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ACRS Subcommittee Meeting Summary/Minutes
For Severe Accidents
March 7, 1989
Bethesda, Maryland

Purpose

The ACRS Subcommittee on Severe Accidents met on March 7, 1989 in Bethesda, Maryland. The purpose of this meeting was to discuss the NRC Staff's proposed Severe Accident Research Program (SARP) Plan. Copies of the agenda and selected slides from the presentation are attached. The meeting began at 8:30 a.m. and adjourned at 11:58 a.m. and was held entirely in open session. The principal attendees were as follows:

Attendees

ACRS	NRC/RES
W. Kerr, Member	B. Sheron
I. Catton, Member	F. Costanzi
C. Siess, Member	N. Zuber
D. Ward, Member	R. Meyer
P. Davis, Consultant	
D. Houston, Staff	

Review Document

The principal document for discussion at this meeting was:

Memorandum dated February 10, 1989, from Brian W. Sheron, Division Director, Office of Nuclear Regulatory Research, to Forrest J. Remick, Chairman, ACRS, "Revised Severe Accident Research Program Plan (Attached draft SARP plan predecisional).

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DESIGNATED ORIGINAL

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Actions, Agreements, and Commitments

(1) On the basis of the preliminary review, the Subcommittee agreed that the program plan was a positive step and that a Committee letter could be drafted for consideration at the March 9-11, 1989 meeting.

(2) In response to I. Cattor's remarks, the Staff agreed to look at Meiner's work of 15 years ago on the convection process inside a heated crucible.

Discussion

In his opening remarks, W. Kerr indicated that the Subcommittee had not had sufficient time for a thorough review of the draft Severe Accident Research Program (SARP) Plan, but that on the basis of his preliminary review, he believed that the plan had a number of positive aspects. He expressed a view that there was an undesirable emphasis on direct containment heating (DCH) and that the schedule and resource allotment were overly optimistic. He cautioned the Staff not to refer to SECY-88-147 as an integration plan since previous reviews and a Committee letter had found or stated that there was little integration displayed in that plan.

C. Siess asked the Staff to clarify the various parts of the SARP plan, i.e., short-term, long-term, new vs. original. The short-term part appeared to be those items of importance while the long-term closely resembled the original plan to find out everything about everything.

B. Sheron (RES) discussed the historical background of the Severe Accident Research Program (SARP) Plan and how it had been recently redirected. The redirection was mainly to reduce the number of independent programs in the field of study and to attempt to integrate the on-going programs. The near-term SARP activities are concerned with

scenarios and phenomena that can lead to early containment failure. The longer-term SARP activities will address other phenomena important to severe accidents. He discussed the overall objectives of the program and indicated what areas of study would be emphasized.

F. Costanzi (RES) discussed the details of the near-term program indicating (for each issue) the specific questions to be addressed, the task breakdown for each question and some comments received on the draft SARP plan in each area. The five issues for the near-term program were given as: (1) Scaling Analyses, (2) Depressurization and DCH, (3) BWR Mark I Containment Shell Melt-Through, (4) Adding Water to Degraded Core, and (5) The Use and Status of Severe Accident Codes. He briefly discussed the long-term program which included: (1) Modeling of Severe Accident Phenomena, (2) Core Melt Progression and Hydrogen Generation, (3) Fuel-Coolant Interaction, (4) Core-Concrete Interaction, (5) Fission Product Behavior, and (6) Fundamental Data Needs.

N. Zuber (RES) briefly discussed the increased emphasis on scaling rationale for experiments. He indicated that this effort would be similar to the Code Scaling, Applicability, and Uncertainty (CSAU) methodology which was recently developed for the evaluation of thermal-hydraulic codes.

During the presentation, various aspects of the draft SARP plan were discussed and the following comments and concerns were expressed (random order):

(1) The priority and designation of the near-term and long-term issues was questioned. The modeling of severe accident phenomena seemed to be of immediate interest rather than for sometime in the future.

(2) The effort and funding (70% of total funds) devoted toward the phenomena of DCH appeared to be excessive. The Subcommittee

believed that more effort should be devoted toward making this problem go away by studying modifications to plant equipment or revisions of operating procedures.

(3) The Subcommittee agreed with the efforts to redirect the program and expressed a concern that the Staff not bow to any opposition that they are likely to encounter.

(4) The integration of this program into other RES activities was discussed and a question of who was responsible for this aspect was asked. It appears that this is still a weak area, integration being performed on an ad hoc basis.

(5) The Staff was asked why they have not applied the results for natural circulation (in-vessel) as presented by EPRI and INEL. The Staff indicated they would take another look at it.

(6) A concern was expressed that there is a lack of coupling between the front-end and back-end and between accident sequences and uncertainties in the consequence assessment.

Future Subcommittee Action

W. Kerr indicated a further detailed review of the final SAPP plan would be appropriate, as well as, a continuing review of the program as it progresses.

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NOTE: Additional meeting details can be obtained from a transcript of this meeting available in the NRC Public Document Room, 2120 L Street, N.W., Washington, D.C. 20006, (202) 634-3273, or can be purchased from Heritage Reporting Corporation, 1220 L Street, N.W., Suite 600, Washington, D.C. 20005, (202) 628-4888.

ACRS Subcommittee Meeting on
Severe Accidents
March 7, 1989
Bethesda, Maryland

- Proposed Agenda -

A.	Subcommittee Chairman Remarks	W. Kerr	8:30 am
B.	Introduction and Goals of Severe Accident Research Plan	B. Sheron	8:45 am
C.	Meeting Near-Term Goals	F. Costanzi	9:15 am

Issue 1: Scaling Analyses
Issue 2: Depressurization and DCH
Issue 3: BWR Mark I Containment Shell Meltthrough
Issue 4: Adding Water to a Degraded Core
Issue 5: The Use and Status of Severe Accident Models (Codes)

*** Break *** 10:00-10:15 am

D.	Meeting Long Term Goals	F. Costanzi	10:15 am

1. Severe Accident Phenomena

Issue L1: Modeling Severe Accidents
Issue L2: In-Vessel Core Melt Progression and Hydrogen Generation
Issue L3: Fuel-Coolant Interactions (In-Vessel)
Issue L4: Molten Core-Concrete Interaction (MCCI)
Issue L5: Fission Product Behavior and Transport

2. Fundamental Data Needs

E.	Severe Accident Scaling Methodology (SASM)	F. Costanzi	11:15 am
F.	Subcommittee Discussion and Concluding Remarks	W. Kerr	11:45 am

*** Adjourn *** 12:00 pm (noon)

RES STAFF PRESENTATION TO THE ACRS CLASS 9 ACCIDENT SUBCOMMITTEE

ON

REVISED SEVERE ACCIDENT RESEARCH PROGRAM PLAN

BRIAN SHERON, DIRECTOR
DIVISION OF SYSTEMS RESEARCH
OFFICE OF NUCLEAR REGULATORY RESEARCH

FRANK COSTANZI, CHIEF
ACCIDENT EVALUATION BRANCH
DIVISION OF SYSTEMS RESEARCH
OFFICE OF NUCLEAR REGULATORY RESEARCH

MARCH 7, 1989

BACKGROUND

- ABOUT A YEAR AGO, STAFF RECOGNIZED THAT THERE WERE ABOUT A DOZEN OR SO PROGRAMS PROCEEDING SOMEWHAT INDEPENDENTLY THAT WERE RELATED TO SEVERE ACCIDENTS
- RELATIONSHIPS AND (HOPEFULLY) COORDINATION OF THESE ACTIVITIES WAS DEVELOPED AND DESCRIBED IN STAFF'S SEVERE ACCIDENT INTEGRATION PLAN (SECY 88-147)
- SEVERE ACCIDENT RESEARCH WAS A KEY ELEMENT OF THE PLAN AND A SUPPORTING ELEMENT OF THE CLOSURE PLAN
- ONE OF THE OBJECTIVES OF THE CLOSURE PLAN WAS TO ADDRESS GENERIC CONTAINMENT PERFORMANCE ISSUES. THESE ISSUES PRIMARILY FOCUS ON SCENARIO AND PHENOMENA THAT CAN LEAD TO EARLY CONTAINMENT FAILURE (HIGH RISK)
- RESEARCH PROGRAM WAS REFOCUSED TO ENSURE THAT SUFFICIENT RESEARCH WAS AIMED AT TRYING TO MAXIMIZE UNDERSTANDING OF PHENOMENA THAT DRIVE EARLY CONTAINMENT FAILURE. THIS IS REFFERED TO NEAR TERM PROGRAM.
- THE SEVERE ACCIDENT RESEARCH PROGRAM WILL RETAIN A LONGER-TERM ELEMENT AS WELL TO CONTINUE TO ADDRESS OTHER PHENOMENA IMPORTANT TO SEVERE ACCIDENTS.

OBJECTIVES

- DEVELOP A TECHNICAL BASE OF SEVERE ACCIDENT INFORMATION WHICH CAN BE USED IN ALL COMMISSION ACTIONS RELATED TO SEVERE ACCIDENTS
- DEVELOP A TECHNICAL BASE OF SEVERE ACCIDENT INFORMATION TO CONFIRM DISCUSSIONS RELATED TO SEVERE ACCIDENTS
- DEVELOP UNDERSTANDING OF MOST LIKELY PLANT RESPONSE TO SEVERE ACCIDENTS AND HELP ENSURE THERE ARE NO UNEXPECTED PHENOMENA THAT WILL CHANGE OUR PERCEPTION OF RISK

- IN ADDITION TO RESTRUCTING PROGRAMS INTO NEAR AND LONGER TERM ELEMENTS, PROGRAMS ALSO REVISED APPROACH TO RESEARCH METHODOLOGY
- SPECIAL, INCREASED EMPHASIS ON SCALING RATIONALE OF EXPERIMENTS. N. ZUBER WILL HEAD THIS UP
- INCREASED EMPHASIS IN UNDERSTANDING LATE PHASE CORE MELT BEHAVIOR. OBJECTIVE TO GET BETTER HANDLE ON EXPECTED AMOUNT, COMPOSITION, AND TEMPERATURE OF CORIUM THAT IS AVAILABLE FOR RELEASE FOR THE LOWER HEAD OF A LWR
- INCREASED EMPHASIS ON UNDERSTANDING EXPECTED LOWER HEAD FAILURE MODE
- INVESTIGATION OF THE STOCHASTIC NATURE OF SEVERE ACCIDENTS AND HOW IT MIGHT BE FACTORED INTO RESEARCH APPROACH
- SUCCESS IN CARRYING OUT ABOVE APPROACH HOPEFULLY WILL REDUCE LARGE UNCERTAINTIES IN EX-VESSEL BEHAVIOR AND REDUCE LARGE RANGE OF PARAMETERS CURRENTLY BEING STUDIED IN EX-VESSEL BEHAVIOR EXPERIMENTS
- STRUCTURES - NEAR TERM AND LONG TERM PROGRAMS ARE NOT TWO SEPARATE PROGRAMS IT IS ONLY TO IDENTIFY THOSE ISSUES THAT NEED TO BE RESOLVED IN THE NEAR TERM

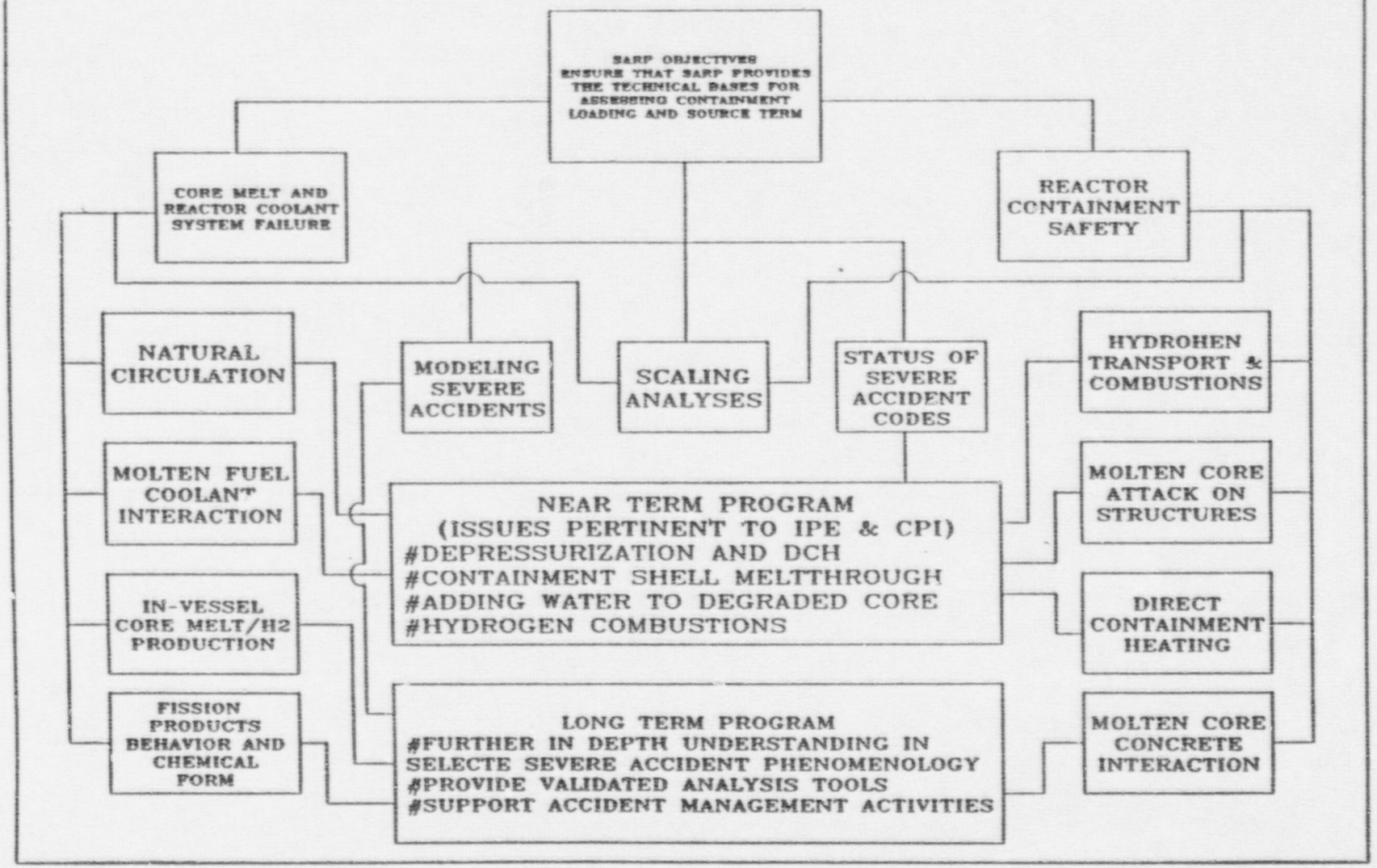
CODE DEVELOPMENT REVISIONS

- CODE DEVELOPMENT WILL BE SLOWED DOWN AND PUT ON A MORE STRUCTURED SCHEDULE (CONSISTENT WITH CURRENT APPROACH FOR T/H CODES)
- CODES WILL BE PROPERLY DOCUMENTED AND DEGREE OF QA ESTABLISHED
- NRC CURRENTLY SUPPORTS 4 CORE MELT PROGRESSION CODES (MELPROG-TRAC, RELAP-SCDAP, BWRSAR, MELCOR). NEED FOR THIS MANY CORE-MELT PROGRESSION CODES WILL BE ASSESSED, AND PROGRAM REVISIONS WILL BE MADE ACCORDINGLY.
- NEED FOR CODE IMPROVEMENTS WILL PROCEED ON A MORE STRUCTURED, DEPENDABLE BASIS. NEEDED IMPROVEMENTS WILL BE BETTER JUSTIFIED ON THE BASIS OF IMPORTANCE TO UNDERSTANDING BEHAVIOR (AND IMPORTANCE TO RISK?)
- AN ATTEMPT WILL BE MADE TO GET A BETTER HANDLE ON CODE ACCURACY CRITERIA. OBJECTIVE IS TO ELIMINATE ENDLESS CODE DEVELOPMENT WITH NO ESTABLISHED GOALS OF "HOW GOOD IS GOOD ENOUGH"
- PLANNING FOR THE "N+2" VERSION OF A CODE WHILE THE "N" VERSION IS STILL UNDER ASSESSMENT AND THE "N+1" VERSION NOT YET RELEASED WILL BE STOPPED. THE NEED FOR FUTURE REVISIONS OF CODES WILL BE PUBLISHED (ASSESSED INDEPENDENTLY)

MAJOR AREAS OF EMPHASIS IN NEAR TERM

- DIRECT CONTAINMENT HEATING
- MARK I LINER MELT THROUGH
- EFFECT OF WATER ON A MOLTEN CORE
- IMPACT OF IN-VESSEL STEAM EXPLOSIONS ON CORE MELT PROGRESSION
- CONTAINMENT FAILURE MODES FOR ICE CONDENSER CONTAINMENTS
- CONTAINMENT FAILURE MODES FOR MARK II (EX-VESSEL STEAM EXPLOSION)
- SCALING
- "ACCURACY" GOALS FOR CODES

REVISED SARP
NEAR AND LONG TERM PROGRAMS



2. GOALS OF THE REVISED SARP

- THE REVISED SARP PLAN:
  - o GOAL ORIENTED
  - o STRUCTURED TO FOCUS RESEARCH ON THOSE SEVERE ACCIDENT ISSUES NECESSARY TO ACHIEVE CLOSURE AS SET FORTH IN SECY 88-147

- NEAR TERM RESEARCH FOCUSES ON SEVERE ACCIDENT ISSUES THAT LEAD TO EARLY CONTAINMENT FAILURE:
  - DIRECT CONTAINMENT HEATING
  - BWR MARK I CONTAINMENT SHELL ATTACK
  - MOLTEN FUEL COOLANT INTERACTIONS IN BWR MARK II AND MARK III
  - HYDROGEN COMBUSTION IN BWR MARK III AND PWR ICE CONDENSER

- NEAR TERM RESEARCH ALSO SUPPORTS THE RESOLUTION OF BROADER, MORE GENERAL QUESTIONS REGARDING THE RESPONSE OF VARIOUS CONTAINMENT DESIGNS TO SEVERE ACCIDENTS

2. GOALS OF THE REVISED SARP (CONT.)

- LONG-TERM RESEARCH FOCUSES ON:
  - CONFIRMATION OF CLOSURE OF SEVERE ACCIDENT ISSUES,
  - DEVELOPMENT OF METHODOLOGIES FOR REGULATORY ASSESSMENT OF SEVERE ACCIDENT RISKS

- LONG TERM PROGRAM MUST HAVE FLEXIBILITY TO REPRIORITIZE ISSUES, DELETE ISSUES OR IDENTIFY ISSUES THAT NEED ATTENTION

- LONG TERM RESEARCH EFFORT WILL BE GUIDED BY STRIKING A BALANCE BETWEEN THE RISK IMPORTANCE OF THE ISSUE AND THE NEED TO REDUCE UNCERTAINTY

3. NEAR TERM OBJECTIVES
ISSUE 1 SCALING ANALYSIS

- THERE ARE SUBSTANTIAL NUMBERS OF ANALYTICAL AND TEST PROGRAMS TO ADDRESS THE SEVERE ACCIDENT ISSUES

- TO EXTRAPOLATE FROM SMALL SCALE EXPERIMENTS TO FULL SCALE NUCLEAR POWER PLANTS IT IS IMPORTANT TO SHOW:

  - DISTORTIONS OF SCALE ARE NOT IMPORTANT TO THE PROCESS UNDER INVESTIGATION

  OR DISTORTIONS ARE CHACTERIZED, UNDERSTOOD AND ACCOUNTED FOR WHEN USING CODES

ISSUE 2 - DEPRESSURIZATION AND DCH

SOME OF THE KEY QUESTIONS THAT WILL BE INVESTIGATED IN ORDER TO THE RISK ASSOCIATED WITH HIGH PRESSURE CORE MELT ACCIDENTS ALONG WITH AN ESTIMATE OF THE RISK REDUCTION THAT WOULD BE OBTAINED BY INTENTIONAL DEPRESSURIZATION, TAKING INTO ACCOUNT ANY INCREASE IN RISK ASSOCIATED WITH DEPRESSURIZATION:

A. WHAT IS THE LIKELIHOOD THAT THE RCS WILL FAIL BY NATURAL CIRCULATION PRIOR TO SIGNIFICANT DAMAGE AND SLUMPING OF THE CORE? (TASK 2.1)

B. IS THERE A LOW-PRESSURE CUTOFF BELOW WHICH THERE IS NO DCH THREAT? (TASK 2.2 AND 2.3)

C. IF SO, WILL THIS PRESSURE BE REACHED BY NATURAL CIRCULATION INDUCED FAILURE OF THE RCS, OR THROUGH OPERATOR ACTION TO DEPRESSURIZE, OR BOTH? (TASKS 2.1 AND 2.4)

D. IF OPERATOR ACTION IS NECESSARY, IS THERE TIME AVAILABLE FOR THIS ACTION? (TASK 2.2)

E. ARE THERE ADVERSE CONSEQUENCES TO DEPRESSURIZATION? (TASK 2.4)

F. WHAT IS THE NATURE OF THE DCH THREAT, AND WHAT MECHANISMS EXIST EX-VESSEL THAT WILL MITIGATE OR ELIMIATE IT? (TASKS 2.5 - 2.7)

ISSUE 2 - Depressurization and DCH

TASK 2.1
Evaluate current research program addressing challenges to containments.

TASK 2.2
Assess the likelihood of RCS structural failure by natural circulation.

TASK 2.3
Determine if there is a low-pressure cutoff for DCH.

TASK 2.4
Investigate the influence of cavity and containment compartment structures on DCH and hydrogen production.

TASK 2.5
Explore the feasibility of intentional RCS depressurization over the relevant spectra of PWR severe accident scenarios.

TASK 2.6
Determine the mode of bottom head failure of the reactor pressure vessel in a high-pressure sequence.

ISSUE 2 - Depressurization and DCH (Cont.)

TASK 2.7

Determine the likely range of quantity, composition, and timing of molten core material arriving on the bottom head of a PWR during a core melt accident at high and intermediate system pressures.

TASK 2.8

Use the results obtained in Tasks 2.3 and 2.4 and from the SURTSEY tests to upgrade DCH models in CONTAIN.

TASK 2.9

Investigate hydrogen combustion and detonation in high-temperature hydrogen- steam-air mixtures.

TASK 2.10

Perform depressurization cost/benefit analysis

ISSUE 2 - DEPRESSURIZATION AND DCH
COMMENTS RECEIVED AS OF 3/3/89

- LOW-PRESSURE CUTOFF IS SIMPLISTIC AND COULD BE MISLEADING: DISPERSAL IS MORE DIRECTLY RELATED TO THE FLOW VELOCITY OF RPV BLOWDOWN VIA AVAILABLE PATHWAY THAN THE RPV PRESURES
- ENTRAINMENT VS RPV PRESSURE HAVE BEEN DEVELOPED AT ANL UNDER EPRI SPONSORSHIP
- HYDRODYNAMIC INTERACTIONS OF MELT JET WITH WATER MELT BREAK UP AND QUENCHING, AND INTERACTION WITH CORE SUPPORT ASSEMBLY IMPORTANT TO ASSESS LOWER HEAD FAILURE
- GOAL SHOULD BE TO DEVELOP ANALYTICAL CAPABILITY, WITH GUIDANCE FROM EXPERIMENTS AT TWO SCALES FOR TWO DIFFERENT PLANTS (SURRY AND ZION) DCH FOR THESE TWO PLANTS WOULD BE MADE IN 2-3 YEARS ALONG WITH RESIDUAL UNCERTAINTIES. DCH MUST BE CONSIDERED PLANT-SPECIFIC.
- CONTAIN NEED FURTHER DEVELOPMENT
- CLEAR UNDERSTANDING OF WHAT WE HAVE ALREADY LEARNED DEVELOP NEW MODELS, AND RUN NEW EXPERIMENTS

ISSUE 2 - DEPRESSURIZATION AND DCH
COMMENTS RECEIVER AS OF 3/3/89

- A THROUGH FIRST PRINCIPLE INVESTIGATION OF THE NATURAL CIRCULATION PHENOMENA SHOULD BE PERFORMED AND UNCERTAINTIES IN CODE PREDICTION QUANTIFIED

- OVERRELIANCE ON NATURAL CIRCULATION TO MINIMIZE DCH

- NO SPECIFIC TASK TO INVESTIGATE THE EFFECT OF WATER ON DCH. NEED TO STUDY EFFECT OF WATER CONCURRENTLY WITH OTHER TASKS SINCE IT AFFECTS RCS DEPRESSURIZAION

- ANY ANALYSIS WITH RESPECT TO DEPRESSURIZATION SHOULD ALWAYS BE ASSESSED IN TERMS OF THE CURRENT STATE OF OPERATOR TRAINING AND DOMINANT ACCIDENT SEQUENCE ANTICIPATED

- DCH MODELS IN CONTAIN SUFFICIENT TO REPRESENT PLANT SPECIFIC GEOMETRIES AND NECESSARY EXPERIMENTS TO SUPPORT THEM SHOULD BE THE USEABLE OF TASKS 2-8

- DEVELOPMENT OF AN ENTAINMENT RATE CORRELATION MAY NOT BE POSSIBLE. WHAT IS NEEDED IS PHYSICAL, DYNAMIC MODEL

ISSUE 3 - BWR MARK I CONTAINMENT SHELL MELTTHROUGH

SPECIFIC QUESTIONS TO BE ADDRESED ARE THE FOLLOWING:

A. WHAT IS THE RELATIONSHIP OF THE BWR BOTTOM HEAD FAILURE MODE TO VARIATIONS IN QUANTITY, COMPOSITION, TEMPERATURE, AND TIMING OF ARRIVAL OF THE MELT ON THE BOTTOM HEAD? (TASK 3.1)

B. WHAT IS THE EFFECT OF WATER ON THE DRYWELL FLOOR WHEN THE MELT POURS OUT FROM THE PRESSURE VESSEL? (TASK 3.2)

C. HOW DOES THE ANSWER TO THE ABOVE QUESTION DEPEND ON THE INITIAL CONDITIONS (MELT EJECTION RATE, MELT SUPERHEAT, WATER SUBCOOLING, MELT COMPOSITION) AND WATER ADDITION RATE? (TASK 3.2)

D. UNDER WHAT CONDITIONS WOULD THE CRUST THAT FORMS AT INITIAL CONTACT BETWEEN THE MELT AND THE SHELL BE STABLE AND FOR HOW LONG? WHAT IS THE EXPECTED RATE OF HEAT TRANSFER BETWEEN THE CORE MELT MATERIALS AND THE SHELL FOR VARIOUS MELT CONDITIONS? (TASK 3.3)

ISSUE 4 - ADDING WATER TO A DEGRADED CORE

THE QUESTIONS TO BE ADDRESSED ARE THE FOLLOWING:

A. WHAT IS THE POTENTIAL FOR IN-VESSEL CORE-COOLANT INTERACTIONS SUFFICIENTLY ENERGETIC TO CHALLENGE UPPER INTERNALS OR OTHERWISE SIGNIFICANTLY ALTER THE ACCIDENT PROGRESSION (TASKS 4.1 AND 4.3)

B. WHAT IS THE HYDROGEN GENERATION RATE DURING MELT RELOCATION? (TASK 4.2)

C. IS THERE A POSSIBILITY OF RECRITICALITY IN SEVERE CORE DAMAGE ACCIDENTS? IF SO, WHAT WILL BE THE CONSEQUENCES? (TASKS 4.4)

ISSUE 5 - THE USE AND STATUS OF SEVERE ACCIDENT MODELS

AS PART OF THE CODE DEVELOPMENT PROGRAM, A METHOD MUST BE DEVELOPED THAT CONSTANTLY ASSESSES THE STATE OF CODE DEVELOPMENT FROM A NUMBER OF STANDPOINTS. THESE ARE:

A. HOW WELL DO THE MECHANISTIC MODELS REFLECT THE PHENOMENA BELIEVED TO BE IMPORTANT TO SEVERE ACCIDENTS?

B. HOW WELL DOES THE INTERACTIVE PROGRAM OF CODE ADVANCEMENT/EXPERIMENTATION ACHIEVE THE OBJECTIVE IMPLIED IN A. ABOVE

C. IS THE LEVEL OF DETAIL IN THE CODES APPROPRIATE TO THEIR USE? ARE SOME CODES MORE DETAILED THAN NEEDED, OTHERS NOT DETAILED ENOUGH?

D. WHICH STAGES OF AN ACCIDENT NEED TO BE MODELED BY DETAILED MECHANISITIC CODES, AND WHICH NEED COUPLING TO ADJACENT STAGES?

E. ARE THE EXPERIMENTAL AND CODE DEVELOPMENT EFFORTS SYNCHRONIZED?

F. IS THE LEVEL OF ACCURACY NEEDED FOR REGULATORY USE BEING CONSIDERED IN THE CODE DEVELOPMENT PROGRAMS?

G. IS THE LEVEL OF ACCURACY NEEDED FROM A GIVEN CODE CONSISTENT WITH THE EXPECTED OVERALL LEVEL OF ACCURACY REQUIRED OF AN INTEGRATED ANALYSIS PACKAGE FOR APPLICATIONS AS DISCUSSED ABOVE (E.G., ACCIDENT MANAGEMENT)?

4. LONG TERM OBJECTIVES

- DIRECTED AT
  - REDUCING UNCERTAINTIES IN ESTIMATE OF RISK
  - BROADLY BASED SEVERE ACCIDENT RESEARCH PROGRAM

1. REVIEW OF THE SARP APPROACH TO MODELING SEVERE ACCIDENT PHENOMENA
2. IN-VESSEL CORE MELT PROGRESSION AND HYDROGEN GENERATION
3. FUEL COOLANT INTERACTION (IN-VESSEL)
4. MOLTEN CORE-CONCRETE INTERACTIONS
5. FISSION PRODUCT BEHAVIOR AND TRANSPORT
6. FUNDAMENTAL DATA NEEDS

Long Term Research

ISSUE L1
Modeling Severe Accidents

ISSUE L2
In-Vessel Core Melt Progression and Hydrogen Generation

ISSUE L3
Fuel-Coolant Interactions (In-Vessel)

ISSUE L4
Molten Core-Concrete Interaction (MCCI)

ISSUE L5
Fission Product Behavior and Transport (Ex-Vessel)

ISSUE L6
Fundamental Data Needs