Summary and Conclusions

A.S. Rao

NRC Staff - GE Meeting
June 20 and 21, 2002
Rockville, Maryland

Purpose of Meeting

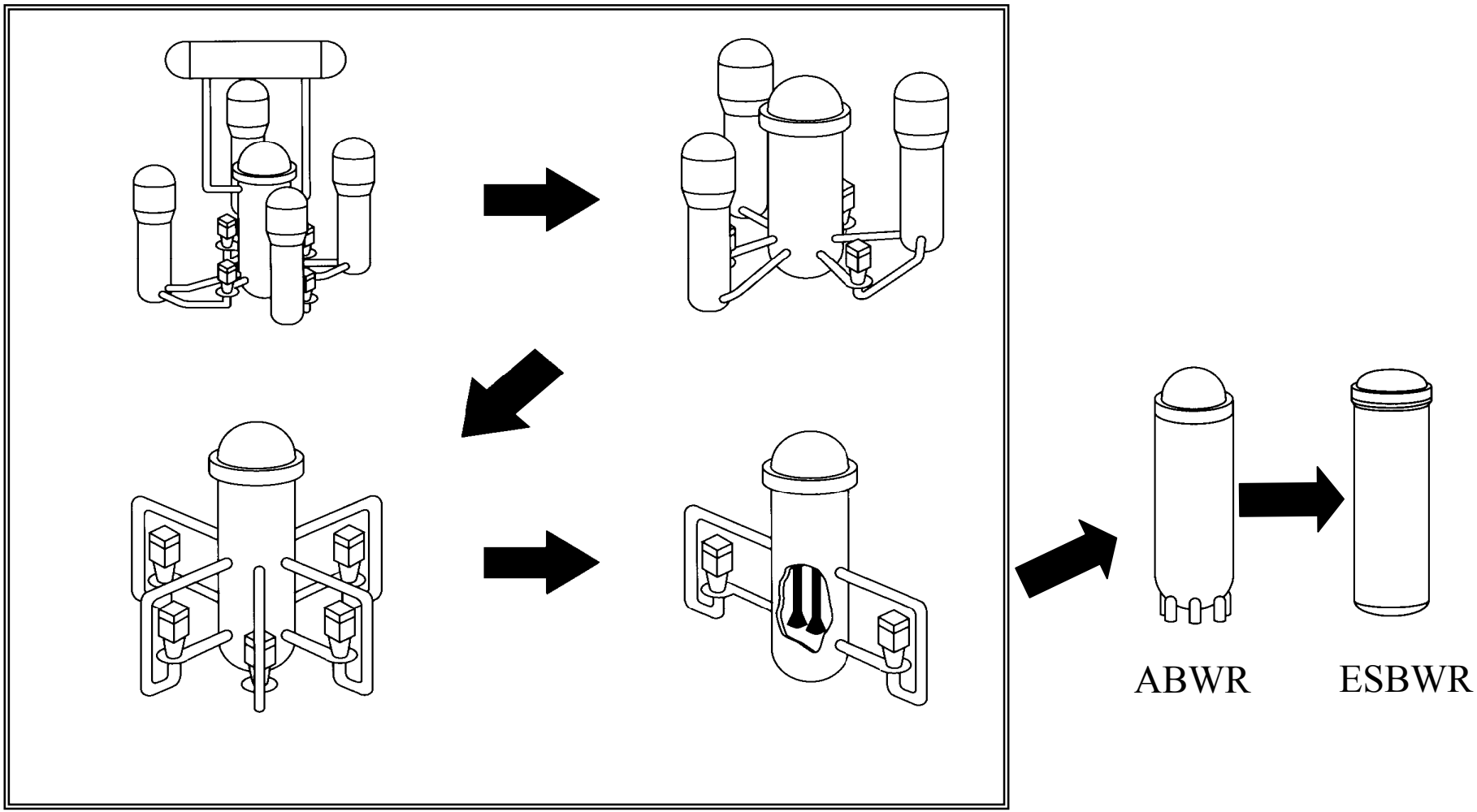
- ***Provide ESBWR background information to NRC staff***
  - Issues to be resolved during pre-application review
    - Adequacy of testing, analysis methodology approval, SSAR details
  - Reference design
  - Testing and technology basis
  - Analysis methodology, qualification and application approach
  - Preview of submittals to be made in August/Sept 2002
- ***Obtain NRC feedback***
  - Overall approach to pre-application review
  - Identification of additional information needed by NRC for completing pre-application review
  - Schedule and steps for reaching agreement on pre-application review scope, schedule and cost and overall plan

Items Covered During the Meetings

- ***Pre-application plan***
  - Testing, Methodology and SSAR
- ***Design description***
  - Simplification of systems/buildings including passive safety systems
  - Simplification results in improved reliability and performance improvement
- ***Improved plant performance by modifying design features***
  - Taller vessel, more water inventory
  - More wetwell airspace, less leakage, containment overpressure system
- ***Technology basis provides high confidence in design***
  - SBWR test program supplemented with ESBWR specific tests
  - TRACG code is well qualified for the ESBWR applications

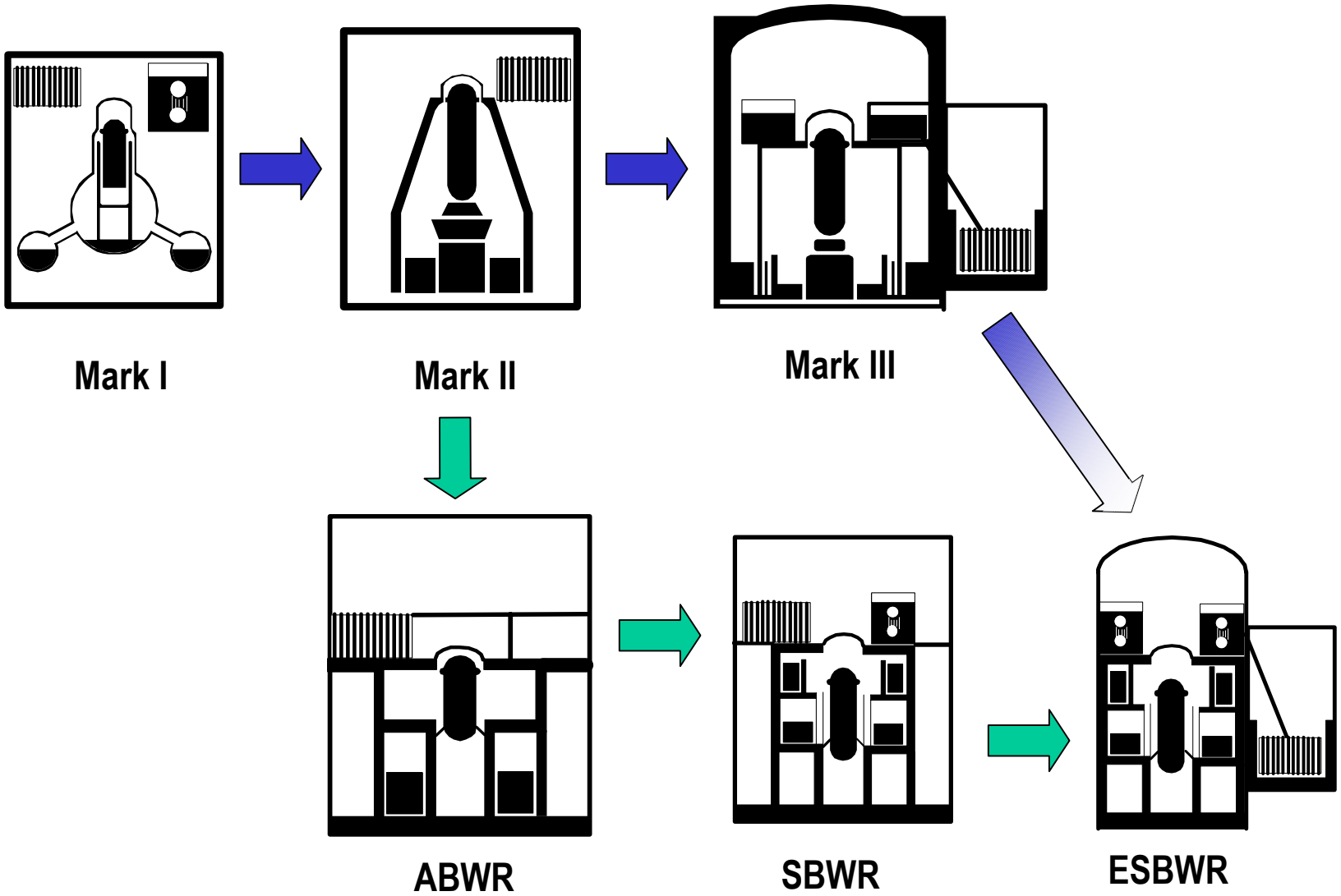
Enhanced performance and economics and a solid technology basis provide confidence in the design

Evolution of the ESBWR Reactor Design



Evolution and innovation towards simplicity and reliability

Evolution of BWR Containments



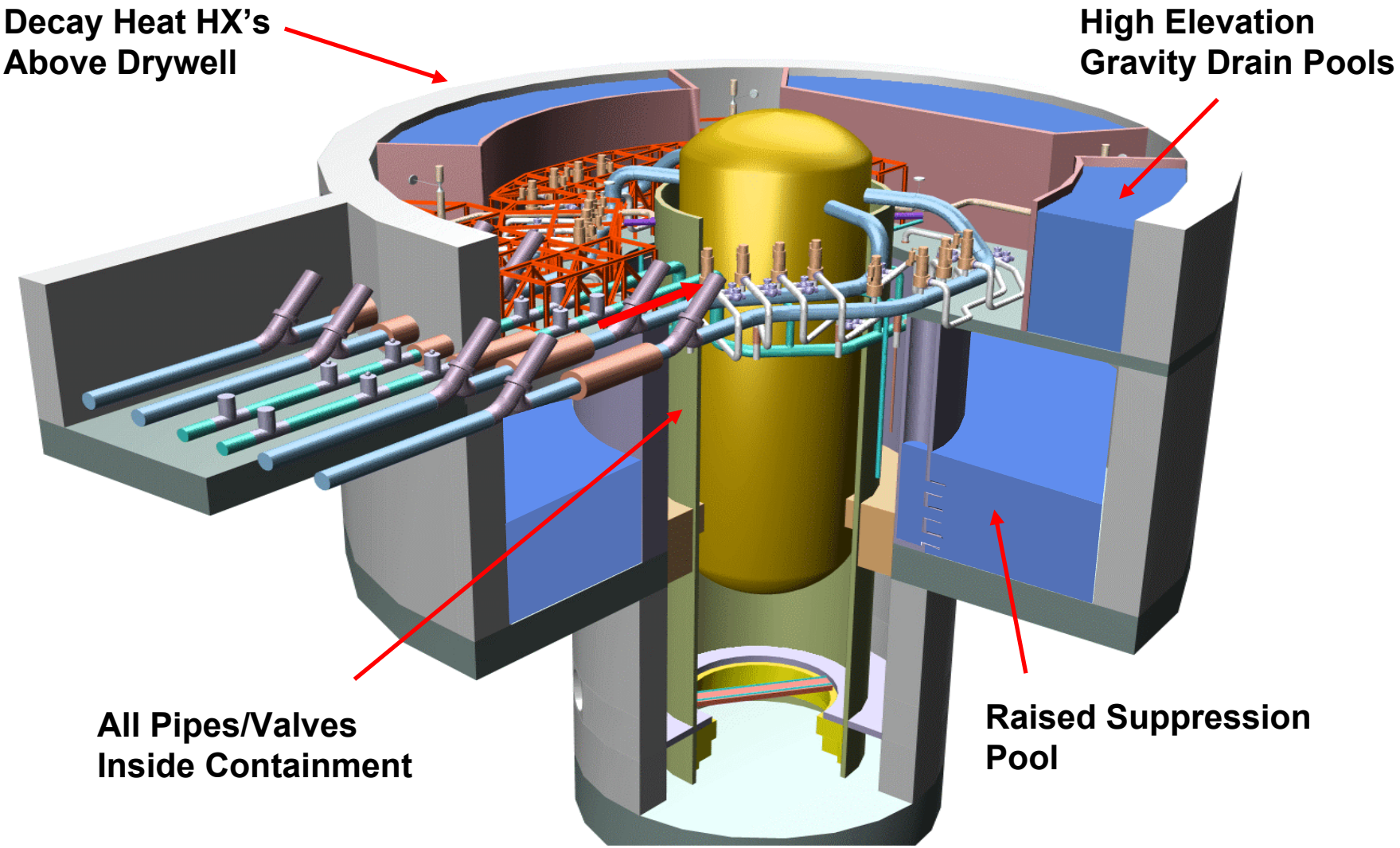
Evolution and innovation towards simplicity and margin

Comparison of Key Parameters

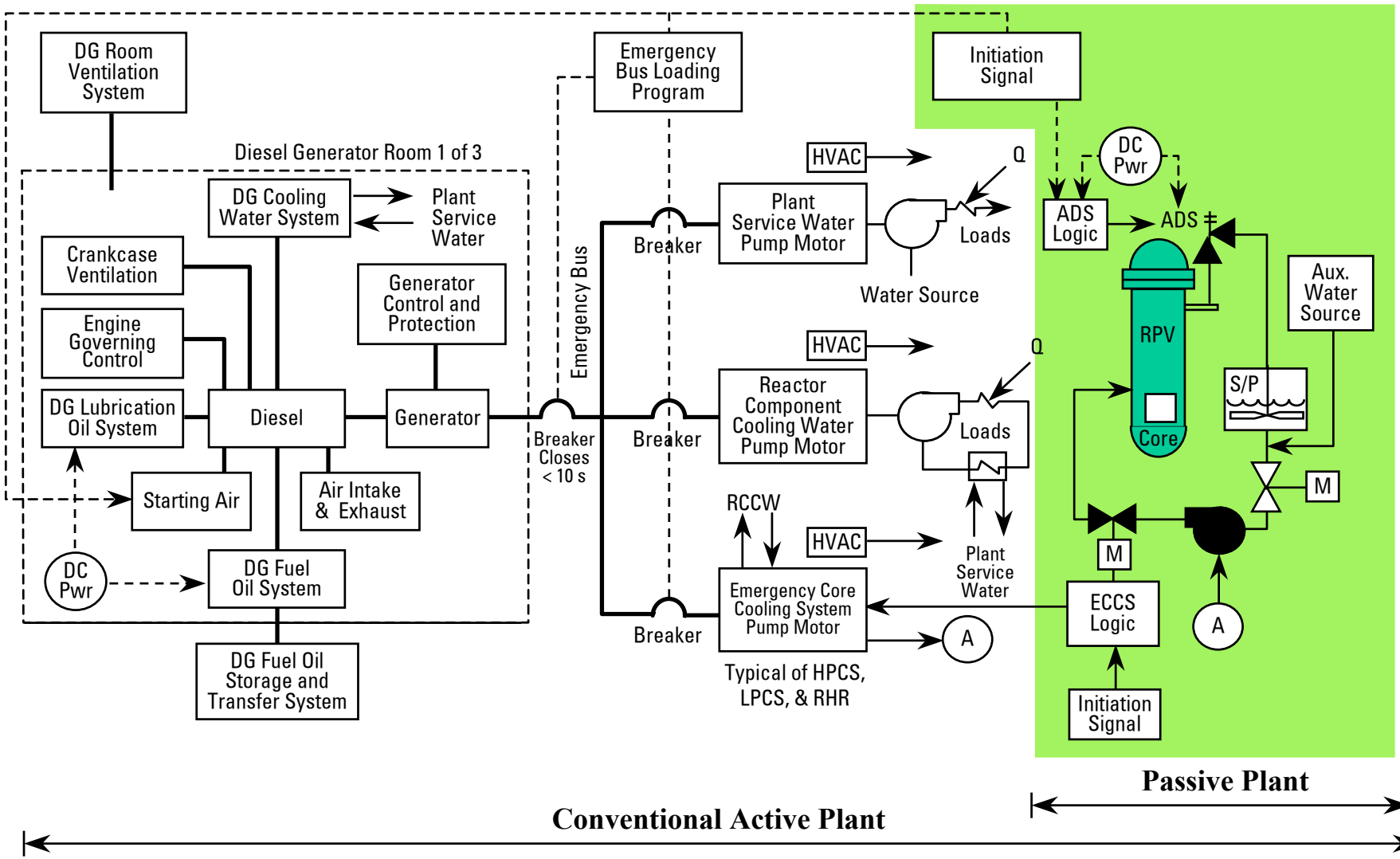
Parameter	BWR/4-Mk I (Browns Ferry 3)	BWR/6-Mk III (Grand Gulf)	ABWR	ESBWR
Power (MWt)	3293	3833	3926	4000
Power (MWe)	1098	1290	1350	1380
Vessel height (m)	21.9	21.8	21.1	27.7
Vessel diameter (m)	6.4	6.4	7.1	7.1
Fuel Bundles (number)	764	800	872	1020
Active Fuel Height (m)	3.7	3.7	3.7	3.0
Power density (kw/l)	50	54.2	51	54
Number of CRDs	185	193	205	121

Evolution towards simplicity within a small range

Safety Systems Inside Containment Envelope

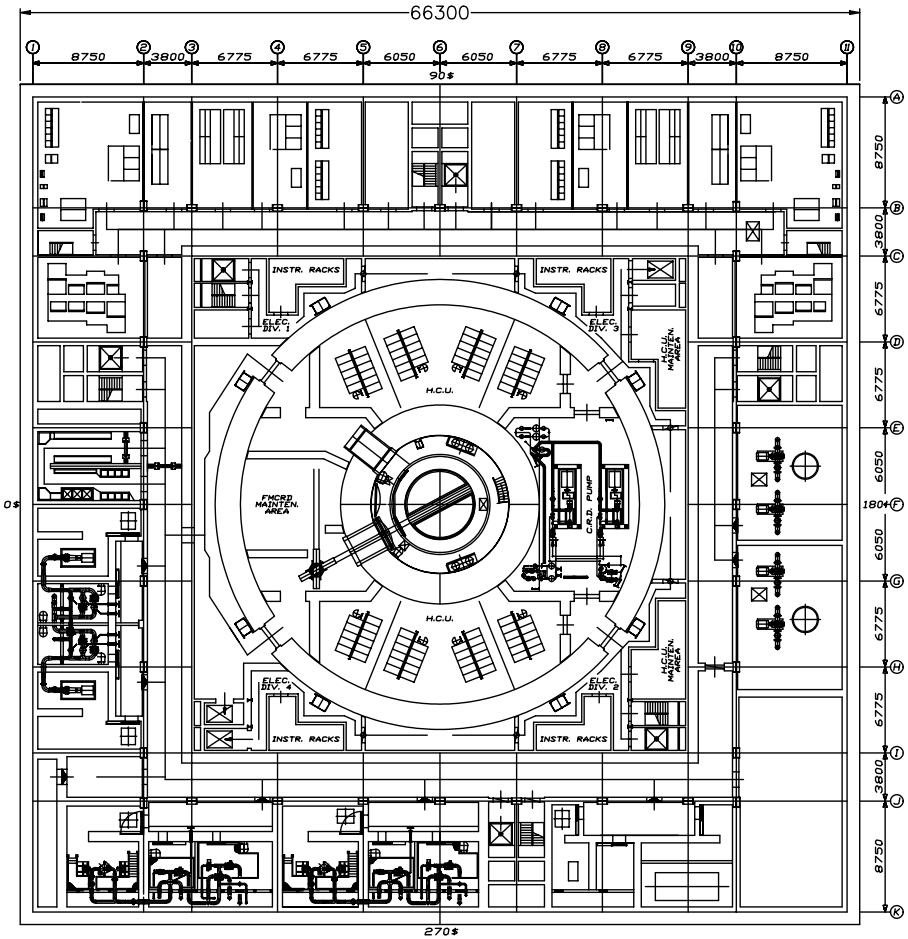


Comparison of Safety System - Passive vs. Active

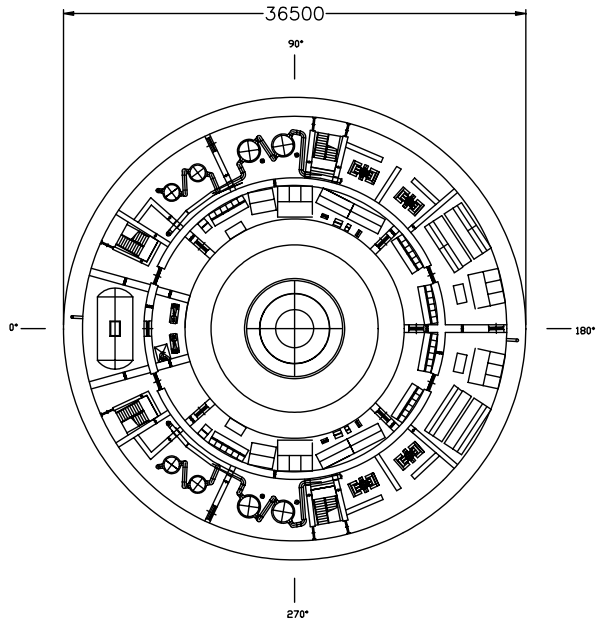


Passive systems are considerably simpler, improving reliability

SBWR (670 MWe)



ESBWR (1380 MWe)

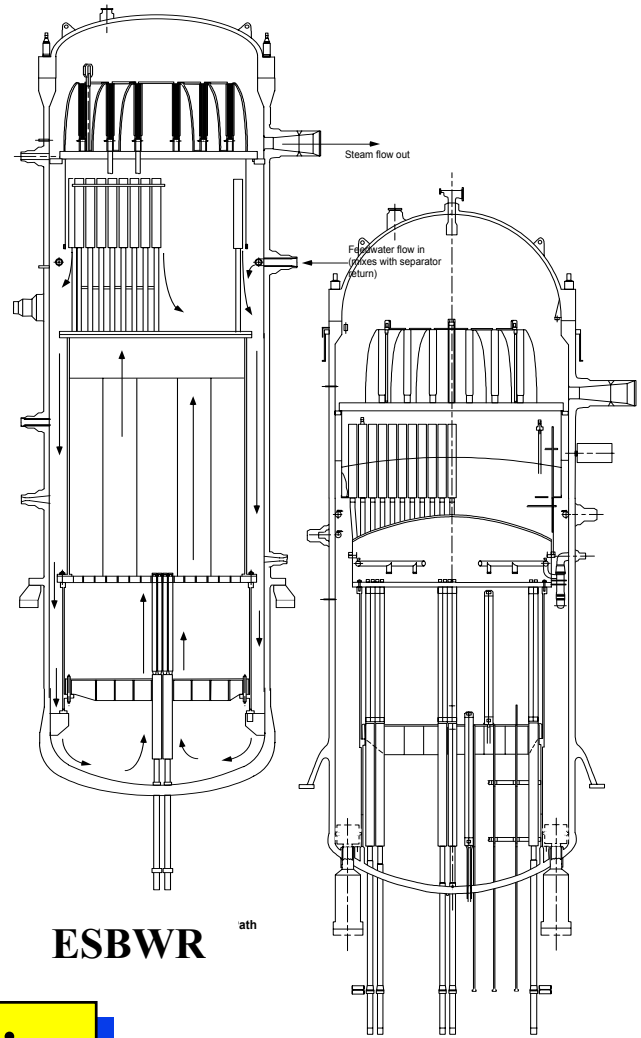


BOTTOM FLOOR EL.-10000

Significant Reduction in Systems & Buildings
– scale up with innovations –

Design Features Affecting LOCA Response

	ESBWR	ABWR	BWR5	BWR4
Large pipes below core	No	No	Yes	Yes
Core height, m	3.05	3.66	~3.66	~3.66
TAF above RPV bottom	~ 1/4	~ 1/2	~1/2	~1/2
Separator standpipes	Long	Short	Short	Short
Vessel height, m	27.7	21.1	~21.9	~21.8
Water volume outside shroud (above TAF), m^3	222	88	94	92



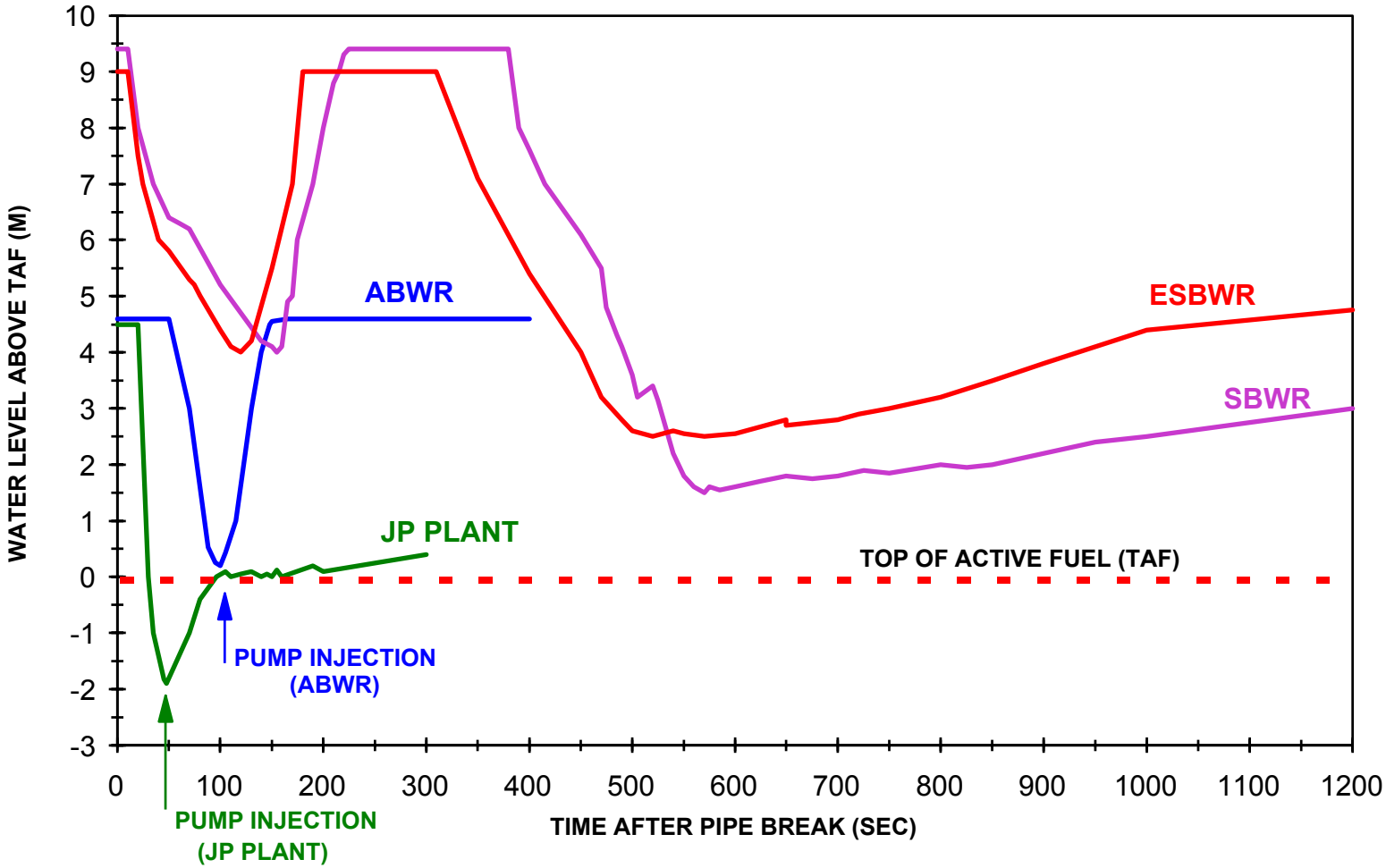
ESBWR

ABWR

ESBWR's greater water inventory results in improved plant LOCA performance

Water Level in Shroud Following a Typical Break

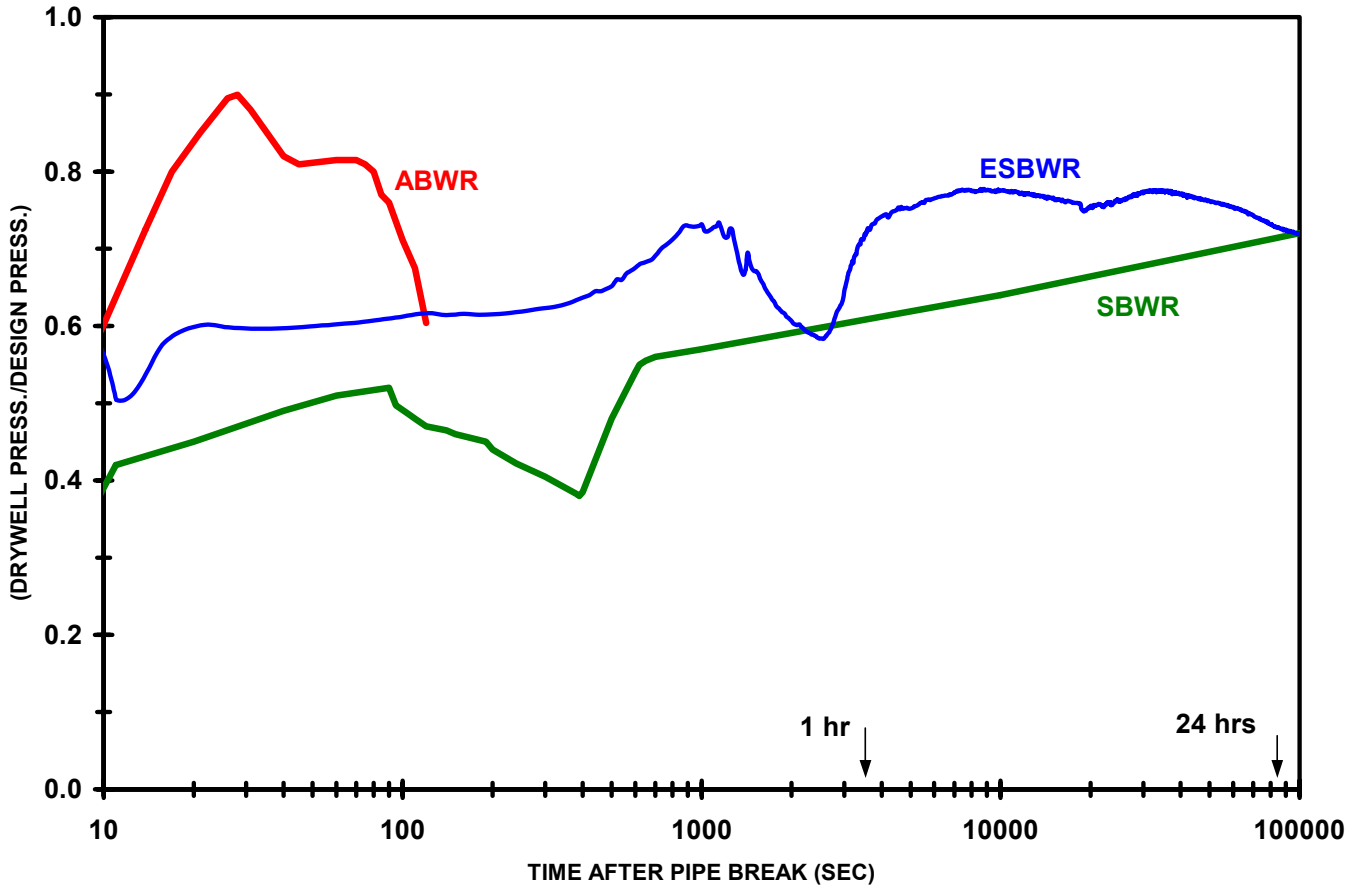
(values are intended to show typical trends for limiting breaks)



Large margins should facilitate regulatory review

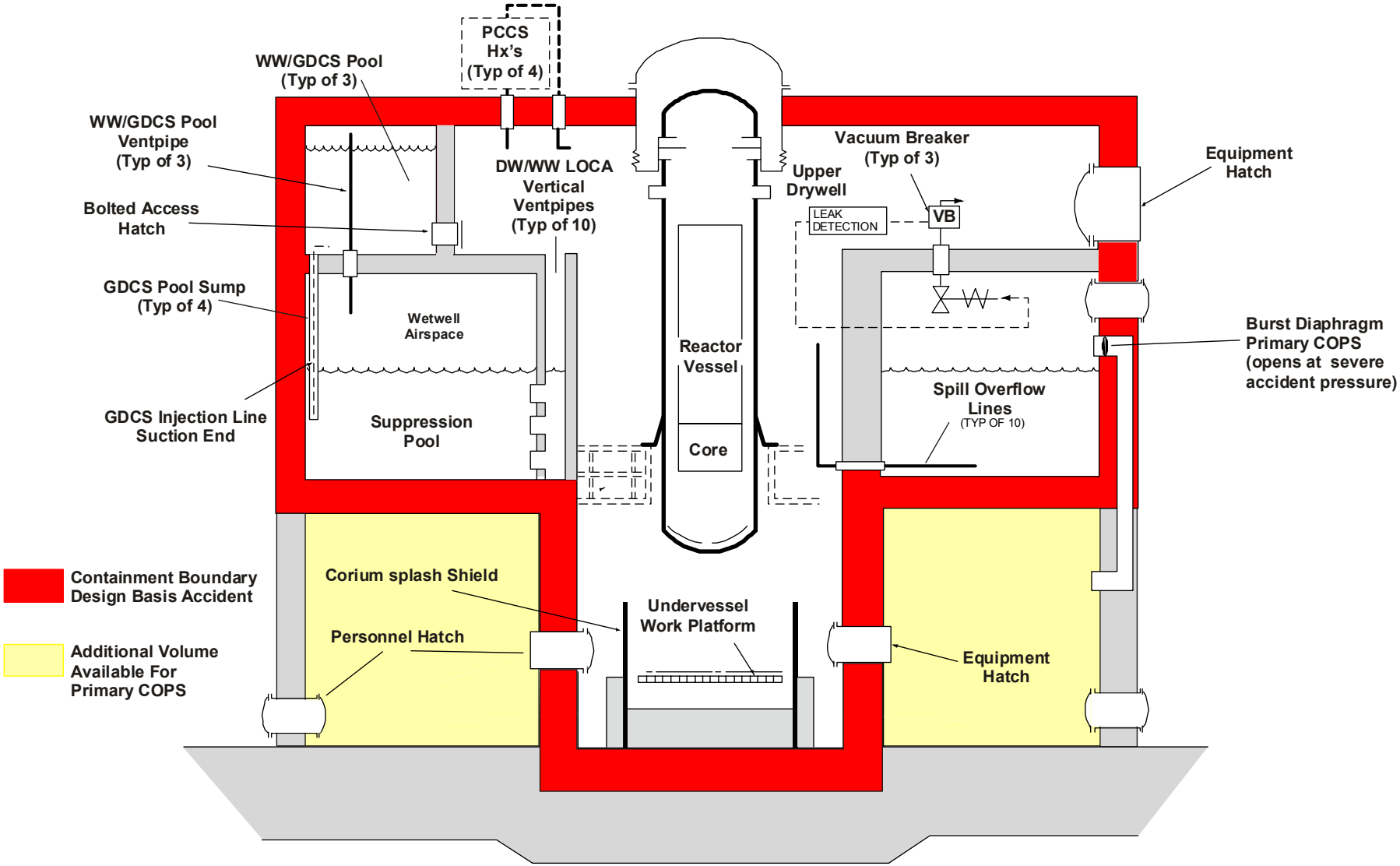
Containment Pressure Following a Pipe Break

(values are intended to show typical trends for limiting breaks – ESBWR has lower design pressure than ABWR/SBWR)



Large margin to design pressure even without COP system

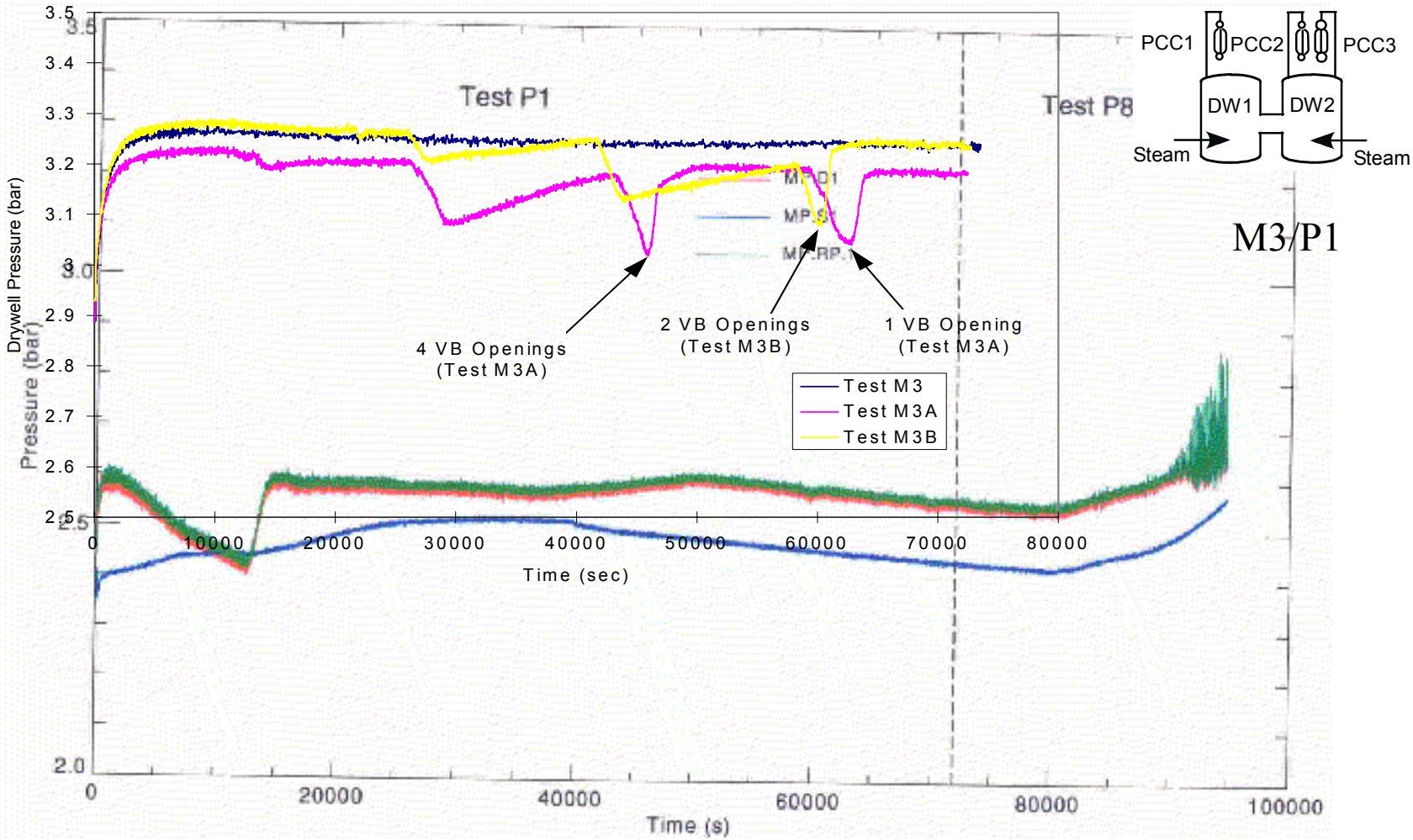
ESBWR Containment System – Schematic Diagram



Extensive Testing Programs

Reactor Depressurization Valve in the Test Facility

Comparison of SBWR and ESBWR PANDA Base Tests



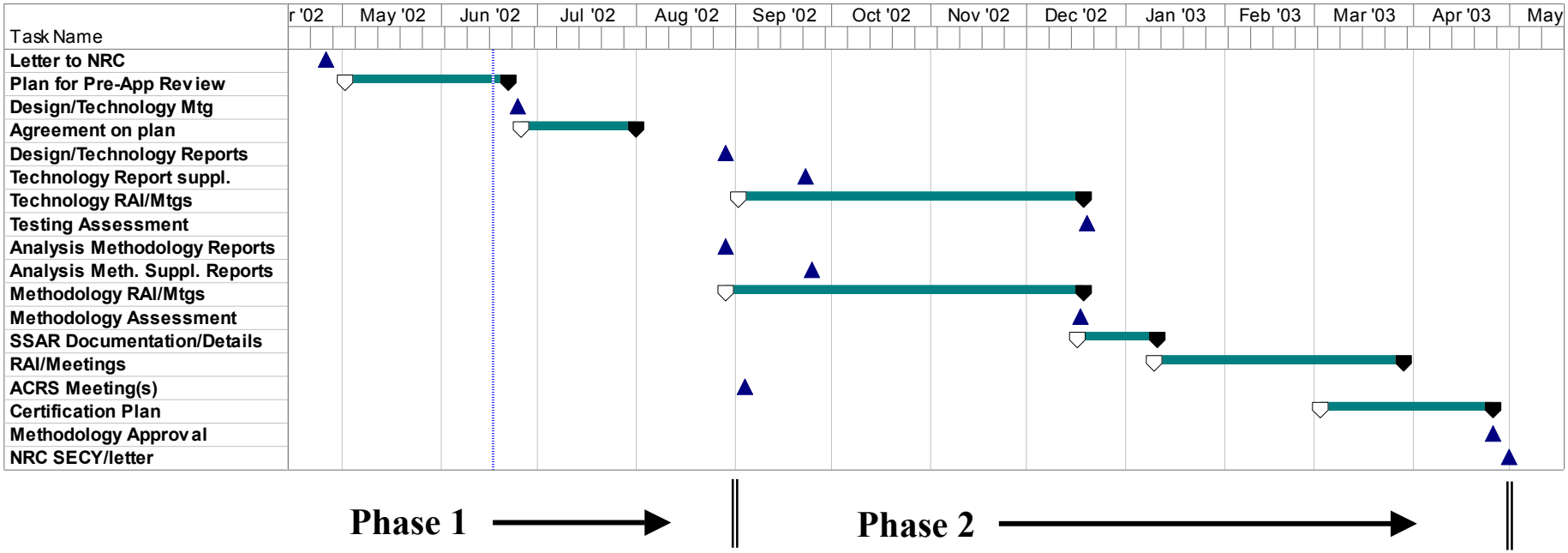
Pressure is reduced for ESBWR test due to configuration change – behavior is similar to SBWR test

ESBWR Program Summary

- ***9 year ESBWR program***
  - Reduced Components and Systems - simplify
  - Reduced the Structures and Buildings - simplify
- ***9 year Technology Studies***
  - Large margins confirmed – increased over SBWR
  - Qualified codes for incremental changes for ESBWR
- ***Challenges for the Coming Years***
  - Can simple design, large margins and completed testing simplify the regulatory challenges?

Improved Performance and Economics
Completed Extensive Technology Program
SBWR/ABWR Ease Regulatory Challenges for ESBWR

ESBWR Pre-Application Schedule



The above DRAFT plan shows the key steps to achieve the following:

1. Phase 1 agreement by July 2002 to define the issues to be resolved during the pre-application review. This agreement to include NRC cost and schedule for the Phase 2 activities.
2. Phase 2 activities are expected to cover the following 3 issues:
   - 2.1 Assessment of the technology basis for the passive safety systems
   - 2.2 Approval of the Analysis Methodology for analyzing plant transient, LOCA, containment response
   - 2.3 Definition/agreement on SSAR and certification document details
   - 2.4 Cost and schedule for certification
3. Phase 2 activities are scheduled based on getting early evaluation of 2.1 and 2.2 and given that the design has large margins to LOCA and containment limits.
4. The DRAFT schedule is based on timely GE submittals – especially the ones defining the start of Phase 2 in August and timely responses to RAI's.

Basis for Schedule

- ***Adequacy of testing issue***
  - **NRC completed review of SBWR testing and analysis program**
    - Found to be adequate – RAI's covered issues that did not affect conclusion
  - **Additional ESBWR testing done for specific configuration changes**
  - **Scaling report covers the test programs**
    - Found to be adequate – RAI's were addressed

- ***Approval of analysis methodology – TRACG***
  - **Model description and qualification report completed for operating plants**
    - Supplement extending qualification to passive safety systems (SBWR)
    - Supplement covering ESBWR specific tests
  - **Application methodology**
    - Transients - same as operating plants
    - LOCA and containment – bounding approach
  - **Large margins in plant performance based on design features**
  - **Plant bounding response can be calculated/analyzed easily**

Basis for Schedule (cont.)

- *Design certification submittal details*
  - Rely on previous reviews regarding details/approach

Extensive SBWR submittals and reviews, new test data and reports, coupled with design changes to add margin, provide a solid design basis

ESBWR Design/Technology Based on SBWR and ABWR

Summary and Conclusions

- ***Passive safety systems have simplified the plant design***
  - Plant evaluations are simpler and rely on less complex analyses
  - Substantial margins exist in the design
  - Defense-in-depth systems provide back-up
- ***ESBWR is an optimized design***
  - Simplified the design
  - Improved operation and maintenance
  - Enhanced the plant economics
- ***Next significant step is certification***
  - Design Certification schedule and resources are a key issue

Enhanced performance and economics and a solid technology basis provide confidence in the design