

March 23, 1988

Project No. 669

MEMORANDUM FOR: Lester S. Rubenstein, Director
Standardization and Non-Power
Reactor Project Directorate
Division of Reactor Projects - III, IV,
V and Special Projects

FROM: Paul H. Leech, Project Manager
Standardization and Non-Power
Reactor Project Directorate
Division of Reactor Projects - III, IV,
V and Special Projects

SUBJECT: MEETING WITH ELECTRIC POWER RESEARCH INSTITUTE AT
Rockville, Maryland, March 18, 1988

On March 18, 1988, representatives of the Electric Power Research Institute (EPRI) provided a briefing for ONRR senior management on passive safety systems being considered for the Advanced Light Water Reactor (ALWR) Program. Those persons who attended the meeting are listed in Enclosure 1.

Enclosure 2 consists of copies of the viewgraphs presented by EPRI. As indicated on the fourth and fifth pages, a passive plant design would feature (1) gravity-driven ECCS, (2) natural circulation decay heat removal, and (3) passive containment heat removal. The numbers of components, such as pumps and valves, can be substantially reduced and it is expected that rapid construction can be achieved through modularization and factory fabrication. A reference plant capacity of 600 MWe has been selected as the basis for development of the utility-generated requirements for the passive ALWR, which can be either a BWR or a PWR.

EPRI informed the staff that the rest of the Chapters (6 through 13) of the Utility Requirements Document for the 1100-MWe ALWR plant will be submitted, as planned, by the end of 1988 for NRC review. Then, a revised Chapter 1 and a parallel set of Chapters 2-13 for the 600-MWe passive plant will be submitted in 1989. EPRI's view is that, since most of the material in the two sets of documents will be the same, a six-month extension (to mid-1991) of the NRC's schedule for completion of its Final Safety Evaluation should be adequate.

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original signed by
Paul H. Leech, Project Manager
Standardization and Non-Power
Reactor Project Directorate
Division of Reactor Projects - III, IV,
V and Special Projects

Enclosures:
As stated

DISTRIBUTION:

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03/27/88

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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ATTENDANCE LIST

Meeting with Electric Power Research Institute (EPRI)
at the One White Flint North Building in
Rockville, Maryland
March 18, 1988

<u>Name</u>	<u>Organization</u>
Thomas Murley	NRR
Frank Miraglia	NRR
Dennis Crutchfield	NRR
Larry Shao	NRR
Conrad McCracken	NRR
Lester Rubenstein	NRR
Thomas Kenyon	NRR
Paul Leech	NRR
Thomas Walker	RES
Frank Gillespie	NRR
William Sugnet	EPRI
Joseph Yedidia	EPRI
John DeVine, Jr.	EPRI
Dan Giessing	DOE

Passive Plant

**PRESENTATION TO
NRC STAFF
March 18, 1988**

AGENDA

- Passive Plant Program Overview J. C. DeVine Jr./EPRI
- Passive Plant Design Concepts W. R. Sugnet/EPRI

EPRI ALWR Program

Passive Plant

ALWR PROGRAM GOALS

- Establish utility leadership and effect positive progress toward a revitalized nuclear power option in the United States
- Formulate a practical and credible foundation for the design of advanced light water reactors for the next decade

EPRI ALWR Program

Passive Plant

ALWR PROGRAM OBJECTIVES

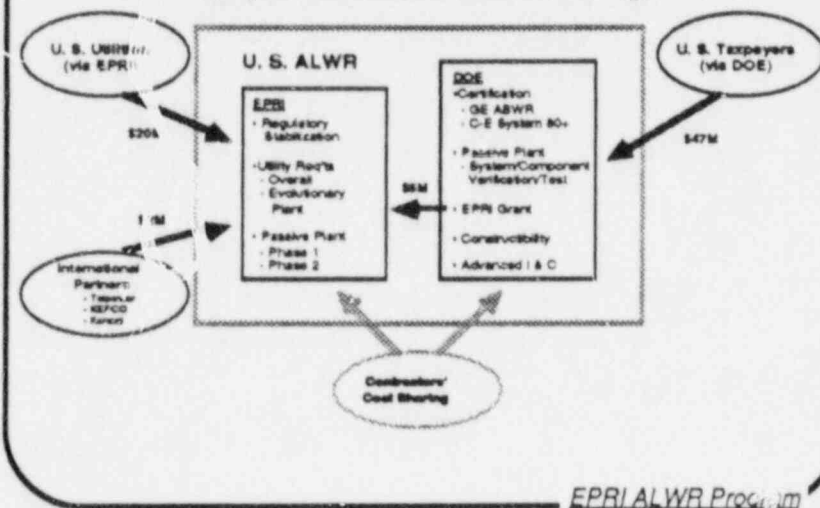
In support of these goals, the ALWR Program objectives are:

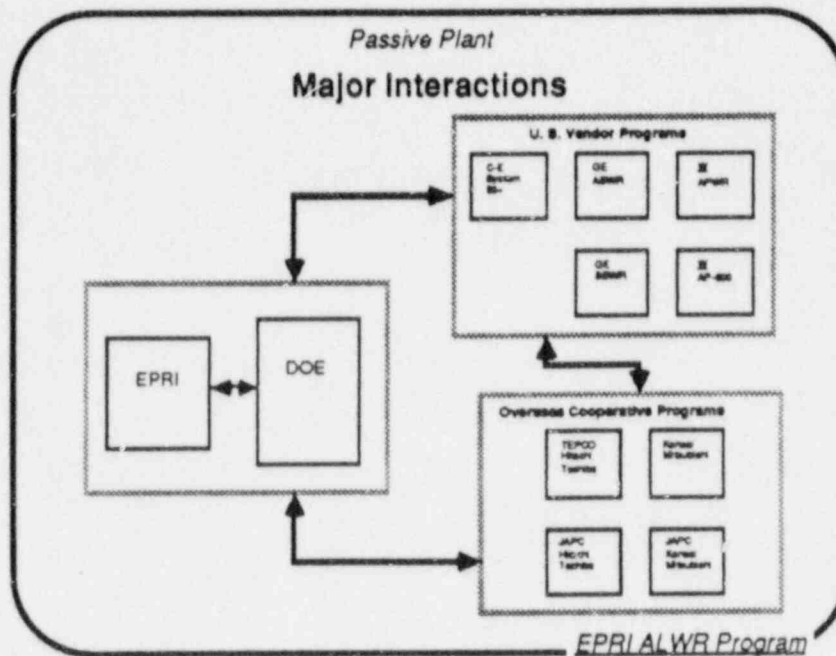
- A stabilized regulatory basis, via cooperative effort with NRC to identify and resolve outstanding issues of nuclear plant safety
- Development of a set of specific design and performance requirements for the advanced LWR (The "Requirements Document")
- An assessment of nuclear plant design concepts which would incorporate greatly simplified, passive safety systems

EPRI ALWR Program

Passive Plant

Major Elements and Funding





Passive Plant

CONCEPT

- Utilizes primarily passive means (gravity, natural circulation, stored energy) for accident prevention and mitigation
- Core protected without operator action for about 3 days
- Greatly simplified compared to existing plants
- PWR or BWR, reference size 600 MWe
- Extensive modularization, prefabrication

EPRI ALWR Program

Passive Plant

KEY ADVANTAGES

- Passive Plant offers high potential for renewed public, government and investor confidence
- Fundamental advances in
 - safety
 - simplicity
 - constructibility
- Economic prospects
 - better match to utility needs with uncertain demand growth
 - smaller capital investment to first power generated
 - major simplification and rapid construction to neutralize traditional economy of scale
- Historical high capacity factor for smaller, simpler plants

EPRI ALWR Program

Passive Plant

TECHNICAL APPROACH

- Based on proven technology -- no prototype required
- Perform necessary safety functions by passive means
 - Gravity-driven ECCS
 - Natural circulation decay heat removal
 - Passive containment heat removal
- Rapid construction (36 months) with maximum use of modularization and factory fabrication

EPRI ALWR Program

Passive Plant

PROGRAMMATIC APPROACH

- EPRI leadership in Phase 1
- Expanded emphasis and resources in Phase 2
 - technical evaluation of key issues
 - extend utility requirements to cover passive system concepts
- Two design teams:
 - SBWR: GE/Bechtel/MIT
 - AP600: W/Burns & Roe/Avondale
- Synergism
 - close cooperation with large DOE program
 - encourage international cooperation
 - maintain strong utility liaison

EPRI ALWR Program

Passive Plant

UTILITY REQUIREMENTS DOCUMENT

Evolutionary Plant

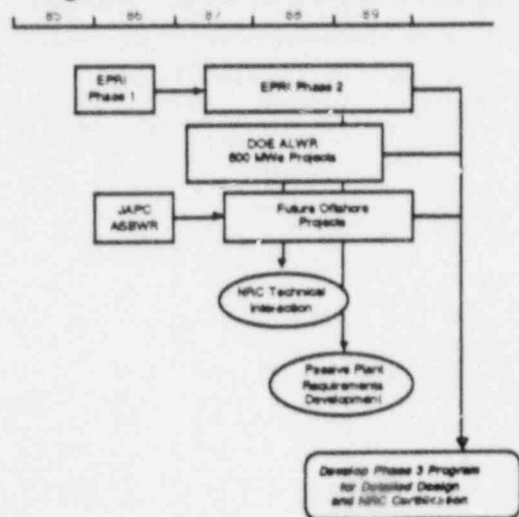
Chapters

- 2 - Power Generation
- 3 - Reactor Coolant System
- 4 - Reactor
- 5 - Safety Systems
- 6 - Plant Arrangements
- 7 - Refueling
- 8 - Cooling Water
- 9 - Site Support
- 10 - MMIS
- 11 - Electric Power

EPRI ALWR Program

Passive Plant

Program Plans and Coordination



EPRI ALWR Program

Passive Plant

SBWR Features

NATURAL CIRCULATION

- Full power capability using natural circulation for core flow
- Major simplification - no recirculation pumps
- Lower power density core
 - more thermal margin
 - better fuel economics
- Larger RCS inventory -- lower pressure rate, better transient response
- Need to control vessel height

EPRI ALWR Program

Passive Plant

SBWR Features

ISOLATION CONDENSER/STEAM INJECTOR

- Natural circulation decay heat removal when reactor is isolated
- Isolation condenser cooled by elevated suppression pool
- No need for separate heat sink for isolation condenser
- Steam injector provides passive means for limited makeup to RCS
- Prevents need to depressurize system for small RCS leaks
- Device development and testing in process

EPRI ALWR Program

Passive Plant

SBWR Features

GRAVITY DRAIN COOLING SYSTEM

- Depressurization valves open to reduce system pressure
- Larger RCS inventory keeps core covered during depressurization (positive synergy between NC and GDCCS)
- Gravity flow from elevated suppression pool provides core cooling
- Demonstration testing and model benchmarking in process

EPRI ALWR Program

Passive Plant

SBWR Features

PASSIVE CONTAINMENT COOLING SYSTEM

- Water-wall concept provides passive heat removal from suppression pool
- Clean water boils to atmosphere - 3-day water supply
- Optimum configuration being studied
 - water-wall approach
 - boiler tube modular approach

EPRI ALWR Program

Passive Plant

AP600 Features

IMPROVED RCS CONFIGURATION

- Canned motor RCPs, directly coupled to S/G outlet
- Removes crossover leg from RCS
- Simplified loop arrangement allows single support on bottom of S/G
- Lower resistance loop and enhanced pump inertia provide capability for loss of flow
- High-inertia pump bearing being tested
- Verification of access/maintainability aspects of configuration in process

EPRI ALWR Program

Passive Plant

AP600 Features

NATURAL CIRCULATION DHR

- Full pressure heat exchanger connected to RCS
- Thermal driving head from core produces natural circulation flow
- In-containment Refueling Water Storage Tank provides heat sink

EPRI ALWR Program

Passive Plant

AP600 Features

GRAVITY-DRIVEN ECCS

- Full pressure Core Makeup Tanks drain to keep core covered during depressurization
- Depressurization valves open; RCS depressurizes to IRWST
- Gravity flow from IRWST floods depressurized RCS for long term cooling
- Studies in process to assess likelihood of and recovery from inadvertent operation

EPRI ALWR Program

Passive Plant

AP600 Features

PASSIVE CONTAINMENT COOLING

- Steel containment with concrete shield building and annulus removes decay heat by natural convection
- Exterior of containment is wetted to improve heat transfer for early phase
- Air cooling sufficient for long term cooling
- Analyses and test being conducted to verify sufficient heat transfer

EPRI ALWR Program

Passive Plant

AP600 Features

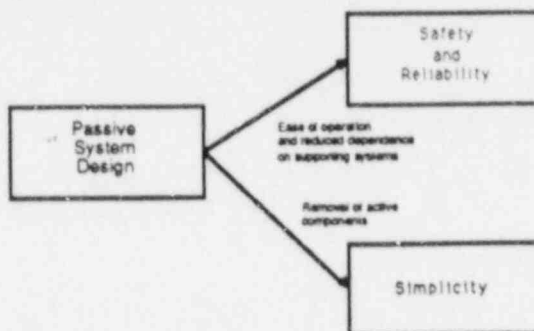
MODULARIZATION

- Modularization and factory fabrication have been integral to the concept from the outset
- Early studies showed economic incentive for factory fabrication in fluid/mechanical areas
- Extensive ongoing work to optimize modular approach

EPRI ALWR Program

Passive Plant

Simplification Through Passive Systems



Passive system design leads to

- improved safety and reliability
- major simplification

EPRI ALWR Program

Passive Plant

POTENTIAL FOR SIMPLIFICATION

TYPICAL
2-LOOPAP 600

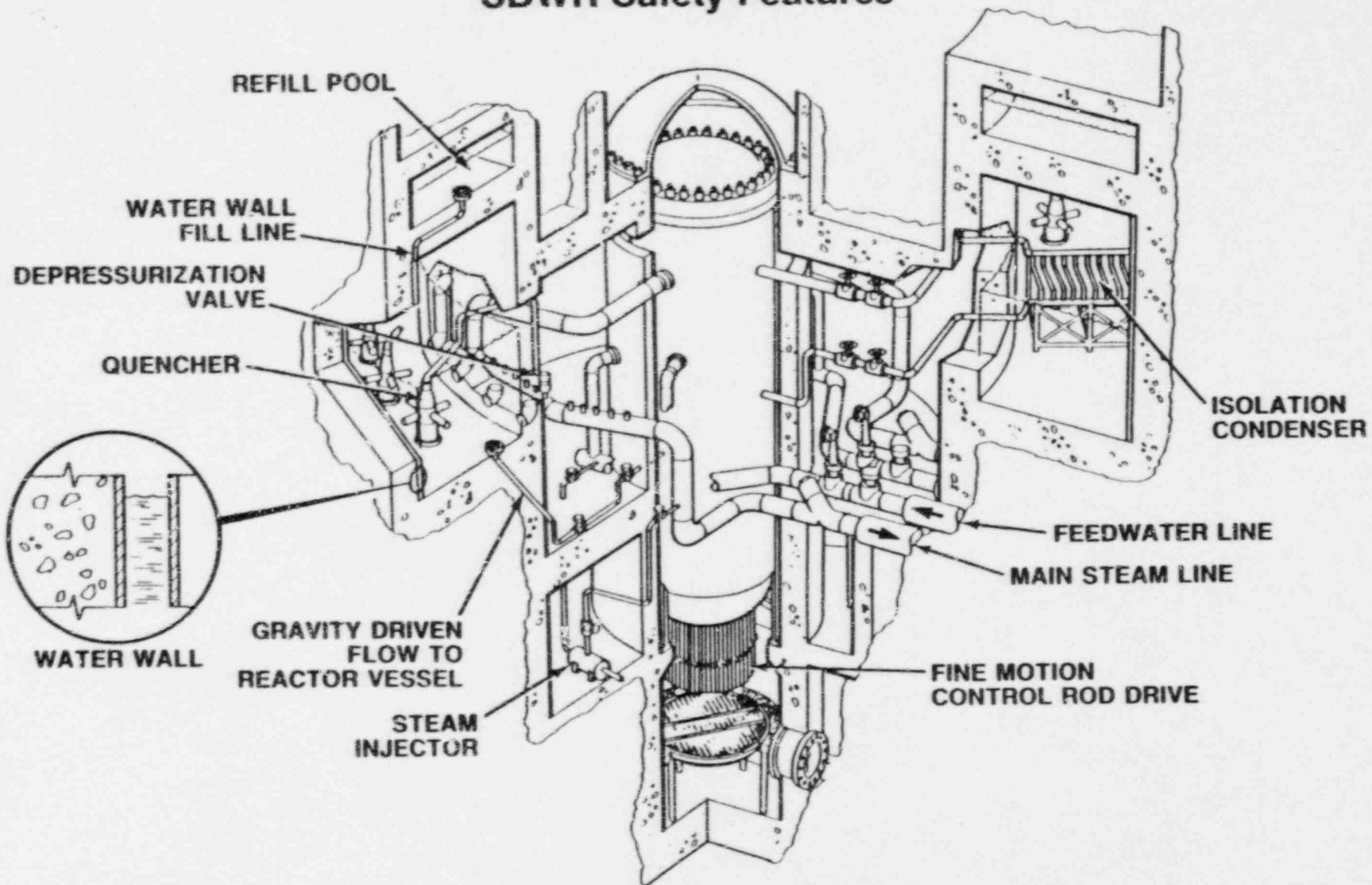
	PLANT	PLANT	REDUCTION
Valves	2,200	400	80%
Pumps	40	14	65%
Seismic Building	274,100m3	157,700m3	40%
Total Building	452,300m3	350,200m3	20%

• Use of passive system design has major potential for simplification

EPRI ALWR Program

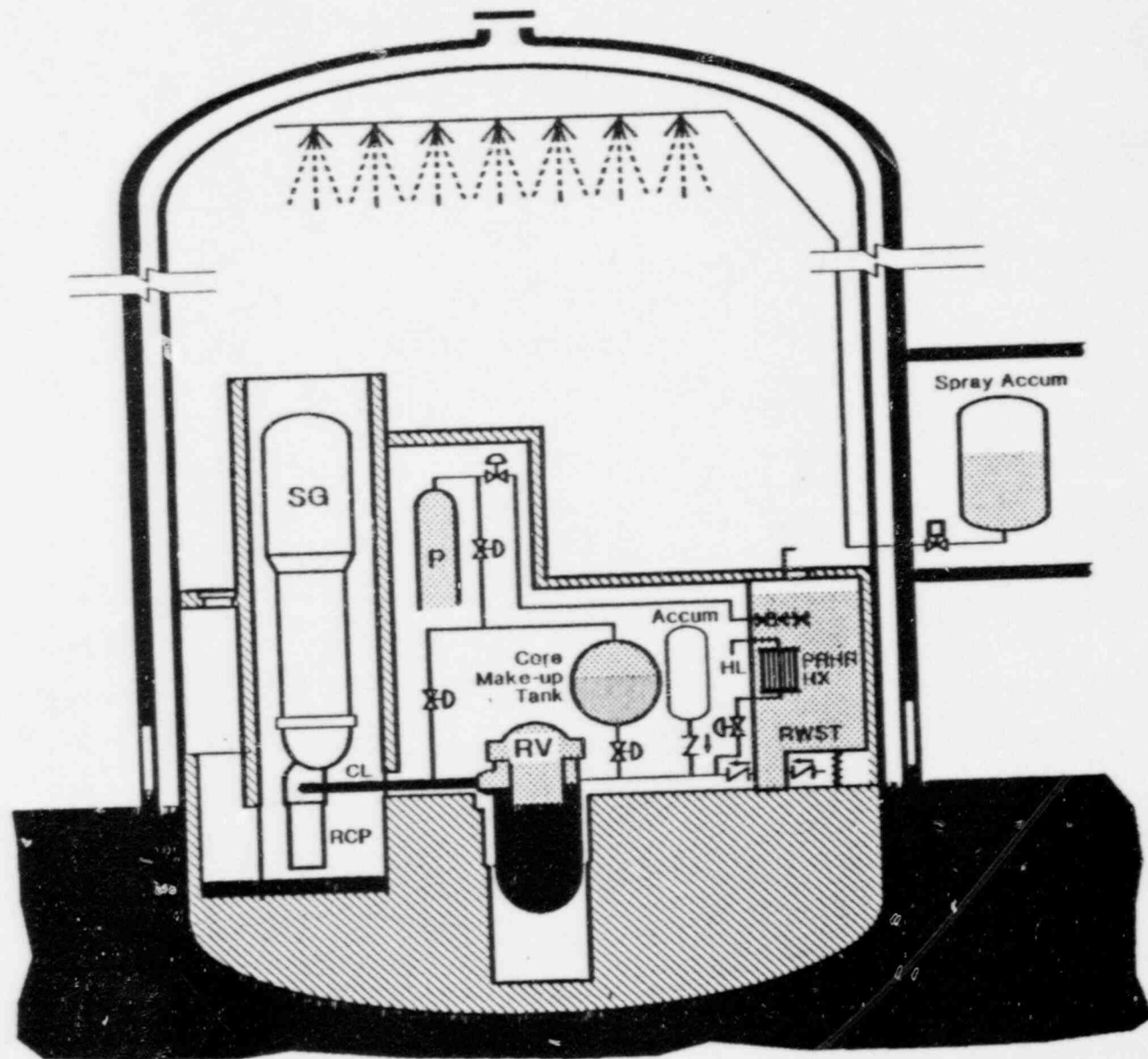
Description of SBWR Features

SBWR Safety Features



AP-600 PASSIVE SAFEGUARDS

LOCA (INITIATION)



AP600 REACTOR COOLANT SYSTEM

