

PROPOSED INTERIM HYDROGEN CONTROL  
REQUIREMENTS FOR SMALL CONTAINMENT

(SECY 80-107)

JUNE 26, 1980

8007140070

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## CHRONOLOGY

|                   |   |
|-------------------|---|
| FEBRUARY 22, 1980 | STAFF ISSUED SECY 80-107, WITH INTERIM HYDROGEN CONTROL REQUIREMENTS FOR SMALL CONTAINMENTS           |
| MARCH 19, 1980    | COMMISSION BRIEFING ON SECY 80-107  |
| MARCH 28, 1980    | COMMISSION REQUESTED ADDITIONAL INFORMATION REGARDING SECY 80-107                                     |
| APRIL 22, 1980    | STAFF ISSUED SECY 80-107A — A PARTIAL RESPONSE TO THE COMMISSION'S REQUEST OF MARCH 28, 1980          |
| JUNE 20, 1980     | STAFF ISSUES SECY 80-107B, WHICH COMPLETES THE RESPONSE TO THE COMMISSION'S REQUEST OF MARCH 28, 1980 |
| JUNE 26, 1980     | TODAY'S BRIEFING  |

ISSUES ASSOCIATED WITH H<sub>2</sub> MANAGEMENT POLICY

UNTIL RULEMAKING PROCEEDINGS ARE COMPLETE:

1. SHALL ALL OPERATING MARK I CONTAINMENTS BE INERTED?  
(AFFECTS V.Y. AND HATCH-2)
2. SHALL ALL NEW MARK I AND MARK II CONTAINMENTS BE INERTED?  
(AFFECTS 14 UNITS)
3. SHALL ADDITIONAL H<sub>2</sub> MITIGATION MEASURES BE REQUIRED FOR  
ICE CONDENSER CONTAINMENTS?  
(AFFECTS 10 UNITS)
4. SHALL ADDITIONAL H<sub>2</sub> MITIGATION MEASURES BE REQUIRED FOR  
MARK III CONTAINMENTS?  
(AFFECTS MANY UNITS)
5. SHALL ADDITIONAL H<sub>2</sub> MITIGATION MEASURES BE REQUIRED FOR  
SUBATMOSPHERIC AND DRY CONTAINMENTS?

DECISION ELEMENTS  
FOR  
H<sub>2</sub> MANAGEMENT MEASURES

1. LIKELIHOOD OF ACCIDENTS THAT GENERATE  
LARGE AMOUNT OF H<sub>2</sub>
2. H<sub>2</sub> CONCENTRATION VERSUS ZR-WATER REACTION  
AND CONTAINMENT VOLUME
3. STRUCTURAL RESPONSE TO H<sub>2</sub> COMBUSTION
4. EFFECTIVENESS OF VARIOUS MITIGATION  
MEASURES

## IMPACT OF CLI-80-16 ON HYDROGEN MANAGEMENT POLICY

### CLI-80-16 STATES:

QUESTION 1 - 10 CFR 50.44 SHOULD NOT BE WAIVED  
BUT SHOULD REMAIN IN PLACE UNTIL  
MORE DELIBERATE AND CONSIDERED  
RULEMAKING CAN BE COMPLETED

QUESTION 2 - APART FROM 10 CFR 50.44, THE  
COMBUSTIBLE GAS CONTROL ISSUE  
CAN BE LITIGATED UNDER 10 CFR  
100

### NRR APPROACH TO HYDROGEN MANAGEMENT IN LIGHT OF COMMISSION GUIDANCE:

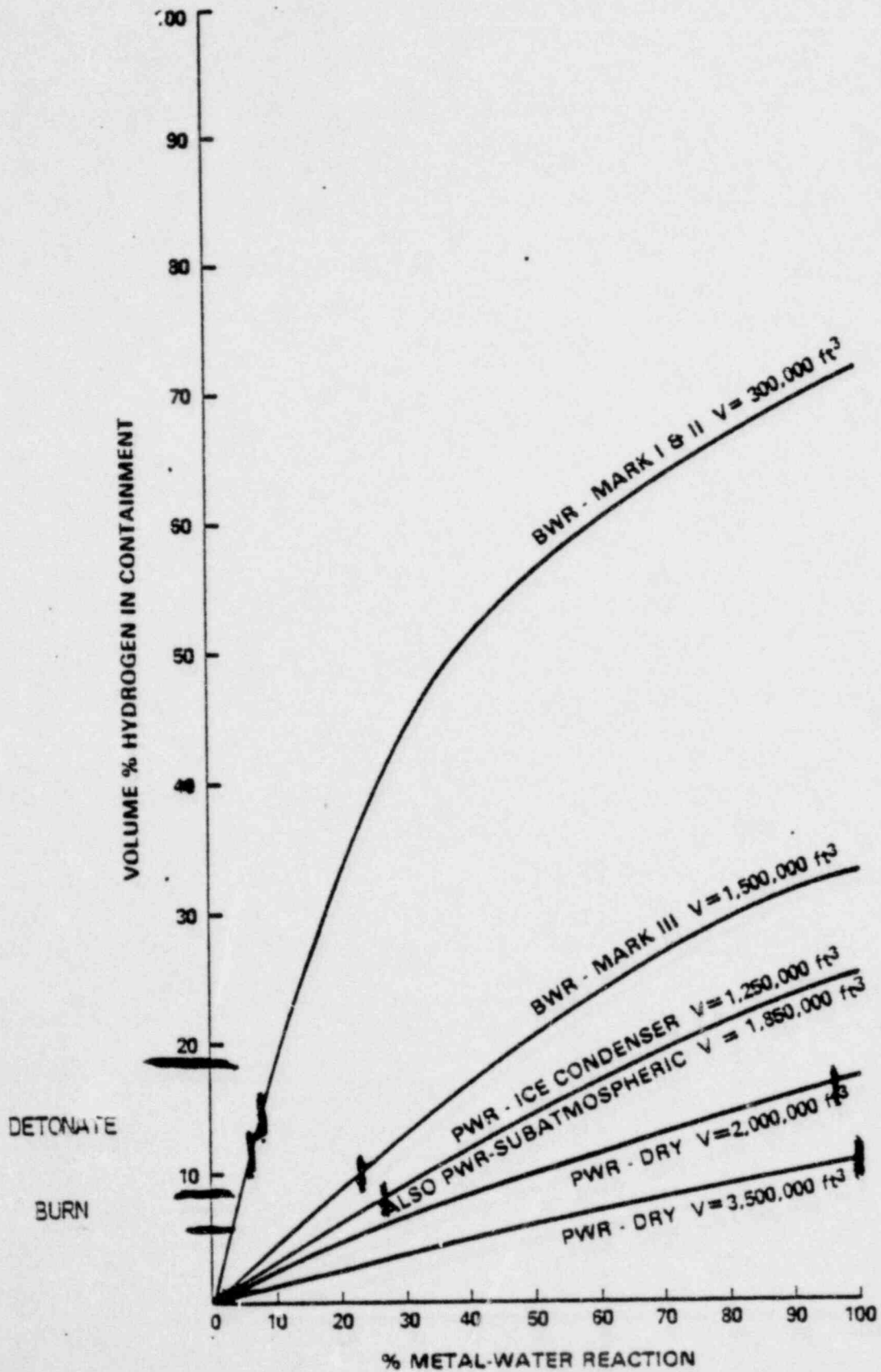
- o 10 CFR 50.44 IN EFFECT AS BASIS FOR POST-ACCIDENT  
COMBUSTIBLE GAS CONTROL
- o HYDROGEN CONTROL MEASURES BEYOND THOSE REQUIRED  
BY 10 CFR 50.44 WILL BE REQUIRED IF IT IS  
DETERMINED THAT THERE IS A CREDIBLE LOCA SCENARIO  
ENTAILING HYDROGEN GENERATION, COMBUSTION,  
BREACH OF CONTAINMENT INTEGRITY AND OFFSITE DOSES  
EXCEEDING 10 CFR 100 GUIDELINE VALUES

EVENTS LEADING TO DEGRADED CORE  
AND PREVENTIVE MEASURES TAKEN SINCE TMI-2

| FAILURE SEQUENCE   | PRINCIPAL PREVENTIVE MEASURES   |
|--|---|
| LARGE LOCA   | TESTING OF RELIEF AND SAFETY VALVES<br>EMERGENCY POWER FOR PRESSURIZER EQUIPMENT<br>DIRECT INDICATION OF VALVE POSITION   |
| LOSS OF ALL ACTIVE EMERGENCY COOLING (AD)  | IMPROVED OPERATING PROCEDURES AND OPERATOR TRAINING<br>SUBCOOLING METER   |
| SMALL LOCA   | PORV SETPOINT MODS; EFWS IMPROVEMENTS   |
| LOSS OF HIGH PRESSURE INJECTION (S <sub>2</sub> D) OR RECIRCULATION FAILURE (S <sub>2</sub> D - MOD) | IMPROVED OPERATING PROCEDURES AND OPERATOR TRAINING<br>SUBCOOLING METER<br>UNAMBIGUOUS INDICATION OF REACTOR VESSEL LEVEL |
| TRANSIENTS   |   |
| LOSS OF ALL AUXILIARY FEEDWATER AND  | VALVES FAIL TO THE OPEN POSITION<br>AUTOMATIC AFW INITIATION<br>INDICATE AFW IN CONTROL ROOM<br>OPERATOR TRAINING         |
| LOSS OF HIGH PRESSURE INJECTION (IMLB)   | IMPROVED OPERATING PROCEDURES AND OPERATOR TRAINING<br>SUBCOOLING METER<br>UNAMBIGUOUS INDICATION OF REACTOR VESSEL LEVEL |

IN ADDITION - MANY GENERAL ITEMS: SHIFT TECHNICAL ADVISOR, SHIFT TURNOVER PROCEDURES, TMI-2 TRAINING, RETRAINING, ETC.

# VOLUME % HYDROGEN IN CONTAINMENT VS % METAL-WATER REACTION





CONTAINMENT ULTIMATE STRENGTH  
AND DESIGN SAFETY MARGINS

- CONTAINMENTS DESIGNED TO CURRENT NRC CRITERIA (ASME SECTION III DIV. 1 AND 2 CODES) GENERALLY HAVE 2.5 TO 2.8 SAFETY FACTORS AGAINST STRUCTURAL YIELD AND SLIGHTLY HIGHER SAFETY FACTORS AGAINST UNCONTROLLED STRUCTURAL DEFORMATION OR FAILURE.

FOR EXAMPLE:

|  | CALCULATED<br>SAFETY FACTOR<br>AGAINST YIELD | ESTIMATED*<br>SAFETY FACTOR<br>AGAINST FAILURE |
|--|--|--|
| ZION PRESTRESSED<br>CONCRETE CONTAINMENT       | 2.7  | 3.0  |
| INDIAN POINT REINF.<br>CONC. CONTAINMENT       | 2.7  | 3.0  |
| SEQUOYAH ICE<br>CONDENSER STEEL<br>CONTAINMENT | 2.7  | 3.2  |
| MCGUIRE STEEL<br>CONTAINMENT                   | 2.8  | 3.4  |

- \* CONSERVATIVELY ESTIMATED VALUES; SHOULD BE VERIFIED BY EXPERIMENTAL RESEARCH.

2. CONTAINMENT RESPONSE TO INTERNAL PRESSURE LOAD  
CONTAINMENTS ARE GENERALLY DESIGNED TO RESPOND TO INCREASING INTERNAL PRESSURE LOADS IN A DUCTILE MANNER WITH HOOP MEMBRANE STRESS CONTROLLING THE DESIGN. DISCONTINUITY ZONES SUCH AS WALL TO MAT, WALL TO DOME JUNCTIONS, EQUIPMENT HATCH, PENETRATIONS NORMALLY HAVE HIGH LOCAL STRESS/STRAIN LEADING TO POTENTIAL LEAKAGE.

3. ONGOING CONTAINMENT RESEARCH/TECHNICAL ASSISTANCE PROGRAMS

|   | FY-80 | FY-81 |
|---|-------|-------|
| (A) REVIEW OF NPP STRUC. DESIGN<br>BY AMES LAB    | 50K   | 104K  |
| (B) STRUCTURAL RESPONSE OF<br>LWR SYSTEMS BY LASL | 150K  | 150K  |

4. UNCERTAINTIES AND CONCERNS

- (A) LEAKAGE OF CONTAINMENT BEYOND DESIGN PRESSURE, ESPECIALLY AT OR BEYOND YIELD OF STEEL, CANNOT BE ACCURATELY COMPUTED OR PREDICTED.
- (B) THERE IS VIRTUALLY NO INFORMATION OR EXPERIMENTAL DATA TO RELATE THE STRESS/STRAIN LEVELS OF LINER

AND WELD MATERIALS TO INITIATION OF LINER CRACKS, CRACK PROPAGATION PATTERN AND SIZE. IT IS BELIEVED THAT THERE SHOULD BE NO CRACK AS LONG AS LINER AND WELD MATERIAL STRESSES ARE KEPT BELOW YIELD. HOWEVER, THIS POINT REQUIRES RESEARCH INVOLVING TESTS FOR FINAL CONFIRMATION.

- (C) NEED FUNDING IN NEXT 2-5 YEARS TO RESOLVE THIS ISSUE.

## H<sub>2</sub> MITIGATION MEASURES

### POTENTIAL METHODS FOR IMPROVING HYDROGEN MANAGEMENT CAPABILITY

INERTING WITH NITROGEN

HALON SUPPRESSION SYSTEM

FILTERED-VENT SYSTEM

HYDROGEN COMBUSTION SYSTEM

OTHER METHODS

USE OF CHEMICAL CATALYSTS

USE OF GAS TURBINES

## RESEARCH

USERS REQUEST HAS BEEN PREPARED AND IS BEING REVIEWED

OBJECTIVE: TO PROVIDE TECHNICAL SUPPORT FOR CONDUCTING A  
RULEMAKING ON DEGRADED/MELTED CORE ACCIDENTS

1. INVESTIGATE FVCS DESIGN PROPOSALS
2. H<sub>2</sub> CONTROL SYSTEMS

THESE ITEMS WILL BE EVALUATED FOR ALL CONTAINMENT TYPES WITH  
INITIAL FOCUS ON ICE CONDENSERS.

DRAW ON INFORMATION LEARNED FROM RELATED STUDIES (Z/IP)

### 3-PHASES OF PROGRAM

1. ESTABLISH RELEASES TO CONTAINMENT FOR  
DEGRADED/MELTED CORE ACCIDENTS
2. DETERMINE CONTAINMENT RESPONSE (BULK AND LOCALIZED)
3. EVALUATE MITIGATION DEVICES

## RELATED TOPICS

- INTERIM RULE

1. REQUIRES INERTING OF MARK I AND MARK II
2. REQUIRES ANALYSES OF OTHERS
3. CODIFIES LESSONS LEARNED ITEMS
4. SHOULD BE READY FOR COMMISSION CONSIDERATION BY JULY 1980

- FINAL RULE

1. PROCEEDING WILL CONSIDER BROAD RANGE OF ISSUES RELATED TO DEGRADED/MELTED CORE ACCIDENTS IN SAFETY REVIEWS
2. ADVANCE NOTICE IS NOW UNDER REVIEW BY NRR
3. COMPLETION = = 1982

- USI POTENTIAL

DEGRADED CORE COOLING, INCLUDING THE HYDROGEN MANAGEMENT ISSUE IS A CANDIDATE FOR ADDITION TO THE NRR PROGRAM FOR USIs.

- Z/IP STUDIES

1. OBJECTIVE: IMPROVE SAFETY AT ZION AND INDIAN POINT PLANTS

## GENERAL ELECTRIC'S OBSERVATIONS

MARK I AND II DO NOT REQUIRE INERTING ....

- o BWR DESIGN FEATURES PREVENT HYDROGEN GENERATION
  - REACTOR VESSEL WATER LEVEL MEASUREMENT
  - RAPID DEPRESSURIZATION CAPABILITY
  - STRONG NATURAL CIRCULATION
  - LARGE PASSIVE HEAT SINK IN CONTAINMENT
  
- o INERTING YIELDS SMALL RISK REDUCTION
  
- o HAZARD TO PLANT PERSONNEL INCREASED
  
- o CONTAINMENT ENTRY DISCOURAGED AND INSPECTION REDUCED

## GENERAL ELECTRIC'S CONCLUSIONS

PROPOSAL SHOULD NOT BE APPROVED ....

- o PRESCRIPTIVE
- o NOT URGENT SAFETY ISSUE
- o INADEQUATE BASIS

ADDRESS IN RULE MAKING PROCESS ....

- o SOLICIT BALANCED AND QUANTITATIVE INPUT
- o TIMING CONSISTENT WITH LOW RISK
- o IDENTIFY GREATEST RISK REDUCTION STEPS



RELATED TOPICS (CONTD:)

- Z/IP STUDIES (CONTD:)
  2. PARTICIPANTS: SNL, LASL, BCL, UTILITIES, STAFF
  3. SCHEDULE: CRITERIA FOR SAFETY DEVICES  
6/30/80  
  
COMPLETE PROGRAM  
9/80

APPLICATION OF DECISION ELEMENTS  
TO VARIOUS CONTAINMENT DESIGNS

|                         | MARK I AND MARK II  | ICE CONDENSERS | MARK III               | SUBATMOSPHERIC         | DRY                    |
|-------------------------|---------------------|----------------|------------------------|------------------------|------------------------|
| LIKELIHOOD              | LOW                 | LOW            | LOW                    | LOW                    | LOW                    |
| HYDROGEN CONCENTRATIONS | HIGH                | MODERATE       | MODERATE               | MODERATE               | LOW                    |
| STRUCTURAL RESPONSE     | PROBLEM             | PROBLEM        | PROBLEM                | NO PROBLEM             | NO PROBLEM             |
| MITIGATION MEASURES     | EXIST               | UNCERTAIN      | UNCERTAIN              | UNCERTAIN              | UNCERTAIN              |
| CONCLUSIONS             | REQUIRE<br>INERTING | STUDIES        | NOTHING<br>MORE<br>NOW | NOTHING<br>MORE<br>NOW | NOTHING<br>MORE<br>NOW |