ACRS-2589

CERTIFIED

DATE ISSUED: 8/13/88

ACRS Subcommittee Meeting Summary/Minutes
For the Severe Accidents
July 13, 1988
Washington, D.C.

Purpose

The ACRS Subcommittee on Severe Accidents met on July 13, 1988. The purpose of this meeting was to discuss the staff's integration plan for closure of severe accident issues (SECY-88-147). Copies of the agenda and selected slides from the presentation are attached. The meeting began at 9:00 a.m. and adjourned at 4:20 p.m., and was held entirely in open session. The principal attendees were as follows:

Attendees

ACRS

W. Kerr, Chairman
C. Michelson, Member (p/t)
P. Shewmon, Member
C. Siess, Member
D. Ward, Member
C. Wylie, Member
I. Catton, Consultant
P. Davis, Consultant
J. Lee, Consultant
D. Houston, Staff

NRC/RES

T. Speis
B. Sheron
M. Cunningham
F. Eltawila

NRC/NRR

L. Shao
C. Thomas

Discussion

The principal document for discussion at this meeting was SECY-88-147, "Integration Plan For Closure of Severe Accident Issues," dated May 25, 1988. The NRC staff had previously discussed this document with the Commissioners on June 2, 1988. Copies of the document and excerpts from

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the transcript of the Commission meeting were provided to the Subcommittee Members and Consultants prior to this meeting.

In his opening remarks, W. Kerr commended the staff for working toward an integration plan but indicated that the plan, as written, was more a listing and description of those severe accident issues and programs that should be integrated. He indicated that it appeared the integration was yet to be formulated.

T. Speis (RES) discussed the severe accident integration plan, its purpose, objectives and elements. He stated that the cardinal part of this plan was to define the issues and their inter-relationships and to structure a research program to address these issues. He briefly described the current state of technology in regard to past studies and real accidents, risk significant sequences, severe accident research, containment loads/performance, source terms, regulations and outstanding issues. He gave some details for the study of containment loads and relative probabilities of failure modes for the general containment types. He also briefly discussed the severe accident research programs.

B. Sheron (RES) discussed the proposed generic letter for Individual Plant Examinations (IPEs). He discussed the major changes made to the letter since the last Subcommittee review of the proposed generic letter in April 1988. One major change was that no major containment modifications would be required until the information associated with generic issues which affect containment performance had been developed by the staff. Another key change in the letter was the emphasized request that each licensee use its staff to the maximum extent possible in conducting the IPE. He discussed the methods of analysis for the IPE and the benefits of doing a PRA or ISAP. While the staff believes the PRA or ISAP is the preferred route to go, they will not make it a requirement. In a 50.54(f) letter, the information requested can be specified but

the methodology can not. The staff is preparing a review document which provides guidance for reviewing IPEs. This document will be discussed with CRGR and ACRS at future meetings and with utilities, industry and the public at a future workshop. Based on comments received, the document will be revised and then issued in final form. The schedule for utility response and participation will not start until the final document is issued.

M. Cunningham (RES) presented an overview of the efforts underway to develop a final NUREG-1150. He briefly discussed the objectives of and improvements in the final report. He discussed the role of expert judgment, process for use of experts and the composition of panels. He indicated that 10 source term code package (STCP) runs had been performed per plant versus 6 runs for the draft analysis. External events would be treated in the analysis of Surry and Peach Bottom. The LaSalle (RMIEP) study would not be finished until next fiscal year with the Babcock and Wilcox and Combustion Engineering plant analyses in two years or so.

L. Shao (NRR) briefly discussed the activities of the External Events Steering Group. The Group is coordinating efforts between the NRR/RES staff and NUMARC. Methodology for the treatment of external events is expected in about 18 months.

C. Thomas (NRR) briefly discussed the current status of ISAP II. He indicated that 12% of the utilities had expressed an interest in participating in ISAP II while 34% were not interested and the remainder were undecided. He stated that the IDCOR IPEM would not be suitable for ISAP.

T. Speis closed with a discussion of the severe accident closure process. This involved the completion of an IPE including improvements as appropriate, a commitment to develop and implement a framework for an

accident management program and the implemention of generic requirements from the containment performance improvements program.

During the presentation, Subcommittee Members and Consultants extensively discussed the staff's integration plan for closure of severe accident issues and the individual activities that fell within the plan. The following topics were pursued during the discussion (random order):

(1) Containment Performance - The staff was asked what is the measure of containment performance. If it is to be improved as indicated, how will these improvements be judged.

(2) Direct Containment Heating - Various concerns were expressed about the staff's treatment of direct containment heating, e.g. the assumptions made about 100% molten core discharge or the phenomena of melt expulsion occurring at all. The research program does not appear to be addressing this properly. The conclusion of the Kouts' report was discussed, that is, the expected resolution based on research is many years away, therefore, the probability of DCH should be made low by hardware changes or procedural measures.

(3) External Initiators - The analysis with the treatment of external initiators should be performed now and not be delayed for another 1½-2 years. The staff appears to have overlooked the significance of these events for the IPE program. They have been shown to be major contributors to risk in previous PRAs.

(4) NUREG-1150 - Concerns were expressed about the suitability of applying certain codes and models beyond the reactor conditions for which they were developed or validated. Also, the makeup of the expert panels was questioned and it would appear that certain experts were neither considered or consulted. It was strongly

suggested that the final version of NUREG-1150 be peer reviewed as part of the process to establish credibility.

(5) Definitions - The staff was asked to provide better definition or guidance in many years. Specifically, definitions were asked for terms such as: Severe Accident, Damaged Core, Core Damage, Core Melt, Vulnerabilities, Large Radioactive Release, Containment Performance, Containment Failure, and Containment Bypass.

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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., Suite 600, Washington, D.C. 20005, (202) 628-4888.

ACRS Severe Accidents Subcommittee Meeting
July 13, 1988
Washington, D.C.

- Tentative Presentation Schedule -

Integration Plan For Closure
of Severe Accident Issues

A.	Subcommittee Chairman Remarks	W. Kerr, ACRS	8:00 a.m.
B.	Discussion of SECY-88-147	T. Speis, RES et. al.	9:15 a.m.
	° Introduction and State of Technology	(Speis)	
	° Individual Plant Examinations	(Sharon)	
	° Containment Performance Improvements	(Speis)	
	~~° Improved Plant Operations~~		
	*** BREAK ***		10:45-11:00 a.m.
	° Severe Accident Research Program	(Speis)	
	° Accident Management	(Sharon)	
	° NUREG-1150, Reactor Risk Reference Document	(Cunningham)	
	° Generic Safety Issues	(Sharon)	
	*** LUNCH ***		12:30- 1:15 p.m.
	(Resume Discussion)	T. Speis, RES	
	° External Events	(Shao)	
	° Integrated Safety Assessment Program	(Thomas)	
	~~° Advanced Reactors~~		
	° Safety Goal Policy	(Speis)	
C.	General Discussion and Plans for Committee Presentation (7/14/88)	All	2:30 p.m.
D.	Adjourn		3:00 p.m.

ACRS SEVERE ACCIDENTS SUBCOMMITTEE

BRIEFING ON

SEVERE ACCIDENT INTEGRATION PLAN

THEMIS P. SPEIS
301/492-3710
OFFICE OF NUCLEAR REGULATORY RESEARCH
U.S. NUCLEAR REGULATORY COMMISSION
JULY 13, 1988

SEVERE ACCIDENT INTEGRATED PLAN

- PURPOSE: TO PRESENT STAFF'S PLAN FOR INTEGRATION AND CLOSURE OF SEVERE ACCIDENT ISSUES

- OBJECTIVES:

  - TO PROVIDE AN UNDERSTANDING OF THE STAFF ACTIVITIES THAT ARE UNDER WAY TO IMPLEMENT THE COMMISSION'S SEVERE ACCIDENT POLICY

  - TO ASSURE THAT THESE ACTIVITIES ARE CONSISTENT WITH THE COMMISSION'S POLICY AND STRATEGIC GOALS

  - TO ASSURE THAT THE STAFF ACTIVITIES ARE CONSISTENT AMONG THEMSELVES, HAVE A COMMON GOAL OF ULTIMATELY LEADING TO IMPROVED PLANT SAFETY, AND ARE PROPERLY COORDINATED AMONG THE RESPONSIBLE NRC ORGANIZATIONS

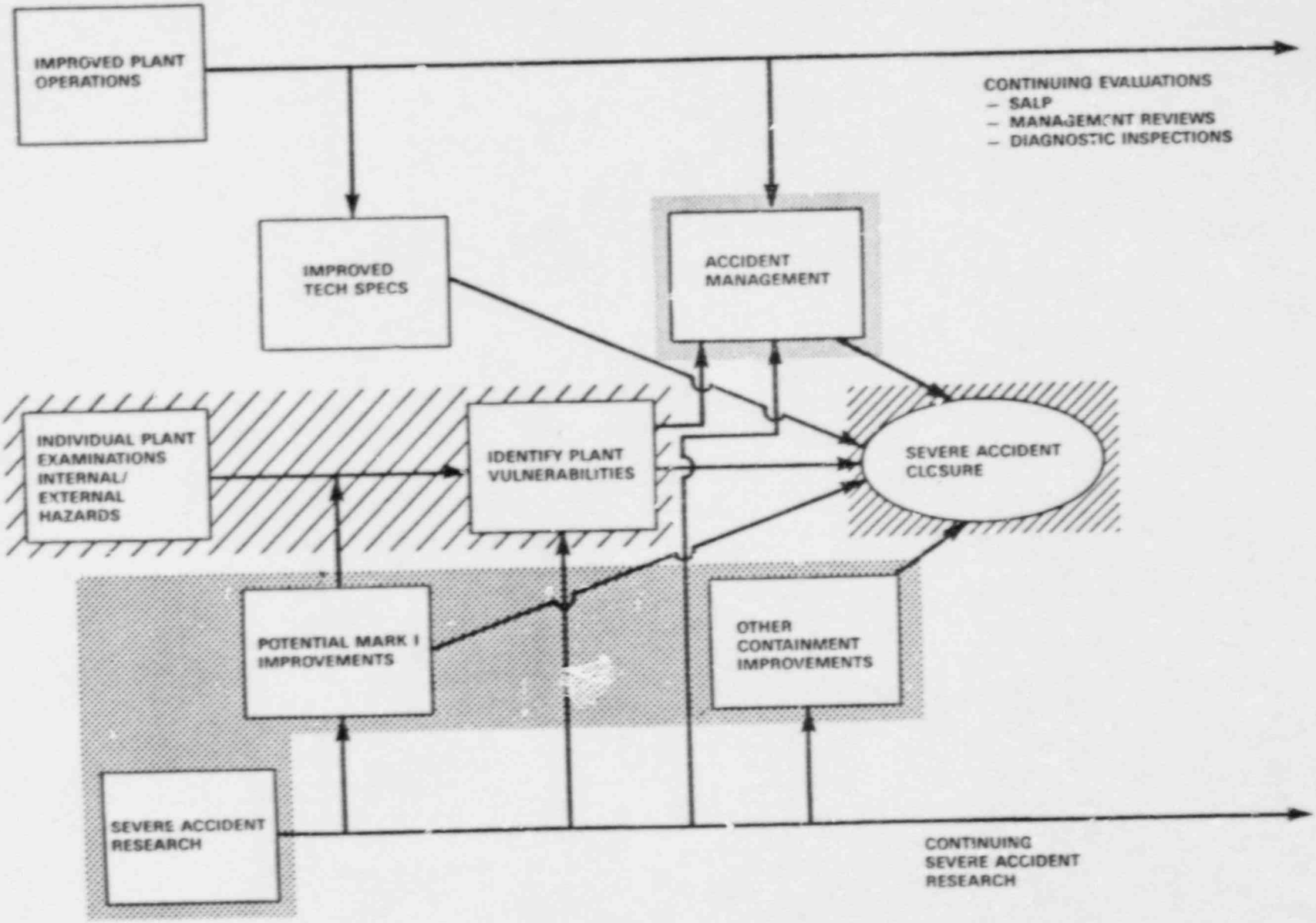
  - TO ASSURE THAT THE COMMISSION IS AWARE OF THE KEY TECHNICAL AND POLICY ISSUES, SOME OF WHICH WILL NEED COMMISSION GUIDANCE OR APPROVAL

  - TO DESCRIBE THE USE OF SAFETY GOALS AND BACKFIT POLICY IN THE CLOSURE PROCESS

SEVERE ACCIDENT ACTIVITIES

- INDIVIDUAL PLANT EXAMINATIONS (IPE)
- CONTAINMENT PERFORMANCE IMPROVEMENTS (CPI)
- IMPROVED PLANT OPERATIONS (IPO)
- SEVERE ACCIDENT RESEARCH PROGRAM (SARP)
- ACCIDENT MANAGEMENT (AM) PROGRAM
- NUREG-1150
- GENERIC SAFETY ISSUES
- EXTERNAL EVENTS
- INTEGRATED SAFETY ASSESSMENT PROGRAM (ISAP)
- SEVERE ACCIDENT POLICY FOR FUTURE PLANTS
- SEVERE ACCIDENT CLOSURE/USE OF SAFETY GOAL

FIGURE 1
SEVERE ACCIDENT PROGRAM - SCHEMATIC



STATE OF TECHNOLOGY

- WASH-1400, OTHER PRA'S, TMI-2 AND CHERNOBYL ACCIDENTS, ALL TELL US THAT SEVERE ACCIDENTS REPRESENT THE MAJOR CONTRIBUTION TO RISK FROM COMMERCIAL NUCLEAR POWER PLANTS

- IDENTIFICATION OF RISK SIGNIFICANT SEQUENCES (PRA'S, OPERATIONAL EXPERIENCE)

- SEVERE ACCIDENT RESEARCH
  - EXPERIMENTS
  - MODEL DEVELOPMENT

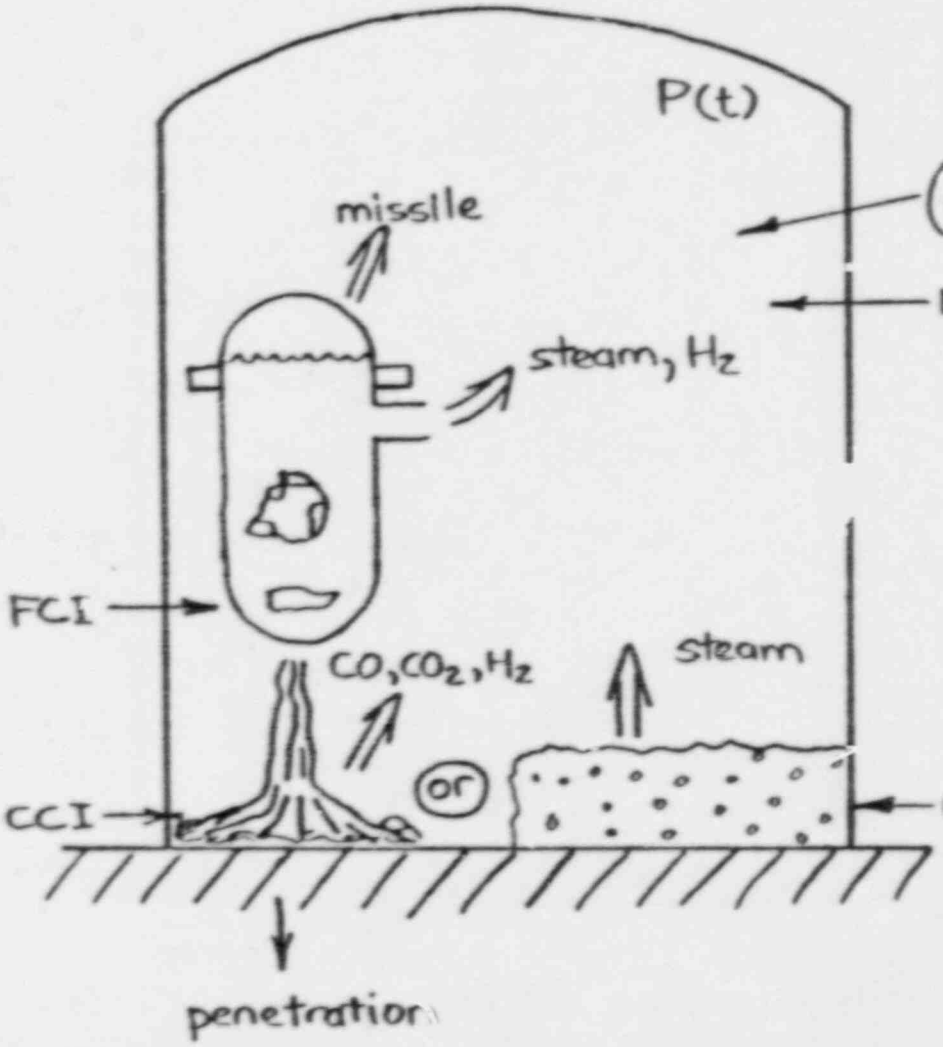
- CONTAINMENT LOADS/PERFORMANCE
  - A GOOD UNDERSTANDING OF SEVERE ACCIDENT CHALLENGES TO CONTAINMENTS (FCI'S; CCI'S)
  - A GOOD UNDERSTANDING OF CONTAINMENT PERFORMANCE

- SOURCE TERMS

- SEVERE ACCIDENT REGULATIONS IMPLEMENTED

- OUTSTANDING ISSUES

Containment Loads



$(H_2 + CO) + O_2 \Rightarrow P$

Melt + Air $\Rightarrow$ P

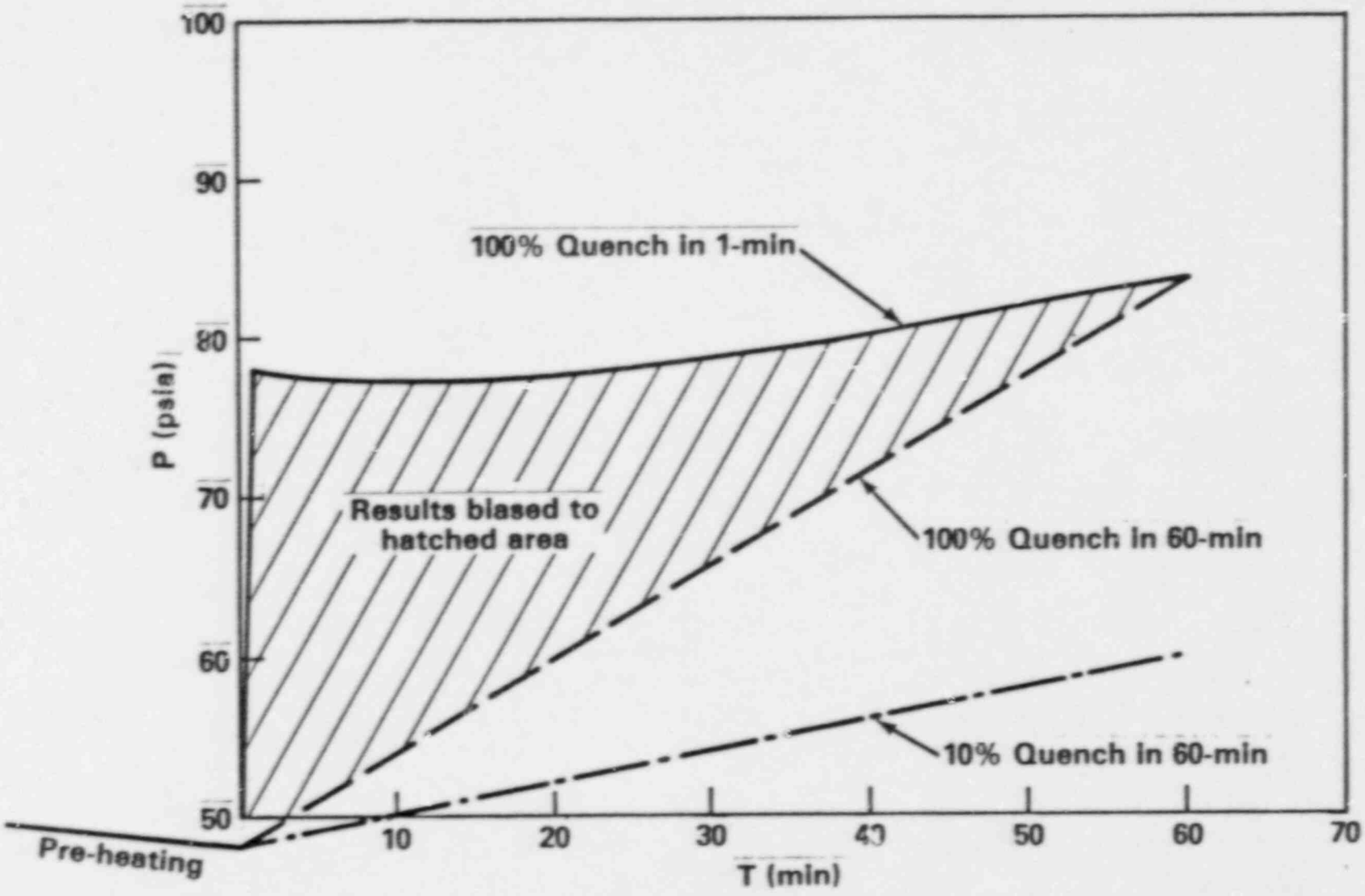
Fuel path is not unique

Energetic vs. Quasi-Static Events

Coolable Debris Bed

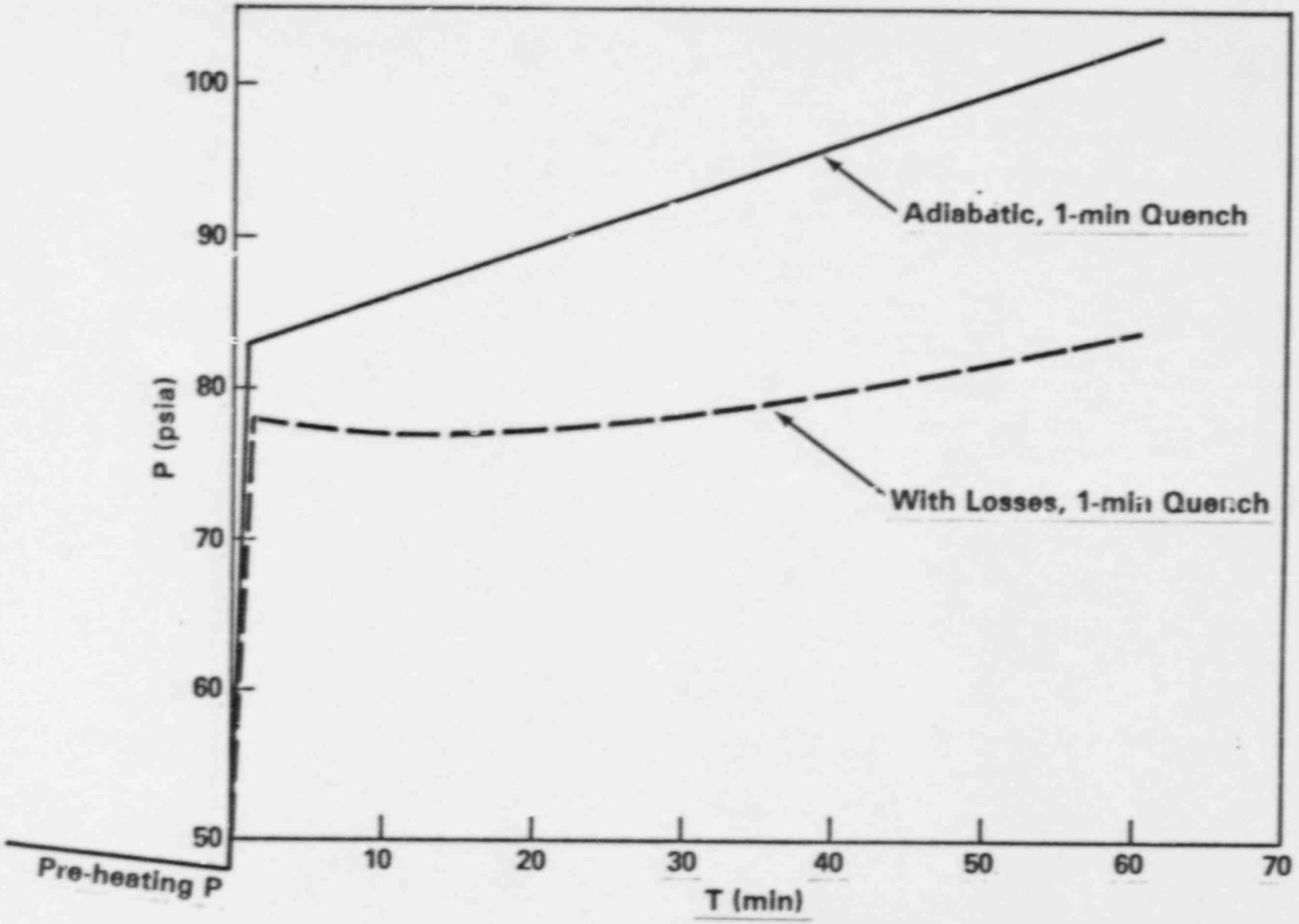
EFFECT OF LOSSES AND TIMING, LOW P SCENARIO COMPARISON CALCULATION CONDITIONS

Sinks pre-heating of ~50 psi for ~300 min



EFFECT OF LOSSES, HIGH P SCENARIO
COMPARISON CALCULATION CONDITIONS

Sinks pre-heating at ~50 psi for ~300 min (TMLB)



Note: Direct heating of containment atmosphere not taken into account.

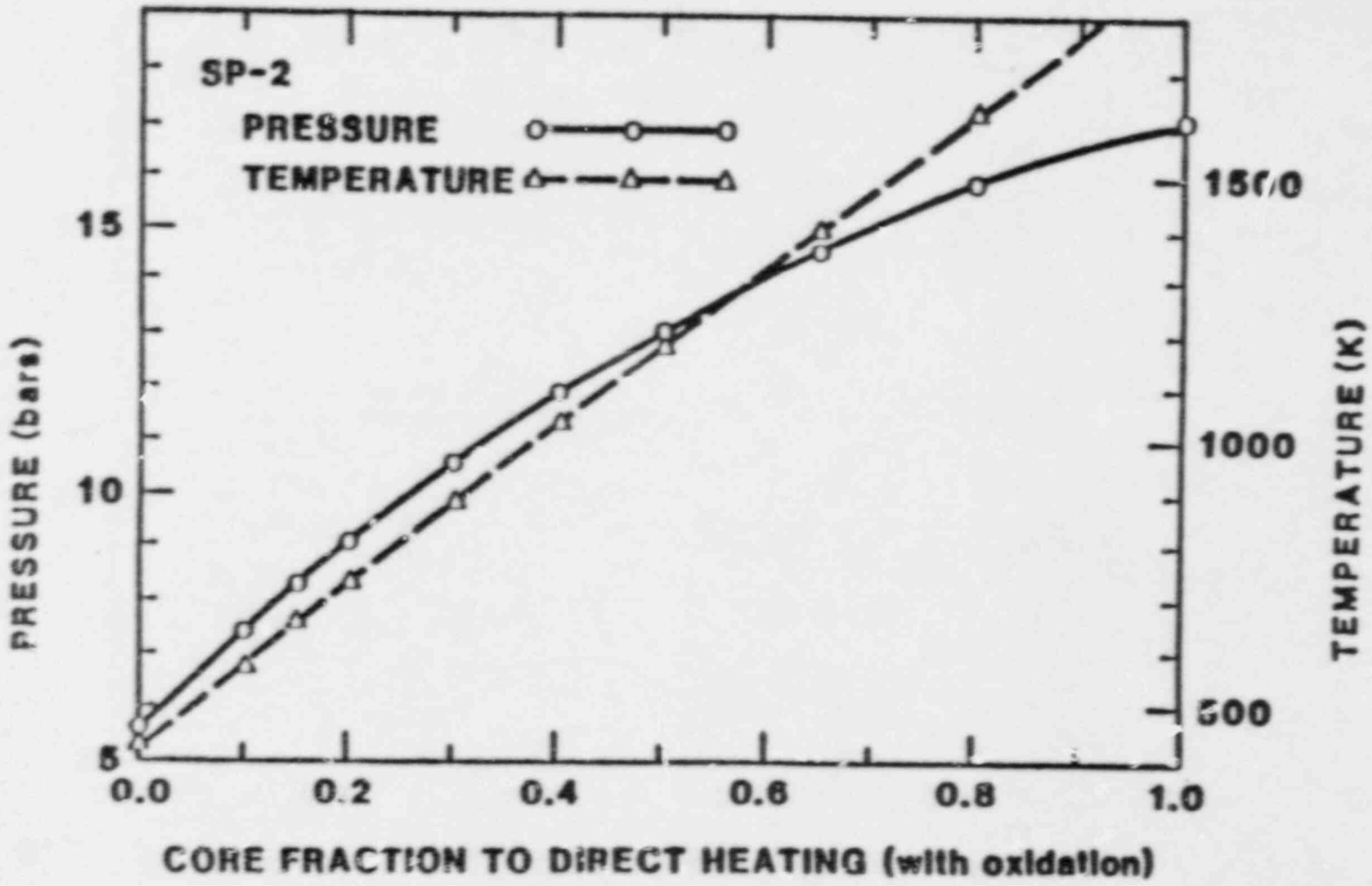


Figure 6.1 SP-2 pressure and temperature as a function of core fraction involved in direct heating (with metal oxidation)

TABLE 1

FAILURE MODES IN LARGE DRY AND SUBATMOSPHERIC CONTAINMENTS

Failure Mode	Relative Probability of Occurrence
Steam Explosion: Missile	Very Low
Failure to Isolate*	Variable
Hydrogen Burn/Detonation	Low
Overpressurization: Early (Due to Steam Spike)	Low
Overpressurization: Early (Direct Heating)	Variable**
Overpressurization: Late (Over 8 Hrs.)	High
Basemat Melt-Through	Medium
Interfacing LOCA: (Containment Bypass)*	Variable

* Mitigation Features are Ineffective Against These Failures. Their Probability Can Be Reduced by Procedural/Design Changes

** Geometry Dependent; Also Wide Range of Views on Phenomena and Consequences

TABLE 2

FAILURE MODES IN MARK I AND II CONTAINMENTS

Failure Mode	Relative Probability of Occurrence
Steam Explosion: Missile	Very Low
Failure to Isolate*	Variable
Hydrogen Burn/Detonation	Very Low (Inerted Containment)
Overpressurization: Early (Due to Steam Spike)	Low
Overpressurization: Early (Corium/Concrete Interaction Plus Steam)	High
Overtemperature: Early (Corium/Concrete Interaction)	High
Steel Containment Melt-Through	Variable** (Applies to Mark-I Only)
Interfacing LOCA: (Containment Bypass)*	Variable

* Mitigation Features are Ineffective Against These Failures. Their Probability Can Be Reduced by Procedural/Design Changes

** Depends on Corium's Ability to Flow to and Melt Through the Liner

TABLE 3

FAILURE MODES IN A MARK-III CONTAINMENT

Failure Mode	Relative Probability of Occurrence
Steam Explosion: Missile	Very Low
Failure to Isolate*	Variable
Hydrogen Burn/Detonation	High (Standing Flames; From Station Blackout Sequences)
Overpressurization: Early (Corium/Concrete Interaction)	Medium
Interfacing LOCA: (Containment Bypass)*	Variable

* Mitigation Features are Ineffective Against These Failures. Their Probability Can Be Reduced by Procedural/Design Changes

TABLE 4

FAILURE MODES IN AN ICE CONDENSER CONTAINMENT

Failure Mode	Relative Probability of Occurrence
Steam Explosion: Missile	Very Low
Failure to Isolate*	Variable
Hydrogen Burn/Detonation: Early	High (For Black-Out Sequences Where Power to Igniters and Air Return Fans is Lost)
Overpressurization: Early (Due to Steam Spike)	Low
Overpressurization: Early (Direct Heating)	Variable**
Overpressurization: Late (Over 8 Hrs.)	High
Basemat Melt-Through	Medium
Interfacing LOCA: (Containment Bypass)*	Variable

* Mitigation Features are Ineffective Against These Failures. Their Probability Can Be Reduced by Procedural/Design Changes

** Geometry Dependent; Also Wide Range of Views on Phenomena and Consequences

CONTAINMENT BUILDINGS

- DESIGNED FOR:
  - DBAs (E.G., LOCA/SLB TEMPERATURES & PRESSURES)
  - EXTERNAL EVENTS (EARTHQUAKES, FLOODS, TORNADOES)
  - TID-14844 FISSION PRODUCT SOURCE TERM (RADIATION; NO S.A. P/T EFFECTS)
  - USE OF CONSERVATIVE CODES/STANDARDS

- MARGINS (AVAILABLE) ABOVE DESIGN LEVELS:
  - MARGINS ARE CONTAINMENT SPECIFIC (VOLUME, MATERIALS, CONFIGURATIONS, ETC.)

  - IN GENERAL, STUDIES (EXPERIM/ANALYTICAL) HAVE INDICATED THAT CONTAINMENT SYSTEMS CAN SURVIVE PRESSURE CHALLENGES OF 2.5 TO 3 TIMES DESIGN LEVELS

- RESIDUAL CHALLENGES FROM SEVERE ACCIDENTS:
  - FOR EACH CONTAINMENT TYPE THERE REMAIN FAILURE MECHANISMS WHICH COULD LEAD TO CONTAINMENT FAILURE

    KEY QUESTIONS: (1) REASONABLE UNDERSTANDING OF CHALLENGES TO CONTAINMENTS (LOADS (P.T.), MARGINS AVAILABLE, FAILURE MODES (TIME, LOCATION), (2) REASONABLE UNDERSTANDING OF PROBABILITIES (E.G., SOME FAILURE MODES, GIVEN A S.A., ARE MORE PROBABLE THAN OTHERS)

RANGE* OF CONTAINMENT DESIGN AND CAPABILITY PRESSURE ESTIMATES

CONTAINMENT TYPE	PRESSURE RANGE	DESIGN PRESSURE RANGE
LARGE DRY	95 - 150 PSIG	45 - 60 PSIG
SUBATMOSPHERIC	120 - 140 PSIG	45 PSIG
ICE CONDENSER	60 - 120 PSIG	12 - 15 PSIG
MARK I	120 - 180 PSIG	60 - 65 PSIG
MARK II	135 - 150 PSIG	45 - 55 PSIG
MARK III	60 - 100 PSIG	15 PSIG

* - RANGES REFLECT BOTH UNCERTAINTIES ABOUT FAILURE MODES AND DIFFERENCES IN DESIGN DETAILS FOR THE SAME CONTAINMENT TYPE.

CONTAINMENT PERFORMANCE IMPROVEMENTS

- o SOME CONTAINMENTS POTENTIALLY VULNERABLE TO EARLY FAILURE DURING SEVERE ACCIDENT (DRAFT NUREG-1150)

- o EVALUATING GENERIC CHALLENGES, FAILURE MODES & POTENTIAL IMPROVEMENTS

- o STATUS FOR MARK Is:

  - APPROACH BEING PURSUED INVOLVES BOTH ACCIDENT PREVENTION AND MITIGATION

  - ADDITIONAL SOURCES OF WATER BEING EXPLORED FOR CORE COOLING, CONTAINMENT AND DEBRIS COOLING, AND FISSION PRODUCT SCRUBBING

  - ADS RELIABILITY ENHANCEMENT

  - VENTING UTILIZING SUPPRESSION POOL FOR SCRUBBING USEFUL, BUT DOWNSIDES SHOULD BE MINIMIZED

  - REGULATORY ANALYSES OF ABOVE BEING PERFORMED

- o MARK I INTERIM AND FINAL RECOMMENDATIONS DUE TO COMMISSION BY JULY AND FALL OF '88, RESPECTIVELY

- o RECOMMENDATIONS FOR OTHER CONTAINMENT TYPES DUE TO COMMISSION BY FALL '89

SUMMARY OF FEB. 24-26, 1988 BWR MARK I WORKSHOP

- THREE-DAY MEETING WITH 150 INDUSTRY, RESEARCHER, STAFF AND PUBLIC REPRESENTATIVES

- INDUSTRY EMPHASIS ON PREVENTION. ANY FIXES SHOULD BE PLANT SPECIFIC FROM IPE.

- VARIETY OF VIEWS ON PROBABILITY OF LINER MELT-THROUGH
  - MANNER OF VESSEL FAILURE AND RELEASE OF DEBRIS IMPORTANT
  - INDUSTRY BELIEVES WATER CAN PREVENT LINER MELT-THROUGH
  - WATER BENEFICIAL, BUT NO CONSENSUS FROM NRC RESEARCHERS ON WHETHER LINER FAILS AND WHEN

- GENERAL AGREEMENT--WATER IN DRYWELL USEFUL TO DELAY/ PREVENT SHELL FAILURE AND TO REDUCE FISSION PRODUCT RELEASES

- AGREEMENT THAT ADS RELIABILITY IMPORTANT. IMPROVEMENTS ACHIEVABLE AT MODEST COST. SUSQUEHANNA LICENSEE TAKING ACTIONS NOW.

- POTENTIAL POSITIVE AND NEGATIVE SAFETY IMPACTS OF VENTING
  - REDUCE CORE-MELT LIKELIHOOD, REDUCE CONSEQUENCES, BUY TIME
  - POTENTIAL FOR UNNECESSARY RELEASE, INCREASE CORE-MELT LIKELIHOOD FOR SOME SEQUENCES

- MORE FOCUSED RESEARCH NEEDED ON
  - VESSEL FAILURE AND DEBRIS RELEASE
  - VESSEL FAILURE CHARACTERISTICS AND LIKELIHOOD OF LINER MELT-THROUGH WITH WATER

FAILURE MODES IN

MARK I CONTAINMENTS

FAILURE MODE	RELATIVE PROBABILITY OF OCCURRENCE
0. OVERPRESSURIZATION: OVERPRESSURIZATION LEADING TO CORE DAMAGE (I.E., CONTAINMENT FAILURE BEFORE CORE MELTING)	HIGH+
1. STEAM EXPLOSION: MISSILE	VERY LOW
2. FAILURE TO ISOLATE*	VARIABLE
3. HYDROGEN BURN/DETONATION	VERY LOW
4. OVERPRESSURIZATION: EARLY (CORIUM/CONCRETE INTERACTION PLUS STEAM)	HIGH
5. OVERTEMPERATURE: EARLY (CORIUM/CONCRETE INTERACTION)	HIGH
6. STEEL CONTAINMENT MELT-THROUGH	VARIABLE**
7. INTERFACING LOCA: (CONTAINMENT BYPASS)*	VARIABLE

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*MITIGATION FEATURES ARE INEFFECTIVE AGAINST THESE FAILURES. THEIR PROBABILITY CAN BE REDUCED BY PROCEDURAL/DESIGN CHANGES

**DEPENDS ON CORIUM'S ABILITY TO FLOW TO AND MELT THROUGH THE LINER

+IN THE ABSENCE OF WETWELL VENTING

SEVERE ACCIDENT RESEARCH

- BEGINNING IN 1980, AFTER THE TMI-2 EVENT, RESEARCH HAS PROVIDED A DATA BASE AND MODELS FOR:

  - o FISSION PRODUCT RELEASE, TRANSPORT, DEPOSITION, & REVAPORIZATION
  - o CONTAINMENT LOADING BY HIGH PRESSURE MELT EJECTION (HPE)
  - o HYDROGEN DETONATION AND BURNING
  - o CORE/CONCRETE INTERACTIONS (CCI)
  - o CONTAINMENT PERFORMANCE TESTING
  - o EFFECTS OF NATURAL CIRCULATION ON THE PRIMARY SYSTEM
  - o CORE MELT PREGRESSION (EARLY STAGES)

- FUTURE RESEARCH EFFORTS WILL FOCUS ON SPECIFIC ISSUES SUCH AS:

  - o CONTAINMENT FAILURE PROBABILITY BY DIRECT CONTAINMENT HEATING (DCH) INCLUDING EFFECT OF NATURAL CIRCULATION
  - o MELT SPREADING AND POTENTIAL CONTAINMENT SHELL FAILURE IN MARK Is
  - o RESEARCH DATA AND MODELS TO ASSESS ACCIDENT MANAGEMENT STRATEGIES
  - o LONGER TERM CONFIRMATORY RESEARCH ON:

    - DCH CONSEQUENCES
    - REFINEMENT OF HYROGEN BEHAVIOR MODELS
    - CORE MELT PROGRESSION (LATE STAGES)
    - CORE/CONCRETE INTERACTIONS
    - FURTHER MODEL ASSESSMENT AND REFINEMENTS

AN EXAMPLE OF AN ISSUE AND ITS ASSOCIATED NEAR AND LONG-TERM RESEARCH

CONTAINMENT TYPE — LARGE DRY PWR

ASSOCIATED ISSUES

- o POTENTIAL CONTAINMENT FAILURE MODES
  - DIRECT CONTAINMENT HEATING (DCH)
  - HYDROGEN BURN/DETONATIONS
  - LATE FAILURE BY CCI LOADS (OVER T&P)
- o CONTAINMENT PERFORMANCE
- o ACCIDENT MANAGEMENT STRATEGIES
  - DEPRESSURIZATION OF PRIMARY SYSTEM

RESEARCH TO ADDRESS ISSUE

- o DCH
  - PROBABILITY OF HIGH PRESSURE MELT EJECTION (NATURAL CIRCULATION)
  - CUTOFF PRESSURE FOR HPE
  - MANAGEMENT THROUGH DEPRESSURIZATION
  - CONSEQUENCES

CONTAINMENT PEFORMANCE FOCUSED RESEARCH

PWR LARGE DRY		BWR MARK I & II		BWR MARK III		BWR ICE CONDENSE	
MAJOR ISSUES	RELATED RESEARCH	MAJOR ISSUES	RELATED RESEARCH	MAJOR ISSUES	RELATED RESEARCH	MAJOR ISSUES	REL RES
DIRECT CONTAINMENT HEATING (DCH) (EARLY)	PROBABILITY (NATURAL CIRC.)	SHELL MELT THROUGH MARK-I ONLY (EARLY)	MELT SPREADING TESTS	HYDROGEN BURNS & DETONATIONS (EARLY)	ASSESS COMBUSTION CODES WITH EXISTING DATA	HYDROGEN BURNS SAME AS MARK-III	
	CUTOFF PRESSURE		HEAT TRANSFER TO LINER TESTS			DCH - SAME AS PWR LARGE DRY (EARLY)	
	MANAGEMENT (DEPRESSURIZATION)		MELT SPREADING USING VARIOUS CORE DEBRIS				
	CONSEQUENCES (SURTSEY TESTS)		MODEL COMPLETION				
	INITIAL CONDS. (MELT PROGRESSION)		INITIAL CONDS. (MELT PROGRESSION)				
OVERPRESSURE OVERTEMP. (LATE FAILURE)	LARGE-SCALE CCI TESTS	OVER P&T SAME AS PWR LARGE DRY (EARLY FAILURE)	MANAGEMENT (DEPRESSURIZE) (DRYWELL)	OVER P&T SAME AS PWR LARGE DRY (EARLY-LATE)	MANAGEMENT (DEPRESSURIZE)	OVER P&T SAME AS PWR LARGE DRY (LATE FAILURE)	
	FRG BETA TESTS ON CCI						
	IMPROVE & ASSESS CCI CODES						
	INITIAL CONDS. (MELT PROGRESSION)						

ACRS MEETING

ON

THE IMPLEMENTATION PLAN OF THE
SEVERE ACCIDENT POLICY STATEMENT

INDIVIDUAL PLANT EXAMINATIONS

THEMIS SPEIS, DEPUTY DIRECTOR
OFFICE OF NUCLEAR REGULATORY RESEARCH

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

JULY 13, 1988

2. SUMMARY

- STAFF HAS DEVELOPED GENERIC LETTER TO INDUSTRY TO IMPLEMENT THE SEVERE ACCIDENT POLICY FOR OPERATING REACTORS

- STAFF REVIEW OF THE IDCOR METHODS FOR CONDUCTING THE INDIVIDUAL PLANT EXAMINATION HAS BEEN COMPLETED

- STAFF HAS INTERACTED FREQUENTLY WITH THE ACRS DURING THE DEVELOPMENT OF THE GENERIC LETTER AND DURING THE STAFF'S REVIEW OF THE IDCOR METHODS

- PROPOSED GENERIC LETTER WAS EXTENSIVELY REVIEWED BY THE CRGR

- THE GENERIC LETTER INCORPORATES SUGGESTIONS MADE BY BOTH THE ACRS AND THE CRGR

SUMMARY (CONT.)

DU''ING OUR INTERACTIONS ON THE IMPLEMENTATION PLAN OF THE SEVERE ACCIDENT POLICY WE DISCUSSED THE FOLLOWING

- EXAMINATION PROCESS AND METHODS
- STAFF'S PLAN TO ADDRESS SEVERE ACCIDENTS FROM EXTERNAL EVENTS
- ROLE OF SEVERE ACCIDENT MANAGEMENT
- PROPOSED STAFF POSITION TO RESOLVE USI A-45
- PROPOSED STAFF PLAN TO REVIEW IPE SUBMITTALS AND SCHEDULE
- DISCUSSION ON THE STAFF USE OF THE IPE RESULTS
- CONCLUDING REMARKS

WE PLAN TO PERIODICALLY INFORM THE ACRS, CRGR AND THE COMMISSION ON THE PROGRESS OF THIS TASK

SUMMARY (CONT.)

- WE HAVE SPENT SUBSTANTIAL EFFORTS IN DEVELOPING THE GENERIC LETTER AND THE SUPPORTING DOCUMENTS. WE BELIEVE THAT UTILITIES CAN PROCEED TO PERFORM THE IPEs AND TO FURTHER ENHANCE SAFETY WHERE APPROPRIATE

- AT THE MAY 5, 1988 ACRS MEETING, NUMARC STATED THAT INDUSTRY UNDERSTANDS THE OBJECTIVES OF THE IPEs, HAS SUFFICIENT KNOWLEDGE OF THE STAFF'S WORK ON THE IPE, AND URGES THE NRC TO ISSUE THE GENERIC LETTER SO UTILITIES CAN PROCEED TO PERFORM THEIR IPEs

4. EXAMINATION PROCESS

LICENSEE'S STAFF SHOULD PARTICIPATE IN ALL ASPECTS OF THE IPE SO THAT KNOWLEDGE GAINED BECOMES AN INTEGRAL PART OF OPERATING, TRAINING AND PROCEDURE PROGRAM

LICENSEES SHOULD CONDUCT SYSTEMATIC EXAMINATION OF PLANT DESIGN, OPERATION, MAINTENANCE AND EMERGENCY OPERATION TO:

- IDENTIFY PLANT SPECIFIC VULNERABILITIES (DESIGN AND PROCEDURAL) TO SEVERE ACCIDENTS (FOR BOTH CORE DAMAGE AND CONTAINMENT PERFORMANCE); BOTH INTERNAL AND EXTERNAL INITIATORS ARE TO BE CONSIDERED. EXTERNAL INITIATORS WILL BE CONSIDERED SEPARATE FROM THE IPEs AND ON A LATER SCHEDULE

EXAMINATION PROCESS (CONT.)

- UNDERSTAND THE SEQUENCES THAT CONTRIBUTE THE MOST TO THE TOTAL CORE DAMAGE OR TO POOR CONTAINMENT PERFORMANCE
- UNDERSTAND WHAT COULD PROBABLY GO WRONG IN A PLANT
- IDENTIFY AND EVALUATE MEANS FOR IMPROVING PLANT/CONTAINMENT PERFORMANCE (VIA HARDWARE ADDITIONS/MODIFICATIONS, ADDITION TO PROCEDURES, TRAINING)
- DECIDE WHICH IMPROVEMENTS WILL BE IMPLEMENTED AND SCHEDULE FOR IMPLEMENTATION

6. BENEFITS OF PRA

LICENSE RENEWALS

- PRA COULD BE A BASIS TO IDENTIFY RISK-SIGNIFICANT COMPONENTS AND SYSTEMS THAT SHOULD BE MAINTAINED AT AN ACCEPTABLE LEVEL OF RELIABILITY DURING THE LICENSE RENEWAL PERIOD

RISK MANAGEMENT

- RISK MANAGEMENT PROGRAM THAT CONTINUALLY ASSESSES THE SAFETY OF THE PLANT PROVIDES A POWERFUL TOOL TO THE PLANT MANAGEMENT

SUPPORT FOR LICENSING ACTIONS

- PRA MIGHT BE USED TO JUSTIFY TECHNICAL SPECIFICATION CHANGES

INTEGRATED SAFETY ASSESSEMENT PROGRAM

- OPTIMIZES THE TOTAL SAFETY AND EXPEDITES SCHEDULE TO IMPLEMENT FIXES

7. ROLE OF ACCIDENT MANAGEMENT

- ACCIDENT MANAGEMENT IS A PROCESS IN WHICH ACTIONS THAT CAN PREVENT CORE DAMAGE OR MITIGATE THE CONSEQUENCES OF A SEVERE ACCIDENT ARE IDENTIFIED, EVALUATED, INCORPORATED INTO A STRUCTURED PROGRAM, IMPLEMENTED AT A PLANT SITE AND ARE AVAILABLE TO THE OPERATORS AND PLANT MANAGEMENT IN THE EVENT OF AN ACCIDENT

- ACCIDENT MANAGEMENT ENCOMPASSES HARDWARE, HUMAN, AND ORGANIZATIONAL FACTORS

- IT PROVIDES DECISION MAKERS AT THE PLANT A STRUCTURED PROGRAM FOR MANAGING ACCIDENTS, INCLUDING SEVERE ACCIDENTS

- STAFF AND NUMARC DISCUSSING SCOPE AND SCHEDULE FOR DEVELOPMENT OF SEVERE ACCIDENT MANAGEMENT PROGRAM

ACCIDENT MANAGEMENT (CONT)

- PROPOSED GENERIC LETTER ADDRESSES ACCIDENT MANAGEMENT AS FOLLOWS:
  - UTILITIES ARE EXPECTED TO ULTIMATELY DEVELOP A STRUCTURED, COMPREHENSIVE ACCIDENT MANAGEMENT PROGRAM FOR PREVENTION OR MITIGATION OF RISK IMPORTANT SEVERE ACCIDENTS
  - WHILE A FORMAL ACCIDENT MANAGEMENT PROGRAM MAY BE UNDER DEVELOPMENT WHILE THE IPE'S ARE BEING CONDUCTED, UTILITIES ARE EXPECTED TO IDENTIFY MEASURES THAT PLANT PESONNEL CAN AND SHOULD TAKE TO PREVENT/MITIGATE RISK IMPORTANT SEVERE ACCIDENTS. ASSESS AGAINST THE CRITERIA OF 10 CFR 50.59 AND IF APPROPRIATE, SUBMIT FOR NRC REVIEW IN ACCORDANCE WITH 10 CFR 50.90

8. RELATIONSHIP TO USIs & GSIs

- USI A-45 ANALYSES HAVE SHOWN THAT DECAY HEAT REMOVAL FUNCTION FAILURES ARE SUFFICIENTLY PLANT SPECIFIC AND WOULD REQUIRE SYSTEMATIC EXAMINATION
- PROPOSED STAFF RESOLUTION OF A-45 IS TO SUBSUME ISSUE INTO IPEs
- THE PROPOSED GENERIC LETTER STATES THAT THE IPE SHOULD ENSURE THAT THE VULNERABLE ASPECTS OF DHR FUNCTION ARE IDENTIFIED
- THE PROPOSED GENERIC LETTER PROVIDES INSIGHTS GAINED FROM SIX LIMITED SCOPE PRAs PERFORMED BY NRC UNDER THE A-45 PROGRAM
- FOR OTHER USIs & GSIs
    - IF IPE IDENTIFIES ANY VULNERABILITIES THAT ARE TYPICALLY ASSOCIATED WITH A USI OR GSI AND UTILITY PROPOSES A MEASURES ACCEPTABLE TO THE STAFF TO ELIMINATE OR SUBSTANTIALLY REDUCE THE VULNERABILITY, OR
    - IF IPE SHOWS PLANT HAS NO VULNERABILITY WITH RESPECT TO A USI OR GSI
    - THEN USI OR GSI MAY BE CONSIDERED CLOSED ON A PLANT SPECIFIC BASIS

9. COMMENTS ON ACRS LETTER DATED MAY 10, 1988

- ACRS RECOMMENDED BROADEN SCOPE OF IPE AND REQUIRE EACH LICENSEE TO CONDUCT LEVEL-2 PRA TO SUBSUME ALL OUTSTANDING SAFETY ISSUES (USIs/GSIs)
- ACRS ALSO RECOMMENDED TREATMENT OF BOTH INTERNAL AND EXTERNAL INITIATORS AT THIS TIME
- THE STAFF SHARES ACRS VIEWS THAT A PROGRAM THAT INTEGRATES A NUMBER OF ONGOING REGULATORY ACTIVITIES IS DESIRABLE. HOWEVER, IT IS INAPPROPRIATE TO IMPLEMENT SUCH PRGRAM AT THIS TIME:
    - THE IDCOR IPEMs DEVELOPED BY INDUSTRY IN RESPONSE TO THE 1985 SEVERE ACCIDENT POLICY STATEMENT WAS FOUND (SUBJECT TO STAFF'S ENHANCEMENT) TO SATISFY THE INTENT OF THAT POLICY STATEMENT. WE HAVE NO BASIS FOR NOT ALLOWING USE OF THE IDCOR IPEMs

COMMENTS ON ACRS LETTER (CONT.)

- THE GENERIC LETTER DOES NOT DISCOURAGE, IN FACT ENCOURAGES, UTILITIES TO PERFORM PRAs AND WHERE APPROPRIATE THE STAFF MAY ALLOW MORE TIME FOR UTILITIES WHO ELECT TO PERFORM PRAs

- THE GENERIC LETTER DOES NOT DISCOURAGE RESOLUTION OF USIs/GSIs THROUGH THE IPE PROGRAM

- UTILITIES ARE ADVISED THAT IN THE FUTURE THEY WILL BE EXPECTED TO EXAMINE AND IDENTIFY VULNERABILITIES TO SEVERE ACCIDENT DUE TO EXTERNALLY INITIATED EVENTS. INTEGRATION OF ONGOING ACTIVITIES INVOLVING EXTERNAL EVENTS MUST BE DONE TO PRECLUDE DUPLICATION OF EFFORTS

- IT IS UNLIKELY THAT ANY PLANT MODIFICATION DUE TO INTERNAL EVENT INITIATORS WILL RENDER THE PLANT MORE VULNERABLE TO EXTERNAL EVENT INITIATORS

10. CONCLUSIONS

- DEVELOPED GUIDANCE TO ENABLE UTILITIES TO PERFORM THEIR IPEs AND GAIN INSIGHTS ON ALL PLANT SYSTEMS AND COMPONENTS THAT COULD BE USED TO PREVENT CORE DAMAGE ACCIDENTS
- FOCUS UTILITIES' ATTENTION ON THE KEY EVENTS AND PHENOMENA AFFECTING THE PLANT IN GENERAL AND THE CONTAINMENT IN PARTICULAR
- DE-EMPHASIZING HEAVY RELIANCE ON BOTTOM LINE NUMBERS. EMPHASIZING THE IDENTIFICATION AND IMPLEMENTATION OF RECOVERY PROCEDURES AND ACCIDENT MANAGEMENT PROGRAM
- NO MAJOR CONTAINMENT MODIFICATIONS REQUIRED UNTIL THE INFORMATION ASSOCIATED WITH GENERIC ISSUES WHICH AFFECT CONTAINMENT PERFORMANCE HAS BEEN DEVELOPED BY THE STAFF
- NO DUPLICATION OF EFFORTS BY INDUSTRY: SUBSUMING A-45 RESOLUTION IN THE IPE AND SEPARATING TREATMENT OF EXTERNAL EVENTS AT THIS TIME
- WE RECOMMEND COMMISSION APPROVAL TO ISSUE THE GENERIC LETTER

NUREG-1150: A STATUS REPORT

PRESENTED TO ACRS
JULY 13, 1988

JOSEPH A. MURPHY
OFFICE OF NUCLEAR REGULATORY RESEARCH
U. S. NUCLEAR REGULATORY COMMISSION

- Draft NUREG-1150 published for comment in February, 1987

- Extensive comments received from many sources
  - Government agencies
  - Utilities
  - Academia
  - Public interest groups
  - Nuclear industry
  - Private citizens

- Peer review comments obtained
  - Uncertainty analysis review, H. Kouts Chairman, NUREG/CR-5000 (December, 1987)
  - Overall review, W. Kastenberg, Chairman, NUREG/CR-5113 (May, 1988)

NUREG-1150 OBJECTIVES

- TO PROVIDE A CURRENT ASSESSMENT OF THE SEVERE ACCIDENT RISKS OF FIVE NUCLEAR POWER PLANTS WHICH
  - PROVIDE A SNAPSHOT OF RISKS REFLECTING PLANT DESIGN AND OPERATIONAL CHAACTERISTICS, FAILURE DATA, AND SEVERE ACCIDENT PHENOMENOLOGICAL INFORMATION AVAILABLE IN MARCH, 1988.
  - UPDATES THE ESTIMATES OF THE REACTOR SAFETY STUDY.
  - INCLUDES QUANTITATIVE ESTIMATES OF RISK UNCERTAINTY.
  - IDENTIFIES PLANT-SPECIFIC RISK VULNERABILITIES.

- SUMMARIZE THE PERSPECTIVES GAINED WITH RESPECT TO
  - ISSUES SIGNIFICANT TO SEVERE ACCIDENT FREQUENCIES, CONSEQUENCES, AND RISKS.
  - RISK SIGNIFICANT UNCERTAINTIES WHICH MAY MERIT FURTHER RESEARCH.
  - COMPARISONS WITH THE SAFETY GOALS.
  - POTENTIAL BENEFITS OF A SEVERE ACCIDENT MANAGEMENT PROGRAM.
  - POTENTIAL BENEFITS OF OTHER PLANT MODIFICATIONS IN RISK REDUCTION.

- TO PROVIDE METHODS USEFUL FOR THE PRIORITIZATION OF POTENTIAL SAFETY ISSUES AND RELATED RESEARCH.

NUREG-1150 IMPROVEMENTS

- **ACCIDENT FREQUENCY ANALYSIS**
  - INCORPORATING INDUSTRY COMMENTS
  - REFLECTING CURRENT DESIGN AND OPERATIONAL PRACTICES
  - IMPROVED REACTOR COOLANT PUMP SEAL LOCA MODEL
  - EXAMINING BOUNDARY CONDITIONS AND ASSUMPTIONS
    - STEAM GENERATOR TUBE RUPTURE
    - INSTRUMENT AIR
  - INCORPORATING SENSITIVITY STUDIES INTO UNCERTAINTY ANALYSIS
  - EXPERT PANELS FORMED FOR CERTAIN ISSUES
    - SEAL LOCA
    - PUMP PERFORMANCE BEYOND DESIGN CONDITIONS
    - RECOVERY ACTIONS OUTSIDE WRITTEN PROCEDURES
    - CCW PIPING FAILURE RATE

EXPERT JUDGMENT

- VASTLY IMPROVED PROCESS USING DECISION – THEORETIC TECHNIQUES.

- PROCESS INVOLVES:
  - NORMATIVE TRAINING
  - 1ST SESSION DEFINING ISSUES
  - 6–8 WEEKS FOR EXPERTS TO REVIEW MATERIAL, SURVEY LITERATURE, PERFORM ANALYSES
  - 2ND SESSION – EXPERTS EXPLAIN VIEWS; PRIVATE ELICITATION

- EXPERTS CONTROL PROCESS:
  - ISSUES ARE DECOMPOSED BY EACH EXPERT INDIVIDUALLY
    - NEW ISSUES CAN BE ADDED OR THOSE PROPOSED CAN BE DISCARDED
    - CAN REFUSE TO BE ELICITED AND CALL FOR ANOTHER PANEL, E.G., RCP SEAL LOCA

SOURCE TERM ANALYSES

- STCP RUNS FOR ALL IMPORTANT SEQUENCES
- "VALIDATION" OF XSOR CODES IN PROGRESS BY "BENCHMARKING" AGAINST NEW STCP RUNS
- LINE BY LINE CODING REVIEW
- DROP "CENTRAL" SOURCE TERM
- IMPROVED DOCUMENTATION

CONSEQUENCE ANALYSIS

- COMPLETELY REANALYZED
- RE-EVALUATING ASSUMPTIONS REGARDING
  - EVACUATION
  - RELOCATION
  - RADIATION PROTECTION MEASURES
- ANALYSES OF UNCERTAINTY FROM CONSEQUENCE MODELING UNDERWAY
- MACCS 1.5 BEING BENCHMARKED AGAINST CSNI STANDARD PROBLEMS

EXTERNAL EVENT ANALYSIS

- **PROCESSING WELL**
  - STUDY LIMITED TO SURRY AND PEACH BOTTOM
  - SEISMIC AND FIRE CONSIDERED FOR EACH
  - SCREENING ANALYSIS
  - TORNADO
  - HURRICANE
  - FLOODING
  - AIRPLANE CRASH
  - TRANSPORTATION

- **ANALYTICAL PROCEDURES SIMILAR TO THAT USED FOR RECENT STATION BLACKOUT STUDIES**

- **STRUCTURAL FAILURES ADDED**

Principal Milestones for Completion of NUREG-1150 Project

Date	Milestone
July 8	Complete accident frequency analyses
October 1	Complete risk analyses (NUREG/CR-4551)
October 7	Complete accident frequency analysis documentation (NUREG/CR-4550, Rev. 1)
December 30	Complete risk analysis documentation (NUREG/CR-4551) (except Volume 2 documenting details of expert elicitation)
December 30	Complete NUREG-1150, Summary Report and Appendices
January, 1989	Distribution of: - NUREG-1150 - NUREG/CR-4550, Rev. 1 - NUREG/CR-4551 (except Volume 2)
February, 1989	Complete NUREG/CR-4551, Volume 2
March, 1989	Distribution of NUREG/CR-4551, Volume 2

INDIVIDUAL PLANT EXAMINATION FOR EXTERNAL EVENTS

ACRS SUBCOMMITTEE ON

SEVERE ACCIDENTS

LAWRENCE C. SHAO, DIRECTOR
DIVISION OF ENGINEERING AND SYSTEMS TECHNOLOGY
OFFICE OF NUCLEAR REACTOR REGULATION

JULY 13, 1988

EXTERNAL EVENTS

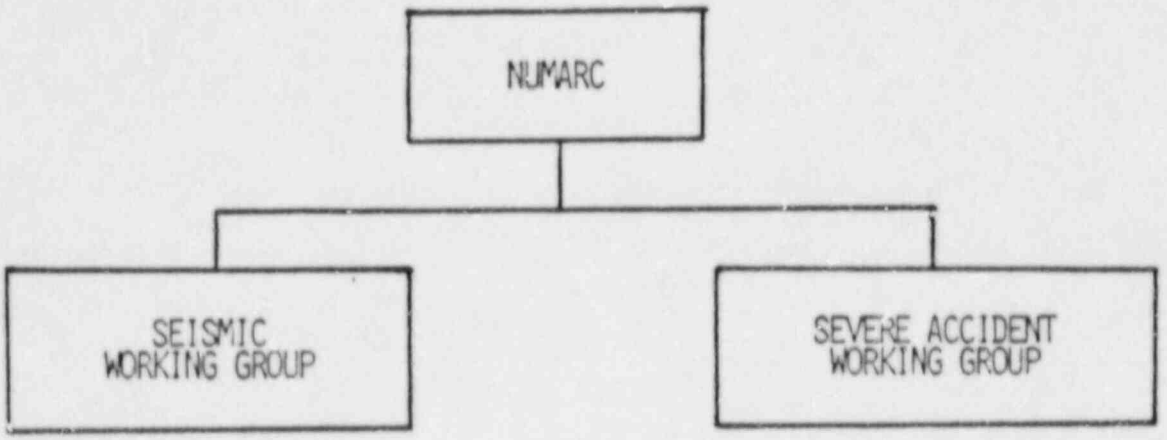
- EARTHQUAKES
- INTERNAL FIRES
- EXTERNAL FLOODS
- WIND AND TORNADOS
- TRANSPORTATION ACCIDENTS AND OTHERS

ISSUES FOR EXTERNAL EVENTS

- MANY POSSIBLE SOURCES OF HAZARDS
- LARGE UNCERTAINTIES ON FREQUENCY OF INITIATING EVENTS
- PLANTS DESIGNED TO VARIOUS CRITERIA
- PROTECTION FOR PLANTS WITH REGARD TO EXTERNAL EVENTS BEYOND DESIGN BASES ARE UNKNOWN (MAY NOT BE CONSISTENT)
- PRA'S INDICATE HIGH RISKS DUE TO CERTAIN EXTERNAL EVENTS
- MORE EMPHASIS ON INTERNAL EVENTS IN THE PAST
- NEED APPROACHES FOR EVALUATING VARIOUS EXTERNAL EVENTS BEYOND DESIGN BASES
- EXTERNAL EVENTS PROGRAMS NEED TO BE INTEGRATED

STATUS FOR EXTERNAL EVENTS

- PAST EMPHASIS ON INTERNAL EVENTS
- NO CONCENTRATED EFFORTS ON EXTRNAL EVENTS
- NRC FORMED EXTERNAL EVENTS STEERING GROUP
- NUMARC IN THE PROCESS OF FORMING SIMILAR GROUPS



CHAIRMAN TO BE ANNOUNCED

ALL SEISMIC ISSUES

CHAIRMAN: CORDELL REED

OTHER EXTERNAL EVENTS

ACCIDENT MANAGEMENT