density, MW/m^3	–	1.6[1]
Fission Product Decay Heat in Metal Layer (%)	60	10
Metallic Layer Thickness (m)	–	0.2[2]
Convection Correlation for Downward Heat Transfer	$Nu_d = 0.1453 Ra^{0.2275}$	$Nu_d = 0.1453 Ra^{0.2275}$
Convection Correlation for Upward Heat Transfer	$Nu_u = 5.884 Ra^{0.1671}$	$Nu_u = 3.825 Ra^{0.1671}$
Ex-Vessel Heat Transfer to a Flooded Cavity	–	0.9 x ULPU Lower Bound[3]
Upward and Sideward Heat Transfer Within Metal Layer	0.167 x Globe-Dropkin	Globe-Dropkin
Melt Thermal Conductivity (W/m-K)	11.5 3.9	7.7 ± 3.8[4]
Crust Effective Thermal Conductivity (W/m-K)	8.6 3.0	5.8 ± 2.8[4]
Melt Density (kg/m^3)	9000 7600	8300 ± 700[5]
Metal Layer Emissivity	–	0.35
Vessel Effective Thermal Conductivity (W/m-K)	42 22	32 ± 10[5]

1 - shift distribution in Figure 7.8 to the right by approximately 0.3 MW/m^3
2 - shift distribution in Figure 7.6 to the left by approximately 0.7 m
3 - alternatively, can use 0.7 x best fit of ULPU results with RPV insulation
4 - broader distribution with generally higher values
5 - not currently treated as an uncertain parameter. Alternatively, can set to extreme value which minimizes margin to CHF