

PROPOSED INTERIM HYDROGEN CONTROL
REQUIREMENTS FOR SMALL CONTAINMENT

(SECY 80-107)

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80040200 91

TECHNICAL DISCUSSION

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RULEMAKING STATUS

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STAFF CONCLUSIONS

THE SMALL CONTAINMENTS, BWR MARK I AND MARK II DESIGNS,
SHOULD BE INERTED. AN IMMEDIATELY EFFECTIVE CHANGE IN
10 CFR 50.44 SHOULD BE MADE TO REQUIRE THIS.

CONTINUED OPERATION AND LICENSING OF OTHER NUCLEAR PLANTS
CAN BE PERMITTED PENDING COMPLETION OF ADDITIONAL STUDIES
AND RULEMAKING.

PARAMETERS THAT GOVERN AN LWR PLANT'S CAPABILITY FOR HYDROGEN MANAGEMENT

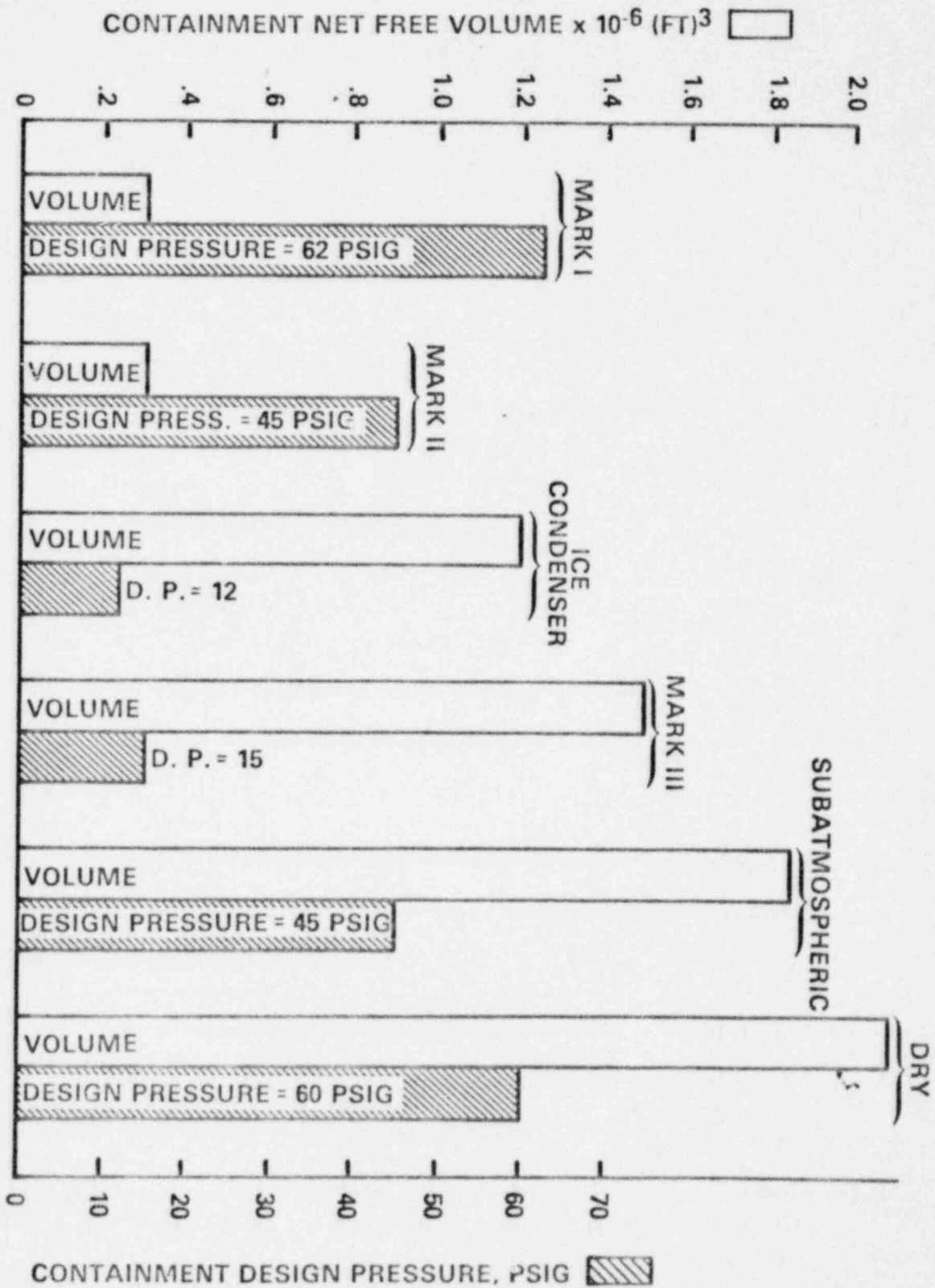
DESIGN PARAMETERS

1. Containment Volume
2. Containment Design Pressure
3. Amount of Zircaloy Cladding

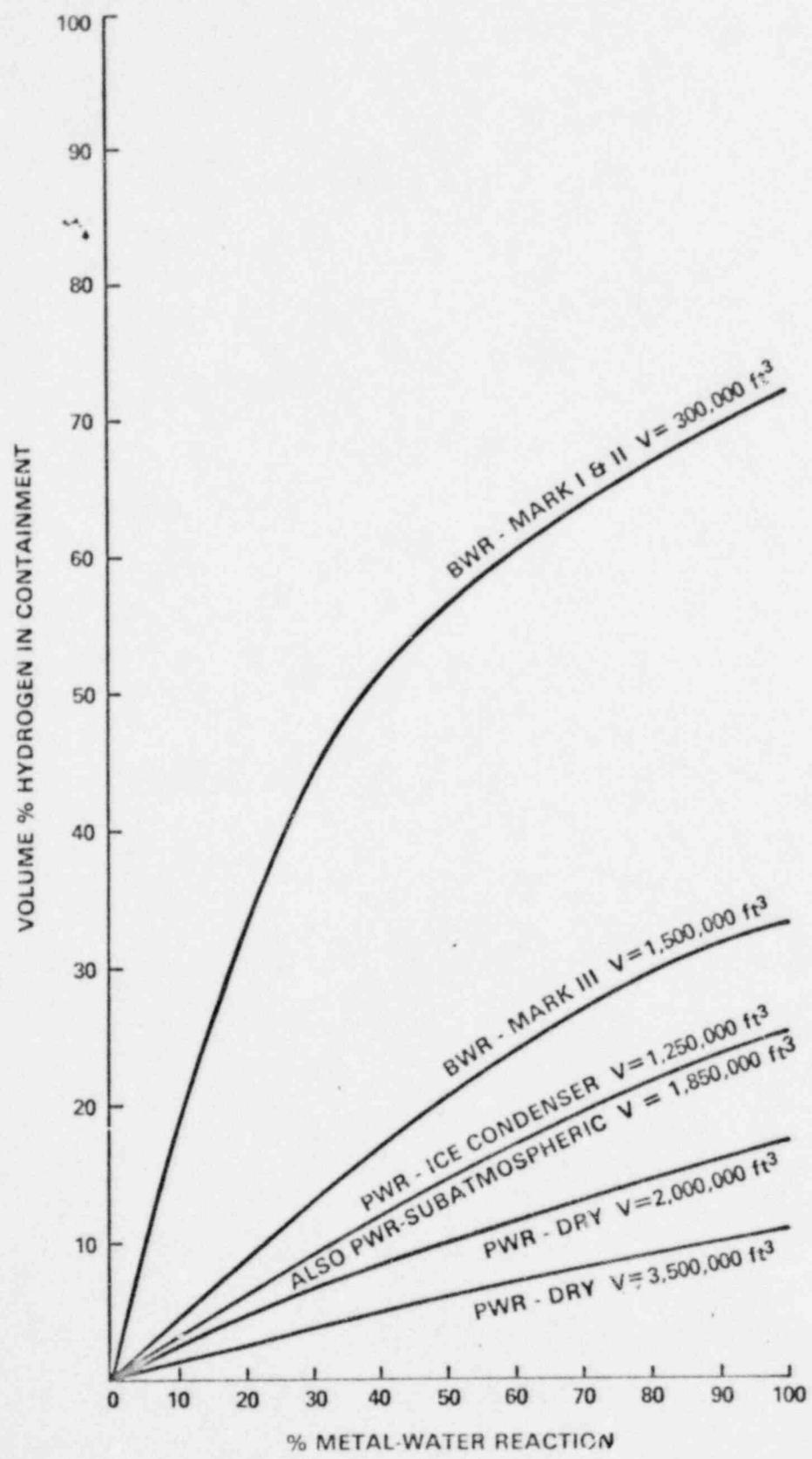
ASSESSMENT PARAMETERS

1. Hydrogen Concentration
 - Combustion Limits
 - Detonation Limits
2. Containment Pressure
 - Non-Condensable Gas Addition
 - Energy Addition
 - Heat Removal System Capability

COMPARISON OF CONTAINMENT VOLUMES AND DESIGN PRESSURES (TYPICAL 1200 MWe PLANTS)



VOLUME % HYDROGEN IN CONTAINMENT VS % METAL-WATER REACTION



**COMPARISON OF AMOUNTS
OF NON-CONDENSIBLE GASSES
(TYPICAL 1200 MWe PLANTS)**

Containment Type	Pre-Accident Atmosphere (SCF)	Hydrogen Gas from 100% M-W
Mark I (BWR)	300,000	700,000
Mark II (BWR)	300,000	700,000
Mark III (BWR)	1,500,000	700,000
Ice Condenser (PWR)	1,250,000	400,000
Subatmospheric (PWR)	1,250,000	400,000
Dry Containments	2,000,000	400,000

COMPARISON OF ENERGY SOURCES AND SINKS

(APPROXIMATE FOR THE TYPICAL 1200 MWe PLANT)

SOURCES:

LOCA Blowdown Energy:	400 Million Btu's
Exothermic M-W Reaction (100%):	250/140 Million Btu's
Combustion of M-W Hydrogen:	200/110 Million Btu's
Steam Generator Energy (PWR):	100 Million Btu's
Decay Heat Energy (1st Hour):	60 Million Btu's/hour

SINKS:

BWR Suppression Pool's ($\Delta T=100^{\circ}F$):	600 Million Btu's
PWR Ice Condensers:	500 Million Btu's
PWR Fan Coolers:	100 Million Btu's/hour
PWR Containment Spray System:	100 Million Btu's/hour
BWR Pool Cooling System:	200 Million Btu's/hour

SUMMARY OF CONTAINMENT CAPABILITY TO ACCOMODATE HYDROGEN GENERATION FROM METAL-WATER REACTION

CONTAINMENT TYPE	WITHOUT HYDROGEN COMBUSTION		WITH HYDROGEN COMBUSTION		REMARKS
	DESIGN PRESSURE	EST. FAILURE PRESSURE	DESIGN PRESSURE	EST. FAILURE PRESSURE	
Mark I	Calculations sufficient to complete this column were not performed.	100%	5%	9%	Inerting should be made a requirement. Inerting need not be made a reqmt. pending the rulemaking proceeding.
Mark II		100%	4%	6%	
Mark III		~100%	17%	23%	
Ice Condenser		~100%	15%	25%	
Subatmospheric		100%	53%	~100%	
Dry		100%	~65%	100%	

SUMMARY OF ANALYSES

PARAMETERS	CONTAINMENT TYPES					
	MARK I	MARK II	MARK III	ICE CONDENSER	SUB-ATMOSPHERIC	DRY CONTAINMENT (SMALL)
DESIGN PRESSURE, PSIG	60	45	15	12-15	45	45-60
FAILURE PRESSURE, EST., PSIG	120	90	30	36-47	90	90-120
ESTIMATED PRESSURE 50% M-W; NO BURN, PSIG	56	56	20-22	30	-	-
ESTIMATED PRESSURE 100% M-W; NO BURN, PSIG	88	88	29-32	38	-	-
ESTIMATED PRESSURE 30% M-W; W/BURN, PSIG	>>200	>>200	55	42	10	3
ESTIMATED PRESSURE 50% M-W; W/BURN, PSIG	>>200	>>200	>100	>100	41	27
% M-W TO REACH ESTIMATED FAILURE PRESSURE W/NO BURN	>100	~100	~100	~100	>100	>100
% M-W TO REACH ESTIMATED FAILURE PRESSURE W/BURN	9	6	22	25	90	90->100

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