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Dr. Ivan Catton, Chairman  
Thermal Hydraulics Subcommittee  
Advisory Committee on Reactor Safeguards  
US Nuclear Regulatory Commission  
Washington, DC 20555

June 15, 1992

Re: NRC RES & NRR / INEL / JAERI Joint Meeting on AP- 600 IST, June 3&4, 1992

Dear Ivan,

The meeting was chaired by Dr. Brian Sheron. The parties were RES and their consultants Peter Griffith and Brent Boyak, NRC Contracts, INEL, JAERI, and Westinghouse. Observers from ETEC, EPRI, and DOE-ID as well as the three ACRS consultants were also present. (The attendance list is attached.) In opening the meeting, Dr. Sheron noted that it was not an open meeting and that discussion/questions would be limited to those seated at the table (RES, INEL, Westinghouse, and JAERI). He did, however, occasionally ask if observers had any questions or comments.

The purpose of the meeting was to review ROSA - IV design changes for the NRC AP - 600 IST program and to reach agreement on instrumentation and the test matrix. In his opening remarks, Dr. Sheron explained that it was not the intent of the program to achieve full simulation of the AP - 600. The purpose of the ROSA -IV experiments is to obtain large scale test data, including the phenomena expected in AP -600, for use in code validation. He gave a brief historical review of the SEMISCALE and MIST programs.

M. Ortiz, J. M. Cozzuol, J. E. Fisher and S. M. Sloan of INEL presented results of RELAP 5 MOD 2.5 calculations of responses of AP -600 and ROSA - IV in selected transients. MOD 2.5 was used because of problems with MOD 3, however they think MOD 3 problems have been resolved and are now to use it. Ortiz described an in-house INEL PIRT study in the context of code assessment needs. B. Boyack was critical of the PIRT report he had seen. Ortiz stated that it was only a draft and will be improved. Ortiz

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pointed out that ROSA - IV is 1/48 scale of PWR and 1/30 (16%) of AP -600. ROSA has only one CMT compared with 2 in AP - 600. Ortiz' slide # 18 summarized the "levels" (1st, 2nd & 3rd) of ROSA - IV modifications. Sheron had already commented that the System modifications had already been pretty well decided in precursor meetings of the principal parties. Based on the draft PIRT and system study, representative transients were chosen as follows:

- \* 3 inch break in cold leg
- \* 1 inch break in cold leg
- \* 3 inch break in Pressure Balance Line (PBL)
- \* SGTR - 1 tube
- \* STGR - 3 tubes
- \* MSL break

Cozzuol presented the comparison calculations for the two cold breaks. He concluded that level one modifications would be sufficient for 3 inch break simulation (qualitative) of AP - 600 for system response and passive safety feature behavior. For the 1 inch break, ROSA - IV and AP -600 would be different. He suggested that modification of upper head flow paths and addition of full length pressurizer would improve the situation. There was considerable discussion on both items. There are obviously modelling problems related to the upper heads in these systems. In addition ROSA is much higher than AP-600 and there will be difficulty making the flow paths in ROSA typical. Dr. Shotkin argued that it is not necessary to change the pressurizer height because it does not change the phenomena involved. The obvious problem here is that the process being pursued assumes that RELAP 5 is capable of capturing the phenomena in both systems. An example of where this may be untrue is the mixing that could be caused by jetting of the steam into CMT with consequent rapid condensation. This potentially important phenomenon is not well modelled in RELAP 5, in my opinion. Suppose it is not seen in ROSA - IV. This would provide no assurance that it will not be important in AP - 600. The atypical tube wall thickness in ROSA - IV SG was also cited as a reason to modify the SG.

Fisher presented the comparisons for SGTRs. Collapsed liquid levels are quite different. The CMT drains faster in ROSA. Sheron is concerned about overfill while Hochreiter says they never get overfill. Level one modifications will be sufficient to preserve the phenomena but results will be more typical if ECC lines are modified to give correct friction losses and the scaled pressurizer is added.

Sandra Sloan presented the PBL break results. Results look similar but she notes that this is fortuitous since the causes are different. Use of a single CMT causes atypical condensation in PBL. This looks like a major problem. Cold leg geometry differences also appear important. Core heatup is calculated for ROSA but not seen in AP - 600. The second CMT is needed for this scenario. The enlargement of upper head flow paths is needed for this scenario.

Cozzuol reviewed the comparison for the MSLB. Concludes that the level one modifications are adequate but the simulation would be improved with that addition of the full length SG.

Ortiz presented the overall INEL conclusions. A copy is appended to this report.

D. Bessett presented the proposed test matrix (copy attached). Phase I included 12 tests in four general categories. Phase II would consist of 6- 12 tests to be identified as phase I results become available. They might be repeat tests or investigate beyond DBA scenarios. During the discussion Griffith suggested using a scheme based upon void fraction. A. Levine said it would be dangerous to omit the single phase part of the transient because what happens in two-phase depends on how you got there. He also suggested a priority ranking and modification of the test matrix. I'm not clear on whether his suggestions were adopted. During this discussion JAERI indicated that they planned to put the steam from the ADS to drive a condensing jet pump. This has the potential capability to measure the ADS flowrate and enthalpy.

M. Modro presented the INEL recommendations on equipment modifications. Basically they suggest Level 1 plus 8 items (listed in the slide, enclosed).

D. Mecham presented the INEL assessment of instrument requirements. More information is needed from Westinghouse on how heated TC's work in actuating the ADS. Impedance probes for film thickness brought objections from Griffith and Hochreiter. Three beam gamma densitometers, drag disks, catch tanks, turbine meters, DP transducers all were suggested. The estimated cost was in the range of \$2M, but a disclaimer was included indicating that it was not a commitment to provide.

JAERI presented some cost estimates for the modifications to ROSA - IV. The cost is estimated to exceed \$6M, as I understand it, without complete elimination of the loop seal. Despite strong urging by Griffith, Hochreiter and others to eliminate the loop seal, Dr. Sheron said that he and Mr. Beckjord are not prepared to provide the necessary \$1-\$1.5M necessary for this modification. Westinghouse would have to present more persuasive arguments in favor of this expenditure.

Some action items were identified as follows:

Westinghouse

1. Design scaled surge and pressurizer internals (1 mo.)
2. Provide time to ADS valves to JAERI.
3. Identify why elimination of loop seal is so important. If they object to 0.4 m loop seal, give their reasons.
4. Provide data on heated TC's in CMT.

INEL

1. Analyze reduced loop seal - two cases.
2. ?
3. Find method for measuring ADS flows.
4. Firm up instrumentation recommendation.

It remained unclear to me what role RES has in mind for INEL. It is not clear that the Japanese can do what is needed without help from INEL or someone.


JAERI

1. Provide recommendation on Test Matrix.
2. Provide firm JAERI costs for items 1,2,4,5,&\*. These were said to be needed for Commission report and for contract.

The meeting was declared adjourned at the end of the morning on June 4. Dr. Sheron said he would meet in closed session with key representatives of JAERI and INEL in the afternoon to work further on instrumentation, cost estimates and test matrix questions. It appeared that he wanted to get an agreement signed with JAERI before departing Idaho.

My view of the situation was left somewhat uncertain. It appears that the RES plan to use ROSA - IV will be pressed forward. I had a hard time understanding significant parts of the discussion and therefore feel that I need more information to comment fully on the program. On the other hand, I was not persuaded by this meeting that it is a good idea to use ROSA to meet the AP - 600 IST needs. My intuition tells me that NRC will later regret having gone this route.

Sincerely yours,

  
Virgil E. Schrock

Participants

Proposed Modifications to the ROSA LSTF Facility for AP600 Safety  
Research Meeting, June 3rd, 1992

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## LEVELS OF ROSA-IV MODIFICATIONS EXAMINED IN THE COMPARISON

### FIRST LEVEL: THE BASIC SET OF MODIFICATIONS:

CMT  
PBLs  
ADS  
PRHR  
REDUCED LOOP SEAL

(Proposed by mere inspection of the  
two designs)

### ADDITIONAL BASIC MODIFICATION

UPPER HEAD FLOW PATH  
ACCUMULATOR STAND PIPE  
TO GET RIGHT VOLUME.

(As a result of the analyses)

### SECOND LEVEL

PRESSURIZER AND SURGE LINE  
PROPERLY SCALED HOT LEG

### THIRD LEVEL

TWO CMTS, SPLIT COLD LEG



## CONCLUSIONS

- AP600 UNIQUE SAFETY FEATURES BEHAVIOR IS BEYOND THE ASSESSED RANGE OF APPLICABILITY OF RELAP5. THE COMPLEX NATURE OF AP600 COMPONENT INTERACTIONS REQUIRES INTEGRAL TESTING FOR CODE ASSESSMENT.
- A MODIFIED ROSA, TO THE FIRST LEVEL OF MODIFICATIONS (INCLUDING CHANGES IN THE UPPER HEAD AND THE ACCUMULATOR VOLUME). CAN CAPTURE MANY OF THE PHENOMENA EXPECTED IN AP600 TRANSIENTS. IT WOULD BE REPRESENTATIVE OF THE 3-IN COLD LEG BREAK. IT WILL EXHIBIT THE PHENOMENA OF THE OTHER SYMMETRIC TRANSIENTS, ALTHOUGH MAGNITUDES AND TIMING MAY BE DIFFERENT.
- THE SECOND LEVEL OF MODIFICATIONS WILL ENHANCE ROSA'S ABILITY TO SIMULATE AP600 TRANSIENTS. IT EXPANDS ROSA'S ABILITY TO SIMULATE AP600 INVENTORY DISTRIBUTION DURING THE SLOWER TRANSIENTS (1-IN COLD LEG BREAK, 1 TUBE SGTR, AND MSLB).

ORNL REPORT NUMBER: 92-10  
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## CONCLUSIONS

- THE THIRD LEVEL OF MODIFICATIONS, AS DEFINED, FAILS TO CAPTURE THE NON-SYMMETRIC TRANSIENT (PBL BREAK) FOR WHICH IT WAS INTENDED. THE SPLIT COLD LEG CONFIGURATION INTRODUCES BEHAVIOR INTO THE SIMULATION THAT IS NOT EXPECTED OF AP600. FURTHER MODIFICATIONS ARE REQUIRED TO ENABLE ROSA TO SIMULATE THE NON-SYMMETRIC BEHAVIOR OF AP600.
  
- A PBL BREAK IN ROSA, WITH FIRST AND SECOND LEVEL MODIFICATIONS, ALTHOUGH LACKING NON-SYMMETRIES AND CMTS INTERACTIONS, CAN STILL PROVIDE DATA OF VALUE FOR CODE ASSESSMENT.



Mike Madro

## Recommendations for ROSA-IV Hardware Modifications

- Based on performed analyses we recommend the Level 1 modifications as providing the most effective means for code assessment
- Considering the inherent limitations of scaled facilities and not complete representation of AP600 configuration, ROSA-IV with the first level of modifications can provide reasonable simulation of most key phenomena expected during the selected AP600 transients

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## Recommendations for ROSA-IV Hardware Modifications (cont'd)

- Based on the analyses and new information about the ROSA-IV facility design we recommend the following additional modifications
  - Vessel upper head flow paths to better represent AP600
  - Corrected accumulator volumes
  - Second CMT
  - Second DVI line
  - Completely removed loop seal
  - DVI deflectors
  - IRWST injection
  - Surge line and connections

*on vertical run of Hot Leg*

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## Recommendations for ROSA-IV Hardware Modifications (cont'd)

- Summary of proposed modifications
  - Two CMTs with pressurizer and cold leg pressure balancing lines
  - Two DVI lines and deflectors
  - Four stages of ADS
  - PRHR
  - Removed loop seal
  - Upper head flow paths
  - Accumulator volumes
  - IRWST injections
  - surge line and connections
  - Pressurizer and surge line

↙ Proper height