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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
THERMAL HYDRAULIC PHENOMENA SUBCOMMITTEE MEETING MINUTES
NOVEMBER 18-19, 1987
WASHINGTON, D.C.

PURPOSE: The purpose of the meeting was to review key elements of NRC-RES's Five-Year Thermal Hydraulic Research Program for input to a proposed ACRS Report on thermal hydraulic research. The Subcommittee also discussed the status of NRC's action on a potentially unanalyzed large-break LOCA scenario.

ATTENDEES:

ACRS

D. Ward, Chairman
J. Ebersole, Member
G. Reed, Member (18th only)
I. Catton, Consultant
V. Schrock, Consultant
C-L. Tien, Consultant

NRC

B. Sheron, RES
L. Shotkin, RES
R. Lee, RES
D. Solberg, RES
Y. Chen, RES
D. Bessette, RES
N. Lauben, RES
C. Rhee, RES
N. Zuber, RES
W. Lyon, NRR
R. Jones, NRR

A complete list of attendees is attached to the Office of copy of these minutes.

MEETING HIGHLIGHTS, AGREEMENTS, AND REQUESTS:

1. Mr. Ward said the Subcommittee should focus on how the T/H research program is servicing the agency's Strategic Plan. He said our comments should reflect on NRC's overall goals. Mr. Ward said the remaining goal of the T/H research now under way should be to aid the uncertainty analyses in support of the CSAU effort.

   Mr. Reed said a diverse DHR method is needed. Research on a blowdown system is lacking and the B&W approach of increasing pressure is the wrong way to go. Mr. Ebersole said NRC Research should be involved in the effort on feed and bleed vis-a-vis LOCA research.

DESIGNATED ORIGINAL

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Dr. Catton said the T/H Five-Year Plan (NUREG-1252) seems to have a number of inconsistencies that RES should address in their presentation.

2. W. Lyon (NRR) presented the status of the NRR effort on the unanalyzed LOCA scenario. A 10 CFR 50.54(f) Letter to Industry is under internal review in NRR. When complete, the ACRS will be consulted. The problem (loop seal plugging) is applicable to W and to a lesser extent, CE plants. The B&W plants are not subject to this concern. A meeting with the WOG was unsatisfactory as the WOG saw no need to address this issue. NRC-Research has not been able to dismiss the concern out-of-hand. The core melt risk contributor is considered low however given the low probability of the accident conditions required.

In response to Mr. Ward, Mr. Lyon said the 50.54(f) Letter would require investigation of the T/H phenomena involved and how the Licensee would assure compliance with the regulations. In response to Mr. Ebersole, Mr. Lyon said it is believed that hot-leg injection may alleviate this problem.

In response to Mr. Boehnert, Mr. Lyon said Commission notification is being delayed, pending a clear understanding of the seriousness of the issue.

3. Prior to Dr. L. Shotkin discussions on the future plans for T/H research, Dr. Catton noted that there seems to be a disconnect between the future plans of NRC Research and what's in NUREG-1252. Also, code development seems to be forever ongoing. Mr. Schrock complained that there is a lack of basic data needed to fix the codes, but this issue is not addressed in the Five-Year Plan.

Dr. Shotkin noted that the Agency has initiated a new approach where all senior managers meet to review the goals of the agency's Strategic Plan. He noted the following observations:

- T/H has a low priority in the Agency. There is very little overall Agency interaction with the T/H research Program.

- T/H research is related to reactor design. The emphasis on reactor operations will result in less of a need for T/H work. The focus in the future will be on operations-related problems, particularly the human factors element of operations.

- T/H will play a lesser role in research and will probably be relegated to an on-call basis with an ongoing minimal level of support.

In response to Dr. Catton, Dr. Shotkin said there will be a need for T/H research and applications, but T/H won't be the key player it once was. Dr. Catton said that the flavor of NUREG-1252 will need to be recast to reflect the above goals.

The Strategic Plan (SP) and Five-Year Plan were discussed. The research philosophy in the SP focuses on the need for independent expertise and to anticipate problems. In response to Mr. Ward, Dr. Shotkin said the key problem will be the retention of knowledgeable people for when they are really needed (i.e., a big accident).

Dr. Tien disagreed that there are not interesting T/H-related issues that need to be addressed (e.g., operations), but what is really needed is a rethinking of priorities.

T/H research will be assigned priorities and risk assessment will be instrumental in determining these priorities per the SP.

The 5-Year Plan includes a topic labelled Plant Performance (T/H), Human Performance, and Accident Management which are all incorporated together. From the 5-Year Plan, the Branch Plan (NUREG-1252) was developed.

The future plans for T/H research were reviewed. The regulatory applications of T/H research focus on the prevention or minimizing of core damage through the understanding of T/H performance under accident conditions.

Figure 1 shows a list of T/H regulatory issues. In response to Mr. Ebersole, Dr. Sheron indicated that depending on the issue at hand, RES may or may not be coordinating their work with NRR. He also said that T/H research will have a major change in emphasis, and will not necessarily be phased out.

The Regulatory Requirements Review Group (RRRG) was discussed. RRRG coordinates the research needs of NRR/AEOD, RES, etc. Dr. Sheron said the RRRG has been very successful.

Dr. Catton said RES needs to develop a T/H laboratory in the U.S. and keep it in continuous operation, rather than surplusing equipment and manpower or going overseas to run tests.

Current and future research users include NRR, AEOD, and the Regional Offices. Research plans to issue comprehensive reports that synthesize the results of disparate programs. Reports are underway on the topics of feed and bleed and natural circulation.

In addition, RES will use the T/H codes in support of major research programs. The future structure of the T/H research Branch will subdivide along the lines of "research" and "applications" (of the research).

Most major T/H programs (ICAP, 2D/3D, ROSA IV, MIST, Codes, etc.) will be completed by the end of CY 1991. RES sees no need at this time for a new integral facility, but this position will be reviewed from time to time.

Baseline programs will continue for the plant analyzer, the INEL TSC and basic studies. Code development and assessment efforts will decline to

a baseline level and efforts will be continued to make code improvements as necessary. New program initiatives include:

- International Code Consortia
- Accident Management Codes (Front End)
- Improved NRC-Owned Simulator Performance
- B&W OTSG Testing (With Industry)
- Scaling of Testing Facilities (CEC, UMCP)
- Support to Regional Inspectors
- Multi-Disciplinary Approach to Issue Resolution
- Technical Support Center at INEL

In response to Mr. Ward, Dr. Shotkin said a synthesis report will be written on the topic of test facility scaling. In reply to Mr. Reed, Dr. Shotkin indicated that no further work is planned on the study of feed and bleed T/H phenomena via such issues as two-phase flow through valves (PORVs, etc.). Dr. Sheron indicated that feed and bleed is not a licensing requirement. Mr. Reed asked how NRR would review the Davis-Besse enhanced feed and bleed system absent research on the T/H of feed and bleed. Mr. Jones said there are no regulatory requirements for feed and bleed. Further discussion brought out the concern that the PORVs have not been qualified for feed and bleed duty. NRC noted that feed and bleed is beyond the design basis.

Commenting on the 5-Year Plan, Dr. Tien said RES needs to show how the old and new programs will relate to the Strategic Plan. Dr. Shotkin indicated that the proposed Accident Management Plan will address the integration of the new programs. RES does not see any major issues that are not being, or have been, addressed. Dr. Tien noted that he does not see any initiatives in such areas as computer aided software for reactor operations. Dr. Shotkin indicated that such items are to be addressed in the ongoing Accident Management Plan. Dr. Catton said the Subcommittee should review these other plans so we'll have the whole picture.

Mr. Ward said the Subcommittee needs to think further on the bounds of its review.

Mr. Ward suggested that RES look at the idea of factoring in the experience and research results to a reevaluation of the design basis accidents. He indicated that NRC needs to revise and update its regulations (e.g., the ECCS requirements). Dr. Shotkin agreed this effort should be pursued and he will look into this. Dr. Sheron noted that a risk-based approach to DBAs is very difficult to evaluate and any industry submittal would result in an argument over numbers. Another problem is establishing a "DBA" for containment (i.e., a severe accident).

Revisiting of the DBAs needs to await the establishment of the severe accident policy. Mr. Ward indicated that the current knowledge base should allow opportunity for interesting work in this area, but the will to act seems to be lacking.

Figure 2 shows the budget and, by implication, priorities for T/H research for FY 88-92. The close out of the current programs is also evident. Accident management and the INEL Technical Support Center will take a significant portion of the budget. The total budget will stay around $15 million. Dr. Shotkin has set up a priority list in the face of future budget cuts. Cuts would be taken in the following order: ROSA IV, Basic Studies, maintenance of TRAC-B and RAMONA, ICAP, Code Improvement, and the TSC synthesis report on natural circulation. In response to Dr. Tien, Dr. Shotkin indicated that the proposed T/H budget cut ($\sim$25%) is an indication of the priority accorded T/H research at this time.

R. Jones commented on NRR's research user needs. He said the NRR/RES coordination is handled through the RRRG. NRR is in basic agreement with the revised thrust and approach of RES. The proposed cuts appear reasonable under the circumstances. Mr. Ward asked if any needs are

arising from advanced reactors. Mr. Jones said no specific T/H research needs have been seen at this time. Given the budget constrictions, NRR cannot justify expenditures for "paper plants" at this time.

Mr. Ward was concerned that lack of research at the PDA stage for advanced plants may cause problems later on. Mr. Jones said research may have to be ongoing with plant construction to confirm some design aspects of these new plants.

4. R. Lee (RES) discussed the status of the MIST Program. As of September 1987, all Phase III MIST tests have been completed. In addition, Toledo Edison ran three tests to support installation of a high point vent between the vessel upper plenum and the candy cane.

Mr. Lee discussed the results of the MIST tests vis-a-vis T/H issues of concern. For the concern of primary depressurization, the results showed that the system always depressurized and fluid mass equilibrium was maintained. Dr. Catton asked if any MIST test was run to confirm the Davis-Besse analyses that the core would uncover during the "bleed" portion of feed and bleed. Mr. Lee said he was not aware of any such test; however, it was noted that the MIST facility mocks up a lowered loop B&W plant while Davis-Besse is a raised loop plant.

Comparing the results of the 10 cm^2 and 50 cm^2 small break LOCA tests, Mr. Lee noted that for both tests, the RCS eventually makes its way to a similar leak flow rate (Fig. 3).

Mr. Ebersole expressed concern that the automatic depressurization of the OTSGs will deprive you of the use of the steam driven AFW pumps.

Results noted for other tests include:

° Feed and Bleed - The loop fluid saturated and voided when the PORV was opened manually and primary system depressurization occurred; depressurization was augmented by surge line uncovery

° Steam Generator Tube Rupture - Loop conditions were highly asymmetric. The primary system depressurized by heat transfer to the affected SG. The intact SG became a heat source. After isolation of the affected SG, the primary system and the affected SG repressurized.

° Noncondensible Gas (NCG) Effects - Venting of the high point vents to remove NCG promoted refill.

Dr. Catton recommended that RES assure that they do not leave the TRAC Code permanently "tuned" to MIST parameters; i.e., the code must be checked to assure it can properly scale up to the full size plant.

Figure 4 lists the RELAP-5 and TRAC code post-test calculations. Dr. Catton noted a significant error in the TRAC Code predictions. He strongly recommended that RES reevaluate this result to assure the code is not in error. Further discussion brought out the fact that the cause of the error may not be well understood.

The B&WOG Analysis Committee has requested B&W to examine this MIST test observations with respect to their applicability to B&W plants. B&W will complete the review and put together recommendations for B&WOG's consideration by end of December 1987. The B&WOG Analysis Committee is scheduled to meet at the beginning of 1988 for resolution of this task.

Figures 5-8 detail the status of the UMCP and SRI-II programs. RES is negotiating with EPRI for additional counterpart tests that NRC feels is needed to assure an effective counterpart analysis of the T/H phenomena.

Dr. Catton suggested a counterpart test(s) between UPTF and MIST, as UPTF has full-scale core vent valves. Dr. Shotkin said he would look into this and that it appears to be a good idea. Dr. Catton also recommended that the MIST calculations should be directed to the CSAU program.

The coordination report on the MIST and counterpart (SRI-II, UMCP, ANL, etc.) experiments will be updated in early 1988. The update will address the following issues:

° An update of design information on integral and separate effects experiments.

° A summary of key results (obtained to date) that address the following issues:

- decay heat removal by single and two-phase natural circulation
    - ° consequence of interruption of natural circulation
    - ° decay heat removal by boiler-condenser mode
    - ° long-term cooling by means of natural circulation or otherwise (e.g., feed and bleed)
- consequence(s) of steam generator tube rupture
- consequence(s) of loop-to-loop oscillation

° A summary of key results (obtained to date) that address MIST atypicalities.

° A summary of key results from post-test analyses.

Details of the MIST Phase IV Test Program are given on Figure 9.

Mr. Ward expressed concern that the B&WOG may be tuning their version of RELAP-5 to the MIST test results. Further discussion noted that RES will not make changes to the codes absent careful evaluation. There is no "B&W version" of TRAC.

5. The status of the OTSG SE test program was given by Mr. Lee. The objectives and current status are given on Figure 10. The AFW near-term activities are shown on Figure 11. Figure 12 lists the details of the OTSG visual AFW tests conducted at INEL. Results of these tests will be reviewed for revision of the RELAP-5 B&W Code.

6. D. Solberg described the work of the INEL TSC (Technical Support Center). A manager's meeting was held on August 5-6, 1987, to discuss the scope and operation of the TSC. Key results of the meeting included:

   - Name change to more correctly define function (from Technical Integration Center to Technical Support Center)

   - Reaffirmed TSC role and objectives defined in NRC T/H integration plan (NUREG-1244)

   - TSC program should be issue oriented and issues should be classified as short term (priority) or long term.

   - Improved TSC structure.

   - Review and agreed upon resolution of ACRS comments (see below).

   - Agreed to greater involvement of TSC in NRC discussions, particularly RRPG meetings.

   - TSC has been seen as doing a good job performing tasks as defined in NUREG-1244.

The structure, role, and interactions of the TSC are illustrated on Figure 13. Dr. Mark cautioned that RES needs to assure it has close oversight of the personnel in the TSC. It was noted that there are no full-time people in the TSC, e.i., the duties are divided among other tasks. Dr. Tien expressed reservations with this approach as did Dr. Mark, given that $2.5 million/year will be devoted to this program. Dr. Catton said the National Science Foundation requires a full-time person to be heading all its projects. RES believes they have the ear of EG&G management so they can get done what needs to be done.

A review of the Objectives, FY 1987 Accomplishments, and FY 1988 Plans for the RES priority issues were detailed (Figures 14-19). In the area of Regulatory Utilization, the TSC is developing synthesis reports of research results. A draft NUREG has been prepared on the topic of feed and bleed and a synthesis report on natural circulation is planned for FY 1988.

Conclusions of the feed and bleed study were presented (Fig. 20). Subcommittee discussion brought out that the need exists for the ACRS to review the operator guidelines for such maneuvers as feed and bleed.

RES responded to ACRS comments on the TSC. RES agreed with our comment to review and assess TSC function after ~2 years of operation

7. Y. Chen overviewed results of the ROSA-IV program conducted at the LSTF at JAERI. ROSA-IV mocks up a ~~a~~ 4-loop PWR. In response to Dr. Catton, Dr. Chen said test data has been slow in coming. RES has taken steps to assure more timely receipt of test data.

Results of natural circulation and small break LOCA tests were discussed. The natural circulation tests showed core cooling could be maintained with RCS mass inventory down to 45% of nominal at 5% core power and down to 3% of nominal at 2% core power. The 5% hot leg small

break LOCA tests resulted in a core heat-up as a result of depression of the core level due to interactions involving the CL loop seal. In all cases, the heat-up was terminated after the loop seal cleared. This phenomena was also seen in Semiscale. RES believes that the amount of level depression is proportional to the core power level. A complete report on the level depression results will be available in February 1988.

Station blackout tests were run assuming various equipment failures (no HPI, 1-3 PORVs used, etc.) to address the issue of direct containment heating. The tests showed that even with all PORVs open RCS pressure never got to the accumulator setpoint, i.e., the operator must use HPI to cool the core.

SGTR test results were shown. Mr. Ebersole raised the issue of potential recriticality due to dilution of borated water via the secondary. RES said that studies have shown one needs to rupture ~25 tubes before there is a problem here. The SGTR tests showed that feeding and steaming of the intact SG was effective (eventually) in depressurizing the RCS.

RES and JAERI are proposing to extend their agreement for four more years (1988-1991). RES has requested that JAERI conduct the following tests.

- Station blackout with a concurrent RCP seal failure.
- Steam generator tube rupture with various recovery techniques.
- Total loss of heat sink scenario with various recovery techniques.
- Steam generator cooling.

° Station blackout with depressurization techniques (DCH scenario).

Results from ROSA-IV small break LOCA tests are being applied to the CSAU methodology for small break LOCA code calculations.

8. D. Bessette (RES) described the code development and assessment program. Final goals of the code programs include: (1) use of the CSAU methodology to demonstrate the ability of the TH codes (TRAC and RELAP-5); (2) use of ICAP to support the CSAU effort; and (3) completion and release of the final code versions in June 1989. The ICAP agreements with various countries will be extended to a common termination date sometime in 1991. In response to Dr. Mark, Mr. Bessette said QA documents for the T/H codes have never been compiled before now.

Mr. Bessette noted that RES has developed a code improvement plan report. A "rough draft" was provided to the Subcommittee and RES solicited comments on the basic approaches stated in the document. In response to Dr. Mark, Mr. Bessette said no future version of TRAC will be released until it can properly conserve momentum (RELAP-5 currently conserves momentum).

Dr. Catton said RES should provide adequate justification before proceeding with a new code version. He indicated that serious fundamental problems remain with the numerics in TRAC and these problems should be addressed before a new model(s) is developed. He is not sure these serious problems are scheduled to be addressed, and he thinks development should stop until these issues are addressed.

Mr. Ward asked why development work isn't halted until the CSAU effort is complete. Mr. Bessette indicated that some code errors are known and by judgment one knows whether the errors are worth correcting. Further discussion of code problems lead Dr. Tien to recommend that TRAC code development be halted until the numerics is fixed.

Mr. Lauben, in response to Mr. Ward, noted that TRAC development has essentially stopped since April 1987 in order to perform the large break LOCA CSAU, and the QA work. A TRAC code modification is being made in support of 2D/3D per RES's international agreement.

In response to Mr. Schrock, Mr. Lauben said the long-standing problem of flow regime modeling is being addressed by the CSAU effort. CSAU is supposed to identify which code deficiencies need to be addressed. Dr. Zuber indicated that the QA report will identify problems with the codes, and that over the last few years, development of code numerics has been a case of the "tail wagging the dog" vis-a-vis development of the physics. Mr. Schrock said more expertise is needed in the area of understanding the fundamental physics of the problems seen with the codes. Dr. Zuber said CSAU will allow use of codes even with these errors, depending on the impact of a given error on the transient/ accident being modeled.

Further discussion ensued. Dr. Zuber said that ICAP has given more objective assessment results than was obtained from the laboratories assessment efforts. In response to Mr. Ward, Dr. Zuber said CSAU will be able to identify problems with the codes that impact analysis of a given transient.

The current status and future plans of the code development program include:

- TRAC-PF1/MOD1 Version 14.3, RELAP-5/MOD2 Cycle 36.06, and TRAC-BF1 have been frozen.

- The codes are in the process of being documented (QA documents due 12/31/87).

- Large break LOCA CSAU is in progress on TRAC (due 2/88).

° New procedures implemented for QA/QC in performing code configuration control.

° TRAC Version 14.4 planned for release in June 88 for UPTF needs. Changes are to be made in the following areas:

- downcomer penetration
- entrainment/deentrainment in upper plenum
- condensation in hot leg and cold leg during ECC injection
- interfacial shear and heat transfer
- CCFL at the upper tie plate

° RELAP and TRAC have a number of deficiencies in common and a common approach will be followed in addressing these deficiencies.

° TRAC-PF1/MOD2 and RELAP5/MOD3 versions scheduled for release in June 1989.

Mr. Ward noted that the BWR code seems to be getting short shrift vis-a-vis the PWR codes. He asked if ICAP is addressing use of the "BF" version of TRAC. Mr. Bessette said NRC is getting full size plant data from BWRs in member countries.

At NRC behest, the ICAP participants have agreed, in principle, to formation of a Consortium to address code deficiencies in a coordinated, structured manner. A meeting is scheduled for December 15-16, 1987, to settle on a program of work. The Code Improvement Plan will serve as a focal point of effort. Peer review will be sought on the QA and Code Improvement documents.

In response to Mr. Ward, RES said RELAP is more favored than TRAC by the ICAP participants. RELAP and INEL are seen as more "user friendly."

Discussing the ICAP consortium, Dr. Zuber noted that in the process of modifying a code, errors are introduced. He noted that only two versions of TRAC have been developed to maturity -- PD2 and PF1/MOD1. He said the last versions of TRAC and RELAP-5 will be mature in 1992 or so. The CSAU exercise has convinced him that TRAC has some fundamental limitations that limit its capability for improvement. He said the current code versions are adequate for large break LOCA and he sees no reason to develop a MOD-3 and MOD-2 version of RELAP-5 and TRAC, respectively. Dr. Zuber believes RELAP-5 should become the working code for NRC use.

Dr. Tien said he agreed that the use of TRAC is limited and a new look is needed. Dr. Zuber agreed and said a strategic-type tool is needed to address the problems of current concern (accident management, operations, etc.).

Dr. Shotkin noted the following points vis-a-vis the Subcommittee comments:

- Traditional T/H issues will continue to arise and will need to be addressed. RES will complete its work on its T/H tools (codes) by June 1989.

- Agency-wide needs and users will dictate some of the T/H work, such as putting TRAC and RELAP on "PC" size computers.

- Overseas commitments will force improvements to TRAC for the 2D/3D program.

- Expertise must be maintained at the laboratories; RES can no longer make code changes without examining the impact of the change on overall reactor safety (i.e., does it make any difference?).

- RES management is urging definitive completion of traditional T/H work.

In response to Mr. Ward, Dr. Zuber said any problems found with TRAC via CSAU can be rectified. Dr. Tien said he tends to agree with Dr. Zuber that the new MOD code versions won't be mature until 1991-92. Dr. Tien said RES needs to set its priorities for the future vis-a-vis accident management. Mr. Bessette asked the Subcommittee for its advice on just what new (or improved) tools are needed in this area.

Further discussion resulted in a suggestion from the consultants that it may be necessary to develop a separate code version for small break LOCAs and transients.

9. G. Rhee detailed the status of the 2D/3D program. Key points noted include:

- All testing is complete at the Japanese facilities (CCTF, SCTF). Test results here have shown cross flows in the horizontal direction effectively mitigate local power density differences. A 50% power difference yields about a 10% difference in quench front (QF) elevations; QF in high power region trails that of the lower power region by about 10%. SCTF will be disassembled in June 1988. JAERI plans a new T/H test facility to study advanced reactor designs, inherent safety, etc. Dr. Schrock asked why the Japanese feel the need for advanced reactor studies and the U.S. does not. RES indicated that there is no real need for such research. Mr. Schrock indicated that this approach is repeating the mistakes of the past.

° For UPTF, 13 of 30 tests have been run. Test results noted included:

- Fluid Mixing Test -- Cold ECC mixed well with the hot primary coolant in the cold legs; ΔT of about 160°C at the injection point reduced to ΔT of about 20°C at DC inlet for the injection rate of 10 Kg/sec.

- Hot Leg CCFL Test -- Steam/water countercurrent flow in a hot leg was stable under a typical PWR conditions. Thus, decay heat can be effectively removed during a small break LOCA through reflux condenser type of cooling.

- ECC Core Bypass Test -- ECC delivery to the lower plenum was better than expected from small scale tests; 80% of injected ECC delivered to the lower plenum as compared with 15% expected, based on small scale tests.

° A UPTF follow-on test program may be set up by extension of the agreement to October 1990.

° UPTF test data is being used to aid the TRAC-PF1/MOD1 CSAU effort.

10. The status of the work on continuing experimental capability (CEC) and an improved scale integral facility (ISIF) were noted. In brief, the CEC/ISIF effort is being phased out as RES has indefinitely deferred work on a new integral T/H test facility. RES will rereview the need for a new facility in about two years.

Mr. Ward urged RES to provide a synthesis report on the issue of facility scaling.

11. N. Zuber discussed the status of three separate effects (SE) research programs. Key points:

    ° Boron Mixing - study boron mixing in the lower plenum during an ATWS to address the stratification question. A test facility simulating a full-scale segment of a BWR LP was constructed at UCSB. Results to date show boron is entrained up to the core for natural circulation flows as low as 5% of rated flow. Dr. Catton suggested a test be run to demonstrate the boron is entrained from the bottom of the vessel to validate the above results.

    ° Review Fuel Rod Thermal Analysis Methodologies - Work still in progress.

    ° Water Hammer Due to Check Valve Failure - Investigate cold liquid fill rates to prevent water hammer in pipes with various orientations. Testing is under way and results obtained to date indicate that water hammer occurrence is indeperdent of subcooling temperatures, i.e., it is controlled by the hydrodynamics of the situation. The goal is to establish filling strategies (and rates) that prevent water hammer. Dr. Tien expressed approval with this program.

12. The Subcommittee held an executive session. Mr. Ward indicated to RES that a full Committee presentation would be timely at the February or March meeting.

    The Chairman distributed a list of discussion items that were to act as a focal point for possible items in a draft report on T/H research (Figs. 21-22). Key highlights of the discussion of these items included:

    ° Mr. Ward requested additional potential discussion topics beyond those on the subject list. Dr. Catton recommended a topic on "the

need for augmented data recording at nuclear plants." Dr. Tien suggested comments on RES's proposed change in approach (philosophy) for the role of T/H in plant safety. Mr. Ebersole suggested discussion of the rationale for feed and bleed, i.e., how well does plant process instrumentation relate to the actual T/H phenomena seen during the feed and bleed process.

- Need to understand the feed and bleed process - Dr. Catton indicated that use of MIST to test the feed and bleed phenomena and reduce uncertainties would seem prudent.

- Need for process instrumentation to understand plant transient T/H phenomena - Suggest new look at process instrumentation needed to assure an operator can negotiate the EPGs.

- Revision of DBAs to reflect current knowledge and experience - Subcommittee agreed this is a good issue to bring forth for consideration.

- Need for research to support advance reactors licensing - Mr. Schrock suggested that NRC evaluate the proposed PDA designs to assure themselves no real problems exist. This work could aid in retention of code expertise.

- Full-time manager for the TSC - No Subcommittee consensus was evident.

- Counterpart tests in SRI-II and MIST vis-a-vis UPTF - Need to assure that redirecting UPTF tests to aid counterpart analyses is worth the trade-offs involved.

- Status of future code development work - Drs. Catton and Tien suggested that there was no strong case to go on with new code

versions of TRAC (MOD2) and RELAP (MOD3). Dr. Tien indicated that there is more important work to be done: e.g., mock up advanced LWR designs with the existing codes.

Dr. Tien said there is a new computer technology called CASE (computer aided software engineering) that seems to hold promise for analysis of complex systems.

- BWR vs. PWR research priority for code development work - Dr. Tien said GE had done a better job on basic research early on than the PWR vendors. This may explain the derth (need for?) of BWR T/H research.

- Water hammer - Dr. Catton urged action here. He feels work is needed in the area of assessment of damage potential.

- Need to augment process instrumentation at plants - Dr. Catton said data is needed to benchmark codes and simulators.

- CEC need - I. Catton and V. Schrock said it was a mistake not to have T/H laboratory capability in the U.S. The need exists for basic T/H research capability on an SE basis. A "captive" laboratory would be desirable.

13. The meeting was adjourned at 3:50 p.m.

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NOTE: Additional meeting details can be obtained from a transcript of this meeting available in the NRC Public Document Room, 1717 H Street, N.W., Washington, D.C., or can be purchased from Heritage Reporting Corporation, 1220 L Street, N.W., Washington, D.C. 20555, (202) 628-4888.

1. REGULATORY APPLICATIONS OF T/H RESEARCH

A. ISSUES AND REGULATORY IMPACT

I. GENERAL: PREVENT OR MINIMIZE REACTOR CORE DAMAGE THROUGH UNDERSTANDING OF PLANT THERMAL-HYDRAULIC PERFORMANCE UNDER ACCIDENT CONDITIONS

II. SPECIFIC: (RECENT EXAMPLES)

ECCS RULE REVISION
CODE SCALABILITY, APPLICABILITY AND UNCERTAINTY
PRESSURIZED THERMAL SHOCK REGULATION
CONFIRMATORY TESTS OF RECOVERY FROM SBLOCA, USING NATURAL CIRCULATION, FOR TMI-RELATED ISSUES IN B&W PLANTS
METHODOLOGY FOR B&W SAFETY RE-EVALUATION
RESPONSE OF B&W OTSG TO ACCIDENT CONDITIONS
CONFIRMATION OF EXTENT OF BORON STRATIFICATION DURING AN ATWS EVENT IN BWR's
EXTENT OF SUPERHEATED CONDITIONS ON CONTAINMENT EQUIPMENT
INSTRUMENT TUBE-LINE RUPTURE IN W PLANTS
OPERATOR'S ABILITY TO DEPRESSURIZE PLANT TO MINIMIZE EFFECTS OF DCH
CHERNOBYL IMPLICATIONS ON REGULATORY REQUIREMENTS FOR REACTIVITY ACCIDENTS
AUDIT OF INDUSTRY SUBMITTALS (UPI)
ANALYSIS OF LWR OPERATING EVENTS (GINNA, DAVIS-BESSE, TMI-2, ETC.) TO AID STAFF INVESTIGATIONS OF THESE EVENTS
WATER HAMMER HANDBOOK FOR REGIONAL INSPECTORS

FIG. 1

FIVE-YEAR PLAN

PROGRAM AREA		FY (M$) 88	89	90	91	92
RESEARCH						
B&W TESTING (MIST + OTSG)		2.3	3.9	1.0	0.5	0
2D/3D		2.9	1.3	1.0	0.2	0
ROSA-IV		0.7	0.6	0.5	0.5	0.2
BASIC STUDIES		1.0	1.0	1.0	1.0	1.0
ICAP		1.3	1.3	1.2	1.0	0.8
CODE IMPROVEMENT		2.5	2.2	2.0	2.0	2.0
CODE UNCERTAINTY		0.7	0.7	0.7	0.5	0.5
	TOTAL	11.4	11.0	7.4	5.7	4.5
APPLICATIONS						
TECH SUPPORT CENTER		1.5	2.4	2.5	2.5	2.5
CONTAINMENT/BOP		0.2	0.4	0.5	0.5	0.5
CHERNOBYL IMPLICATIONS (REACTIVITY ACCIDENTS)		0.3	0	0	0	0
INDUSTRY AUDITS		0.2	0.5	0.5	0.5	0.5
REGULATORY ISSUES		0.2	0.5	0.5	0.5	0.5
ACCIDENT MANAGEMENT		0.2	0.8	1.0	1.0	1.0
NUCLEAR PLANT ANALYZER (TTC & REGIONAL)		0.8	1.0	1.0	1.0	1.0
NUCLEAR PLANT DATA BANK		0.5	0.5	0.5	0.5	0.5
ANALYSIS OF LWR TRANSIENTS		0.3	0.3	0.3	0.3	0.3
	TOTAL	4.2	6.4	6.8	6.8	6.8
(RESEARCH & APPLICATIONS)	TOTAL	15.6	17.4	14.2	12.5	11.3
CONTINUING EXPERIMENTAL CAPABILITY		0.2	0	0.5	2.0	4.0
(ADVANCED LWR'S)	TOTAL	15.8	17.4	14.7	14.5	15.3

F12.2

Tests 3110AA and 320201
Comparison of Leak Flow Rates

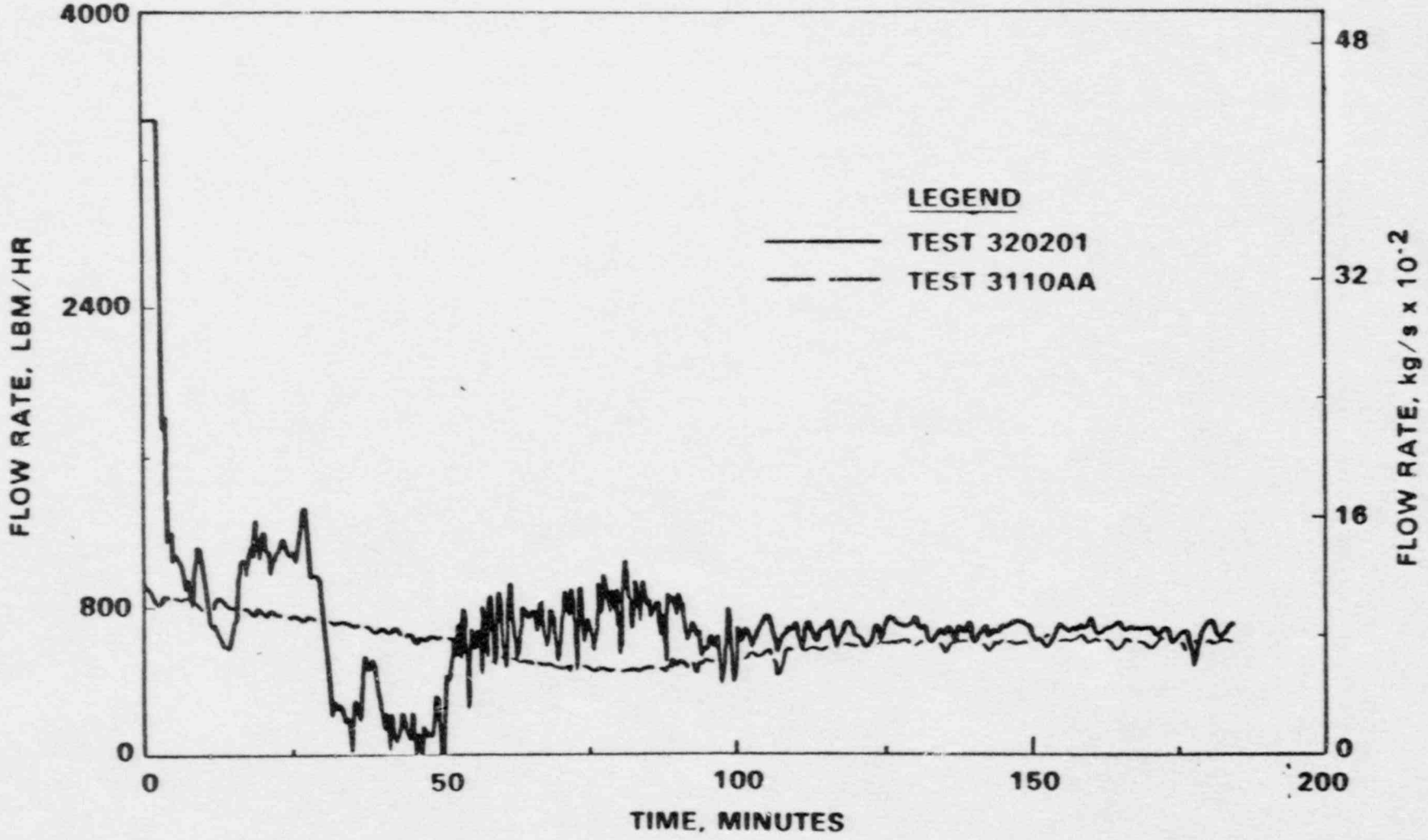


FIG. 3

A. MIST PHASE-III RESULTS AND REPORT STATUS (CONTINUED)

(2) POST TEST CALCULATIONS

RELAP5:		ANALYSIS	DRAFT REPORT
* 320503:	COLD LEG DISCHARGE BREAK WITH LEAK ISOLATION	COMPLETED	ISSUED
340213:	1 SGTR, ONE LOOP COOLDOWN	COMPLETED	NOV. 1987
3801AA:	CORE UNCOVERY	IN PROGRESS	JAN. 1988
3502CC:	NON-CONDENSIBLE GASES	COMPLETED	NOV. 1987
320302:	COLD LEG SUCTION BREAK	COMPLETED	NOV. 1987
TRAC:			
3109AA:	COLD LEG DISCHARGE (10 CM**2) BREAK	COMPLETED	NOV. 1987
320201:	COLD LEG DISCHARGE (50 CM**2) BREAK	COMPLETED	NOV. 1987
3404AA:	10 SGTR, ISOLATED SG	IN PROGRESS	MAR. 1988
330302:	FEED & BLEED, DELAYED HPI	COMPLETED	MAR. 1988

FIG. 4

C. COUNTERPART PROGRAMS STATUS

UMCP 2x4 LOOP

TESTS CONDUCTED:

- 5 SINGLE-PHASE NATURAL CIRCULATION TESTS
- 13 BOILER CONDENSER MODE TESTS
- 1 STEAM GENERATOR MAPPING TEST
- 5 HPI EFFECTS TESTS
- 5 SBLOCA (NO AFW, NO HPI)

SCHEDULE:

APRIL-JUNE, 1987 - INSTALLATION OF DAS AND ASSOCIATED SOFTWARE.

JULY-SEPT., 1987
- CONDUCT SINGLE- AND TWO-PHASE NATURAL CIRCULATION TESTS
- ADDITIONAL SBLOCA (NO AFW, NO HPI)
- PUMP CHARACTERIZATION TESTS (SINGLE-PHASE)

OCT.-DEC., 1987
- HPI EFFECTS
- AUXILIARY FEEWATER EFFECTS
- FINISH PUMP CHARACTERIZATION

FIG. 5

TEST COMPLETED AS OF NOVEMBER 1987

	Test No.	Power	Break size	Sec. Level	Initial Cond.	Comments
*	BCM121886	140 KW	1/8 "	75%	SYMMETRIC	
*	BCM121986	140 KW	1/8 "	75%	SYMMETRIC	
*	BCM071587	141-30 KW	1/8 "	50%	SYMMETRIC	Power Drop Test
	BCM071687	141-30 KW	1/8 "	50%	SYMMETRIC	Repeat of BCM071587
*	BCM073187	141 KW	1/8 "	50%	SYMMETRIC	
*	BCM091587	141 KW	1/8 "	75%	SYMMETRIC	
*	BCM091787	141 KW	1/8 "	50%	ASYMMETRIC	
*	BCM092287	141 KW	1/16 "	50%	SYMMETRIC	
*	BCM092487	141 KW	1/16 "	50%	ASYMMETRIC	
*	BCM100687	141 KW	1/8 "	50%	ASYMMETRIC	Repeat of BCM091787
*	BCM100887	141 KW	1/8 "	75%	SYMMETRIC	Repeat of BCM091587
*	BCM101387	141 KW	1/8 "	50%	SYMMETRIC	Repeat of BCM073187
*	BCM101587	141 KW	1/8 "	75%	ASYMMETRIC	
*	HPI102087	160 KW	1/8 "	50%	SYMMETRIC	HPI on at loop saturation
*	HPI102287	152 KW	1/8 "	50%	SYMMETRIC	HPI on at IRM
*	HPI110487	153 KW	1/8 "	50%	SYMMETRIC	HPI on at loss of sink
*	HPI110687	154 KW	1/8 "	50%	SYMMETRIC	HPI on at BCM
*	HPI110987	153 KW	1/8 "	50%	SYMMETRIC	Repeat of HPI110487
*	ITL031287	132 KW	1/8 "	40%	ASYMMETRIC	Scoping test
*	ITL031887	132 KW	1/8 "	40%	ASYMMETRIC	Repeat of ITL031287
* *	ITL080587	168 KW	1/8 "	50%	SYMMETRIC	
*	ITL080787	168 KW	1/8 "	50%	SYMMETRIC	Repeat of ITL080587
*	ITL081487	168-80 KW	1/8 "	50%	SYMMETRIC	Power drop test
	SNC072987	160 KW	N/A	50%	ASYMMETRIC	Asymmetric to symmetric
*	STP111187	141 KW	1/8 "	50%	SYMMETRIC	Stepwise test: system frozen for three windows i.e., IRM, LOS, & BCM

NOTE: * STANDARD TEST REPORT (STR), ** DATA TRANSFER REPORT (DTR)
ALL HPI AND STP TESTS WERE RUN WITHOUT PRESSURIZER

FIG 6.1

C. COUNTERPART PROGRAMS STATUS (CONTINUED)

UMCP 2x4 LOOP

SCHEDULE (CONTINUED)

DEC.,1987-MAR.,1988 - INSTALLATION OF PUMPS
- STEAM GENERATOR INSTRUMENTATION FOR AFW
- RVVV MODIFICATION

FROM MARCH, 1988 - SBLOCA WITH HPI/AFW
- PUMP BUMPS
- RVVV EFFECTS

FIG 7

COUNTERPART PROGRAMS STATUS (CONTINUED)

[B]ATTELLE-NORTHWEST RESEARCH INSTITUTE 2 FACILITY

TESTS CONDUCTED:

- 2 SINGLE-PHASE NATURAL CIRCULATION TESTS
- 3 TWO-PHASE NATURAL CIRCULATION TESTS
- 1 SMALL-BREAK LOCA
- 2 COUNTERPART MAPPING TEST

ADDITIONAL TEST(S) MAY BE CONDUCTED AT THE BEGINNING OF CY 1988.

FIG 8

E. PHASE-IV PROGRAM

PLAN TO CONDUCT 8 ADDITIONAL TESTS:

(1) SBLOCA w/o HPI (ATOG COOLDOWN, 10 CM^2 CLD)
(2) SBLOCA w/o HPI (SAME AS (1), BUT 30-35 MINS. INTO THE TRANSIENT, INITIATE RAPID BLOWDOWN OF SG)
(3) CRYSTAL RIVER PLANT TRANSIENT 6-16-81 COUNTERPART
(4) RANCHO SECO PLANT TRANSIENT 12-26-85 COUNTERPART
(5) ADDITIONAL SCALING TRANSIENT PROPOSED BY B&WOG
(6) STATION BLACKOUT (80 GPM TOTAL LEAK, 1/2 CAPACITY AFW TO BOTH SGs)
(7) INTERMEDIATE SIZE BREAK (100 CM^2 CLD)
(8) SERIES OF SG STEADY STATE TESTS (AFW SENSITIVITY STUDY)

TOTAL COST IS ESTIMATED AT $2 MILLION. B&WOG JOINED IN THE COOPERATIVE EFFORT IN FY 88. IN FY 88, COST SHARE BETWEEN INDUSTRY AND NRC IS APPROXIMATELY 50-50 SPLIT.

FIG. 9

OTSG Program Plan and Status

ONCE THROUGH STEAM GENERATOR (OTSG) SEPARATE EFFECTS TESTING

OBJECTIVES:

TO OBTAIN OTSG THERMAL HYDRAULIC DATA FOR TRANSIENTS THAT INITIATED FROM FULL POWER CONDITIONS.

TO ASSESS THE AFFECT OF AFW MODELLING ON PLANT TRANSIENT PREDICTIONS AND ADDITIONAL DATA NEEDS.

NRC/INDUSTRY JOINT EFFORT

- NRC AND THE INDUSTRY REACHED AN AGREEMENT TO FORM A TECHNICAL ADVISORY GROUP (TAG) TO INVESTIGATE THE TECHNICAL ISSUES AND DATA NEEDS TO FURTHER THE UNDERSTANDING OF THE OTSG BEHAVIOR UNDER TRANSIENT AND ACCIDENT CONDITIONS.

- TAG WILL IDENTIFY DEFICIENCIES IN EXISTING OR PLANNED EXPERIMENTAL DATA BASE, AND RECOMMEND MEANS (INCLUDING TESTING) TO RESOLVE THESE DEFICIENCIES.

- TAG EFFORT IS SCHEDULED TO TERMINATE BY AUGUST, 1988.

F12-A

OTSG PROGRAM PLAN AND STATUS (CONTINUED)

NEAR TERM OTSG-AFW ACTIVITIES (FY 1988)

- VISUAL AFW EXPERIMENT AT INEL:
  TESTING WILL BE COMPLETED BY DECEMBER 1987.

- AFW MODEL WILL BE DEVELOPED AND IMPLEMENTED IN RELAP5.

  ASSESS RELAP5 CODE AGAINST MIST, SAIC, OCONEE SG, AND TMI SG DATA.

- ASSESSMENT OF THE AFFECT OF AFW MODELLING ON PLANT TRANSIENT PREDICTIONS.

  CODES USED FOR ASSESSMENT: TRAC-PF1/MOD1 AT LANL
  RELAP5 AT INEL

  TRANSIENTS CONSIDERED: STEAM LINE BREAK
  LOSS-OF-FEEDWATER
  PRIMARY OVERCOOLING
  SBLOCA

FIG. 11

VISUAL OTSG TEST AND ANALYSIS (A6855)

PURPOSE: TO PROVIDE THERMAL-HYDRAULIC DATA OF WETTING OF TUBE WALLS AND FLOODING AT TUBE SUPPORT PLATES BY AUXILIARY FEEDWATER (AFW) IN A B&W OTSG.

STATUS:

(A) AIR-WATER SINGLE TUBE ADIABATIC
(B) STEAM-WATER SINGLE TUBE HEATED
AIR-WATER MULTI-TUBE ADIABATIC

(A) AIR-WATER SINGLE TUBE ADIABATIC

- EXPERIMENTS COMPLETED
- OBTAINED LOSS COEFFICIENT AND FLOODING CURVE

(B) STEAM-WATER SINGLE TUBE HEATED

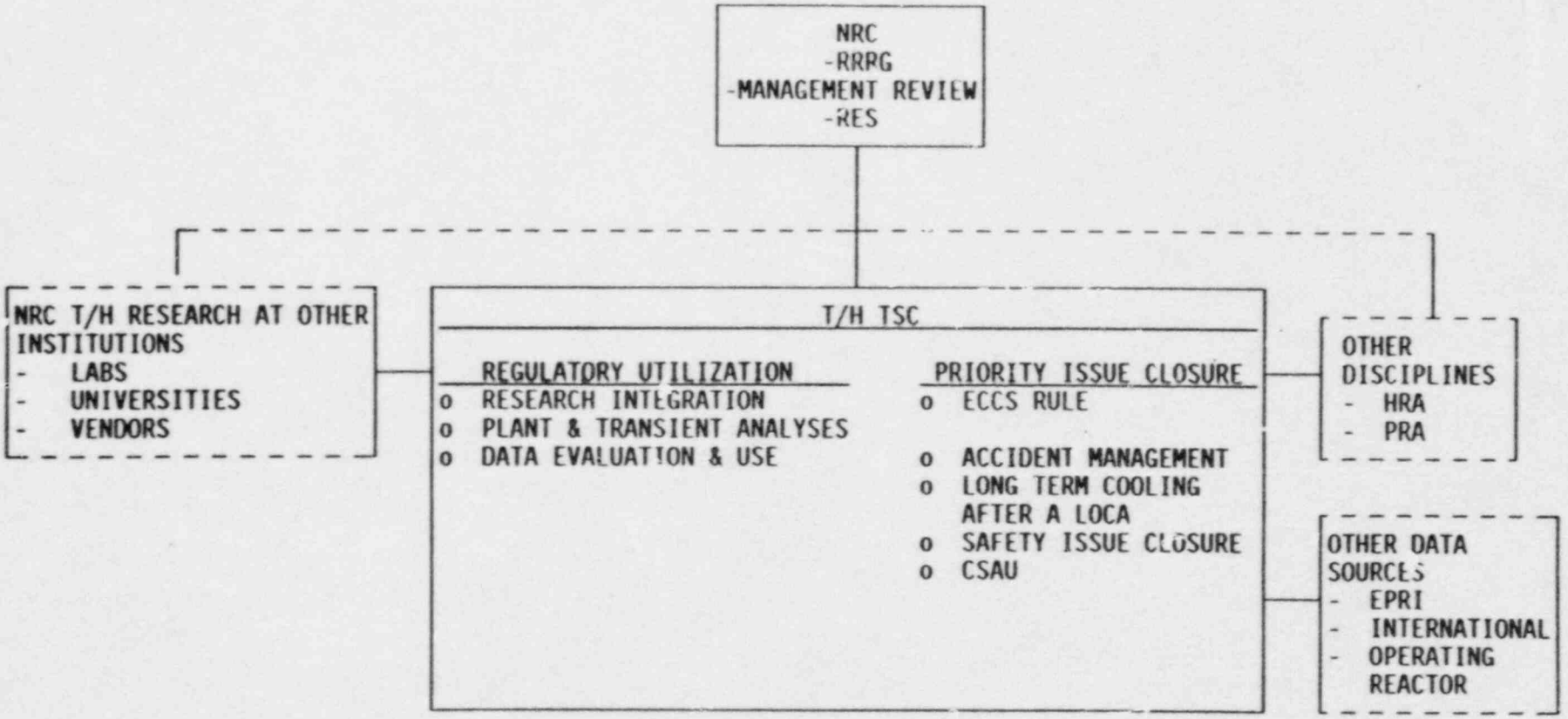
- ONGOING
- PRIMARILY INFORMATION ON HEAT TRANSFER DATA AND HYDRAULIC (FALLING FILM - RIVULET TRANSITION FLOW RATES) WERE OBTAINED.

(C) AIR-WATER MULTI-TUBE ADIABATIC

- 625 TUBES, 1/8 SECTOR OF AN OTSG, THREE TUBE SUPPORT PLATES.
- PRIMARILY INFORMATION ON AFW FLOW DISTRIBUTION (WITH AND WITHOUT UPWARD AIR FLOW), FLOODING CURVES, LOSS COEFFICIENTS WERE OBTAINED.

ALL EXPERIMENTS WILL BE COMPLETED BY DECEMBER, 1987.

Fig. 12



STRUCTURE, ROLE AND INTERACTIONS OF T/H TSC

Fig. 13

ECC RULE SUPPORT

OBJECTIVE: TO ASSIST NRC IN PREPARATION OF ECCS RULE SUPPORTING DOCUMENTATION, ESPECIALLY THE COMPENDIUM

FY 87 ACCOMPLISHMENTS:

- O ASSISTED NRC IN PREPARATION OF COMPENDIUM
  - GRAPHICS SUPPORT
  - CLERICAL SUPPORT

FY 88 PLANS

- O INCORPORATE COMMENTS IN COMPENDIUM
- O CLERICAL SUPPORT ON COMPENDIUM
- O AUTOMATED REFERENCE RETRIEVAL AND SORT SYSTEM

FE16.14

ACCIDENT MANAGEMENT

OBJECTIVE: DEFINE RECOVERY OPTIONS FOR POSTULATED ACCIDENT SCENARIOS

FY 87 ACCOMPLISHMENTS:

- SCOPING EVALUATION OF RV VENTING TO REDUCE DIRECT CONTAINMENT HEATING
- PRESENTATION TO RES MANAGEMENT OF COMPREHENSIVE ASSESSMENT OF ACCIDENT PREVENTION AND MANAGEMENT OPTIONS AND RECOMMENDED RESEARCH PLAN

FY 88 PLANS

- COMPLETED EVALUATION OF RV VENTING AND PUBLISH RESULTS
- INITIATE ADDITIONAL STUDIES AS REQUESTED BY NRC

FY 87

LONG TERM COOLING

OBJECTIVE: DETERMINE SAFETY SIGNIFICANCE, LIKELIHOOD AND CONSEQUENCE OF POSTULATED LOOP SEAL IN WESTINGHOUSE PLANTS AFTER LBLOCA

FY 87 ACCOMPLISHMENTS:

- DEMONSTRATED CREDIBILITY OF POSTULATED SCENARIO

FY 88 PLAN:

- PERFORM ENGINEERING ANALYSES USING SYSTEMS CODES AND SIMPLIFIED ANALYSES AS APPROPRIATE

- DOCUMENT ENGINEERING ANALYSES OF CONTROLLING PHENOMENA AND PLANT RESPONSE

FIG 16

B&W SAFETY EVALUATION

OBJECTIVES:

- TO PROVIDE NRC WITH INDEPENDENT ASSESSMENT CAPABILITY FOR B&W PLANT CHANGES
- TO DEMONSTRATE THE USE OF MULTIDISCIPLINARY METHODS FOR ISSUE RESOLUTION

FY 87 ACCOMPLISHMENTS

- BASIC STUDY COMPLETED
- DRAFT STUDY RESULTS PROVIDED TO NRC STAFF ON SCHEDULE BY 5/1/87
- DRAFT NUREG REPORTS SUBMITTED FOR REVIEW AND COMMENT

FY 88 PLANS

- ISSUE NUREG IN NOVEMBER/DECEMBER

FIG. 17

SHORT TERM EVALUATION STUDIES

OBJECTIVES: TO PROVIDE RAPID TURN AROUND SCOPING EVALUATION OF SAFETY ISSUES, E.G. BY

(A) LITERATURE REVIEWS AND SUMMARY

(B) SIMPLIFIED ANALYSES

(C) HISTORICAL DATA INSIGHTS

FY 87 ACCOMPLISHMENTS

- SCOPING EVALUATION OF LONG TERM COOLING ISSUE
- SCOPING EVALUATION OF REACTOR VESSEL VENTING TO REDUCE DIRECT CONTAINMENT HEATING

FY 88 PLANS

- SCOPING EVALUATION AS NEEDED AND AGREED UPON BY NRC

FIG. 18

CSAU

OBJECTIVE: ESTABLISH THE APPLICABILITY AND UNCERTAINTY ASSOCIATED WITH RELAP5 AND TRAC-PWR ANALYSES OF SPECIFIED PLANT TRANSIENTS

FY 87 ACCOMPLISHMENTS:

- COMPLETED APPLICABILITY ASSESSMENT OF RELAP5 TO ANALYSIS OF LOSS OF FEEDWATER ACCIDENTS IN B&W PLANTS
- PROVIDED DRAFT NUREG FOR STAFF REVIEW AND COMMENT

FY 88 PLANS

- PUBLISH LOF APPLICABILITY REPORT
- COMPLETE AND PUBLISH RESULTS OF RELAP5 APPLICABILITY TO SBLOCAS IN B&W PLANTS

FIG. 12

OVERALL CONCLUSIONS

- FEED & BLEED IS VIABLE OPTION FOR DECAY HEAT REMOVAL IN PWRs WITHIN PLANT DESIGN LIMITS
- PHYSICS OF FEED & BLEED EXPERIMENTS ARE WELL REPRESENTED BY TRAC AND RELAP, PROVIDING CONFIDENCE IN APPLICATION OF CODES TO PLANT ANALYSES
- THE RELIABILITY OF OPERATOR RESPONSE TO IMPLEMENT FEED AND BLEED HAVE NOT BEEN EVALUATED AND THIS COULD BE A MAJOR CONSIDERATION
  - COMPETING ATTEMPTS TO INITIATE FEEDWATER
  - RESULTANT CONTAMINATION/CLEANUP POSSIBILITIES

FIG. 20

2. Sufficient process inst. to understand T/H phenomena

11/19/87
DAW

Items that might be included in an ACRS letter making recommendations on TH research:

1] Need for better understanding of the feed and bleed process. This is often tossed out as a generality, but what more specifically needs doing?. We might consider what Glenn Reed has proposed in his draft letter.

I can see where there might be two specific subissues:
a] Need to better understand how reliably PORVs will perform in the range of conditions during F&B. EPRI tests of some years ago indicated there might be problems. There might be a particularly difficult challenge to those valves that are supposed to cycle open and closed, as in W plants.

Even though there is no specific regulatory requirement for F&B and use of PORVs in this way, the process is being counted on to contribute to the safety performance of most PWRs.

* — b] There might be a need to include in the MIST series tests which simulate opening the PORV without immediate supply of flow from HPI or MUP. This might be of particular importance for the Davis-Besse configuration.

c. ~~Prob~~ Implications of raising RCS pressure to F&B and extended

2 3] The DBAs now considered in the SAR could be updated to reflect experience of the last 25 years. There are two kinds of experience to be considered; 1] direct experience with transients and operating events that have actually occurred at plants, 2] what has been learned about contributers to risk from PRA, SA studies, and other analytical work.

This is applicable directly to only new LWRs, but there could be some eventual benefit opposite new issues that might arise with existing plants.

3 4] Another new reactor issue is whether existing codes and the existing body of experimental information are completely adequate for the eventual complete licensing and safety evaluation that will be required for future LWRs. Given that these LWRs, while not drastically different from the present generation, will have some changes. The NRC Staff does not seem to be taking this issue seriously, suggesting that present PDA applications are just for "paper reactors". I have concern that the vendors and future applicants are expecting more surety from the PDA process than this

F16 21

attitude seems to indicate is going to be provided by the present review process.

4 5] Should the TSCs be required to have a full-time manager for NRC responsibilities.

5 6] Is/should the originally planned SRI-II and MIST counterpart test be completed?

6 7] Should there be a MIST counterpart test in the UPTF given the fact that the NRC had the foresight to have UPTF include RVVVs in the core barrel?

7 8] Should code development work continue with the ICAP effort to produce TRAC-PF/MOD2 and RELAP5/MOD3 by June 1989? Or will that really drag on to 1992? And should code development stop today; using RELAP5/MOD2 and abandoning TRAC-PF to any who want to continue to play with it?

Has the decision point on diminshing returns been reached, passed, or is it being just now approached?

Is the planned code development work appropriate~~ly~~ considering what might be learned from CSAU rather than just the pressures from more traditional code assessment activities [like ICAP]?

8 9] Are BWRs getting enough attention in code development and assessment work? Are there really fewer TH problems with BWRs than with PWRs, or is there some accident of history operating?

9 10) Water hammer; what is the issue? We all know pipes & parts will break. Nuclear plants have 'redundant' systems to provide for this. Should we be worried because —

a) WH ~~failures~~ greatly increases frequency of failures?

b) WH tends to cause failures in all redundant trains at the same time?

c) WH will tend to cause unexpected & complicating failures in transients triggered by other causes? #16-2