Part 52 Design Certification

US NRC

Framatome ANP

March 13, 2002

Rockville, MD

FRAMATOME ANP

Agenda

- Background, Purpose, & Introduction
- Presentation of the SWR 1000
- Discussion of Certification Process
- Discussion of Key Technical Points
- Future Interactions with the NRC

Background

- Framatome ANP plans to submit an Application for Design Certification of the SWR 1000
- Work on the Design Certification Application will be initiated in early 2003

Meeting Purpose

- Provide NRC information necessary for resource scheduling
- Begin Defining Process and Schedule for Design Certification
- Begin Defining Content of Design Certification Application

Specific Objectives

- **We Seek Clear Policy Statements on the Following:**
  - NRC position on the application of PRA and its relationship to Regulatory Treatment of Non-Safety Systems
  - NRC position on the treatment of potential reactor vessel failure
  - NRC position on the treatment of passive systems
  - Influence of new security measures on plant design
  - Criteria for Acceptance of: non-US Codes & Standards, and Testing

Introduction

Framatome ANP, Inc.

FRAMATOME ANP

is

An American Company That Is Part of a Global Family

The Largest Nuclear Component, Systems, Services and Fuel Company in the World

FRAMATOME ANP

Framatome ANP: 13,000 Employees Worldwide

• Engineering • Manufacturing • Services • Offices

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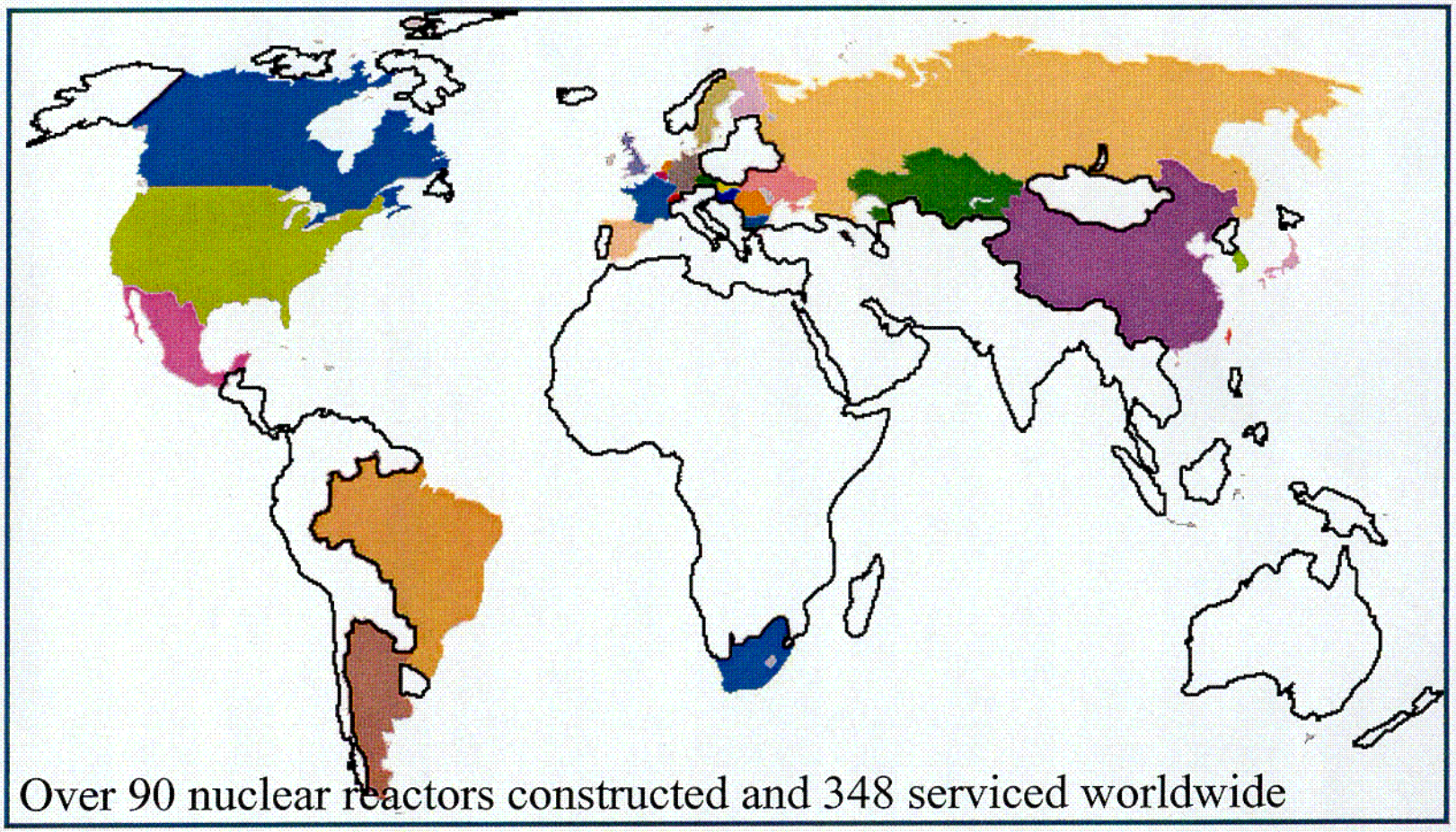
Comprehensive Nuclear Services Worldwide



Over 90 nuclear reactors constructed and 348 serviced worldwide

Framatome ANP is active virtually everywhere there is commercial nuclear power

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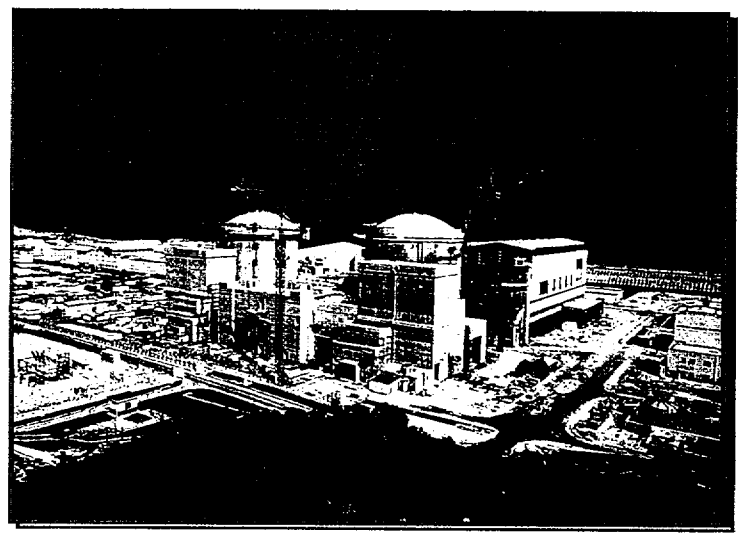
Recent Framatome ANP Plants

Daya Bay

2 Units
944 MWe PWR
Commercial - 1994 (Both Units)

Ling Ao

2 Units
935 MWe PWR
Unit 1 - Commercial - 2002
Unit 2 - Commercial - 2003



Since 1990, 28 new LWR's (non VVER) have been started up, 13 of which are Framatome ANP

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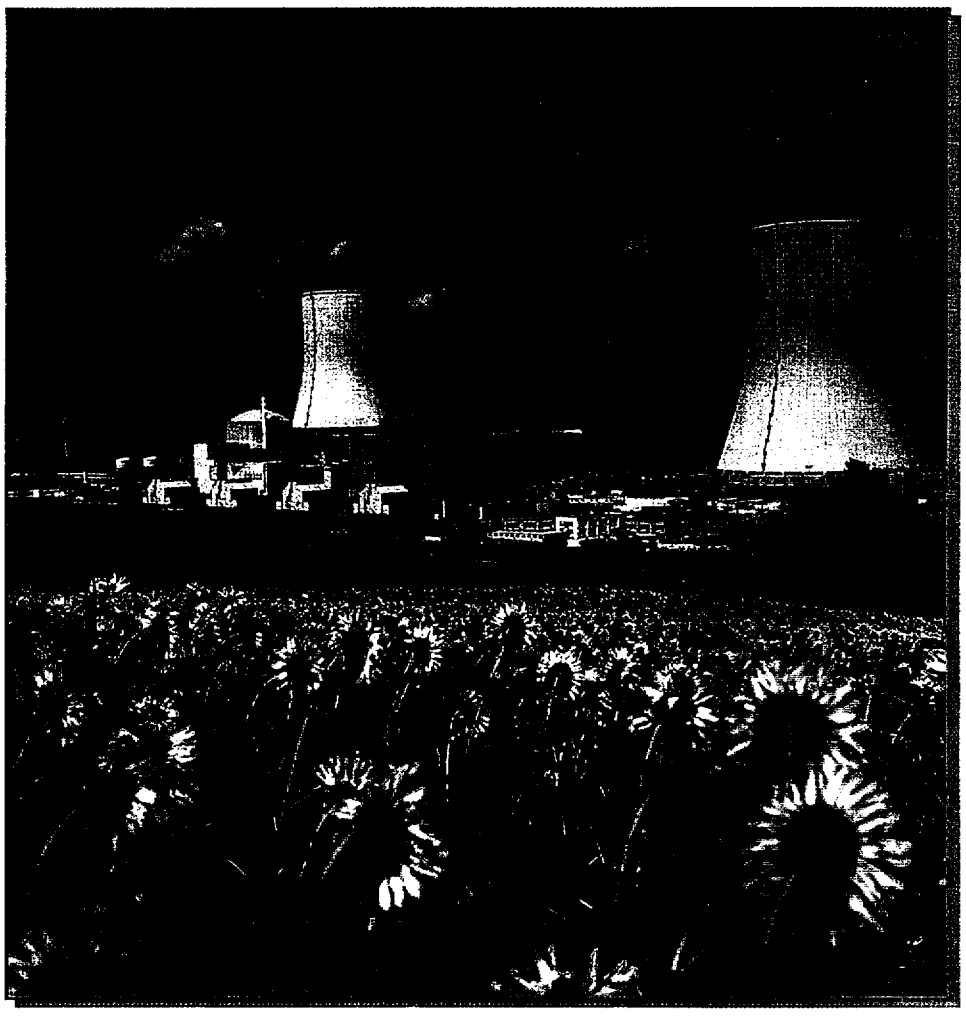
Recent Framatome ANP Plants



Civaux - N4 Plant

2 Units
1450 MWe PWR
Unit 1 - Commercial - 1997
Unit 2 - Commercial - 1999

Two of the highest power nuclear units in the world

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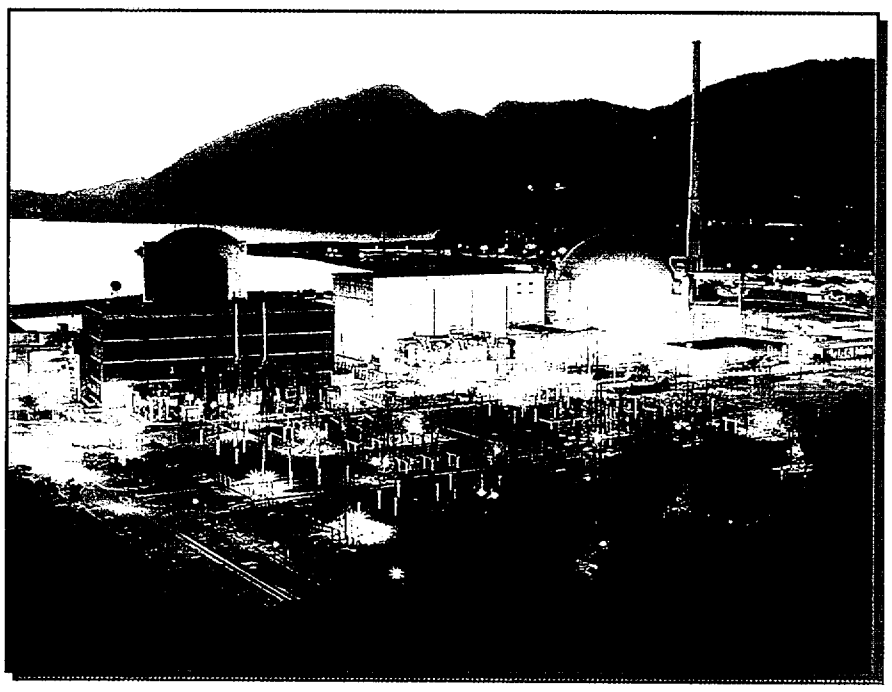
Recent Framatome ANP Plants



- Contract Signed in 1976
- Site Activity Begun in 1977
- Construction Suspended in 1985 at ~70% Completion
- Decision to Complete in 1995
- Site Work Resumed in 1996
- Commercial Operation in 2002

Angra 2
1229 MWe PWR

Framatome ANP has Recent Experience Completing Suspended Nuclear Power Plants

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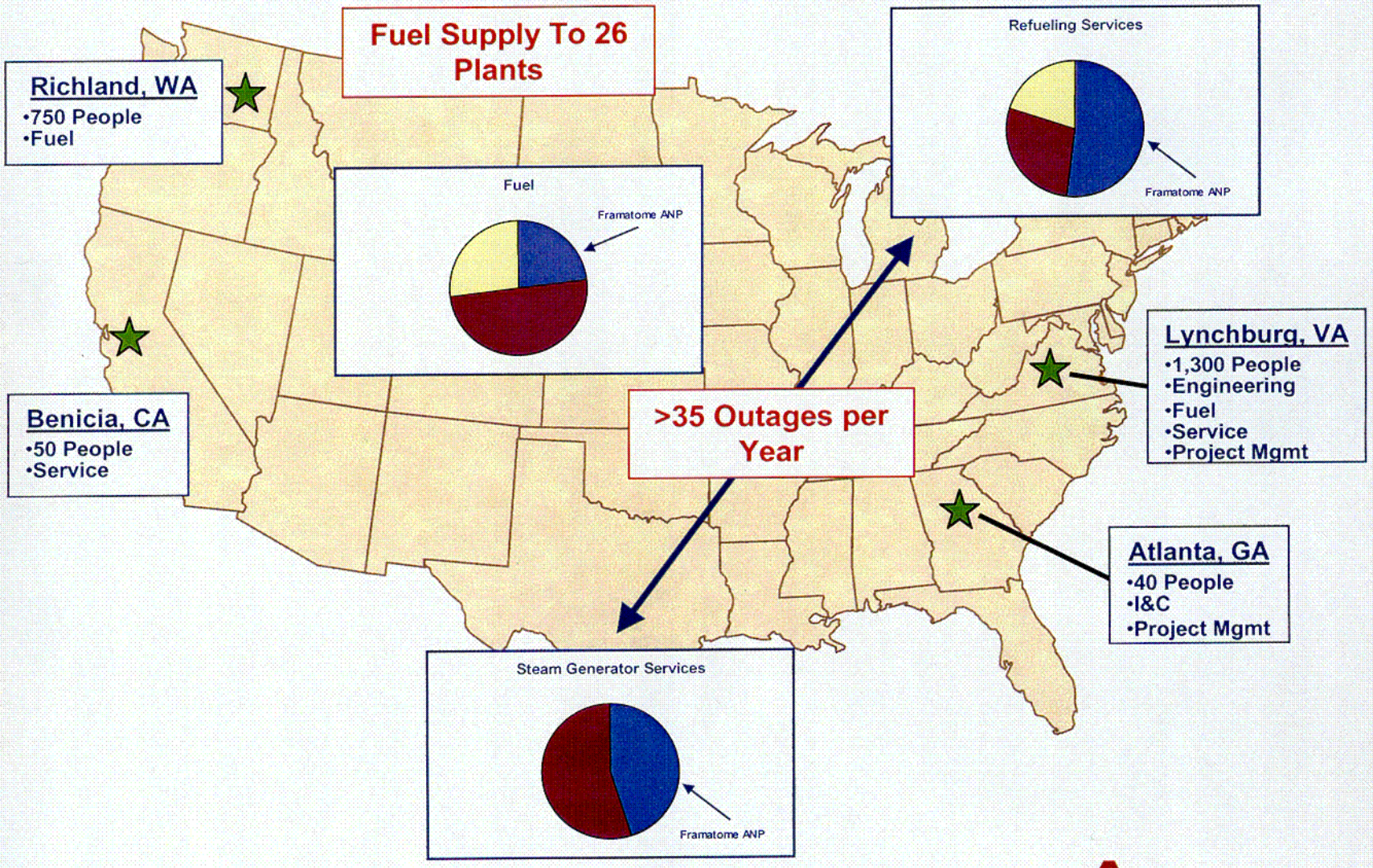
Framatome ANP in the U.S.



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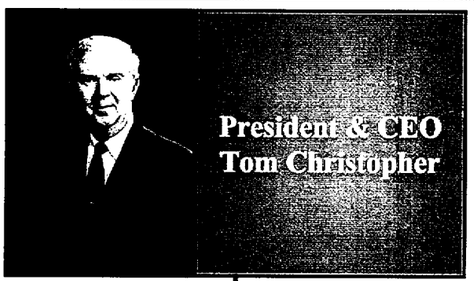
U.S. Organization



President & CEO
Tom Christopher

Vice President
Nuclear I&C
Karl-Heinz
Lochner

Vice President
Engineering &
Licensing
Ray Ganthner

Senior V.P.
Nuclear Services
George Beam

Vice President
Projects & BWR
Integration
Don Janecek

Senior V.P.
Nuclear Fuel

John Matheson

Vice President
Sales &
Marketing
Andy Cook

Framatome ANP

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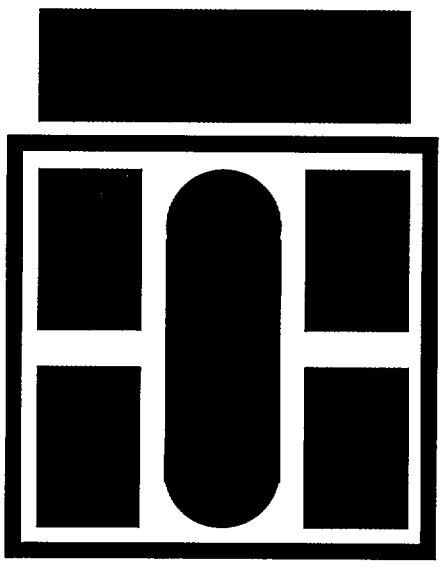
SWR 1000

Framatome ANP's Boiling Water Reactor Concept



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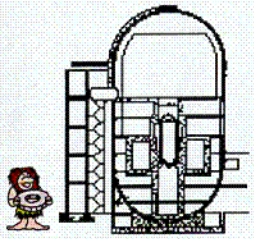
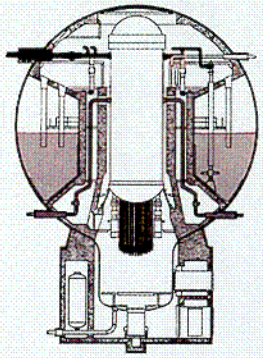
Evolution of Framatome ANP's BWR Technology

- Kahl
- Gundremmingen A
- Lingen



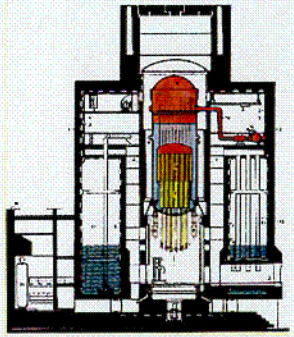
Full pressure containment - 61

- Würgassen
- Brunsbüttel
- Philippsburg 1
- Isar 1
- Tullnerfeld
- Krümmel

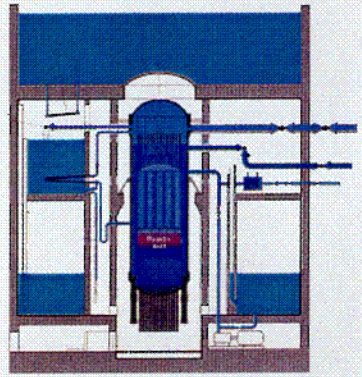


Product Line 69

- Gundremmingen B/C



Product Line 72



SWR 1000

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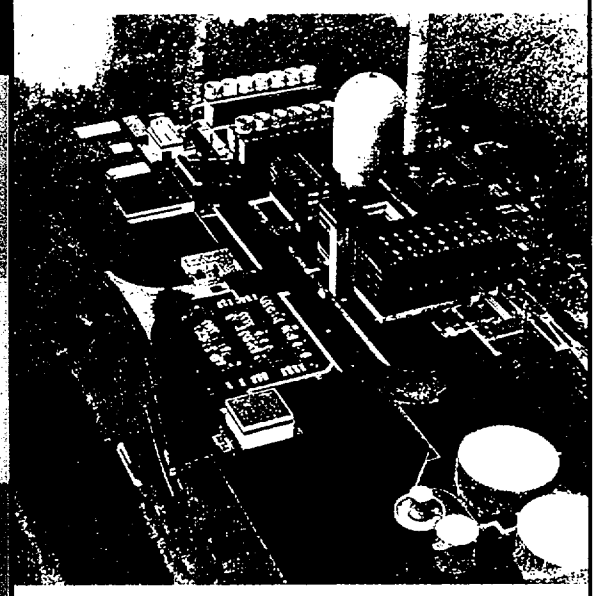
History of Framatome ANP's BWR Development

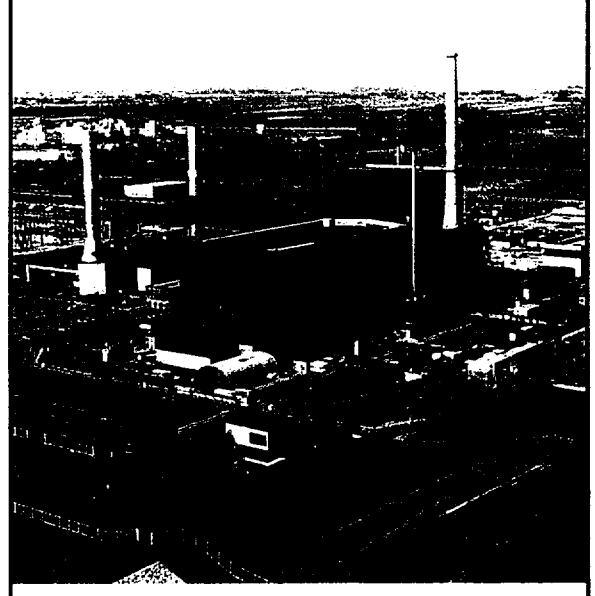
1968



Lingen

- The first FMCRD (**F**ine **M**otion **C**ontrol **R**od **D**rive)

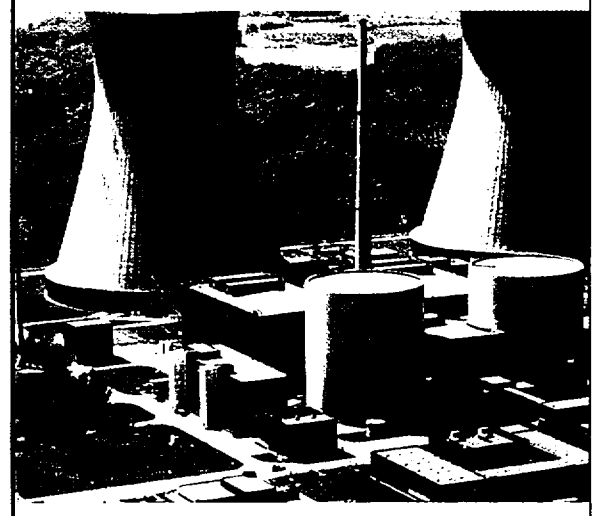
1977



Brunsbüttel

- The first internal recirculation pump

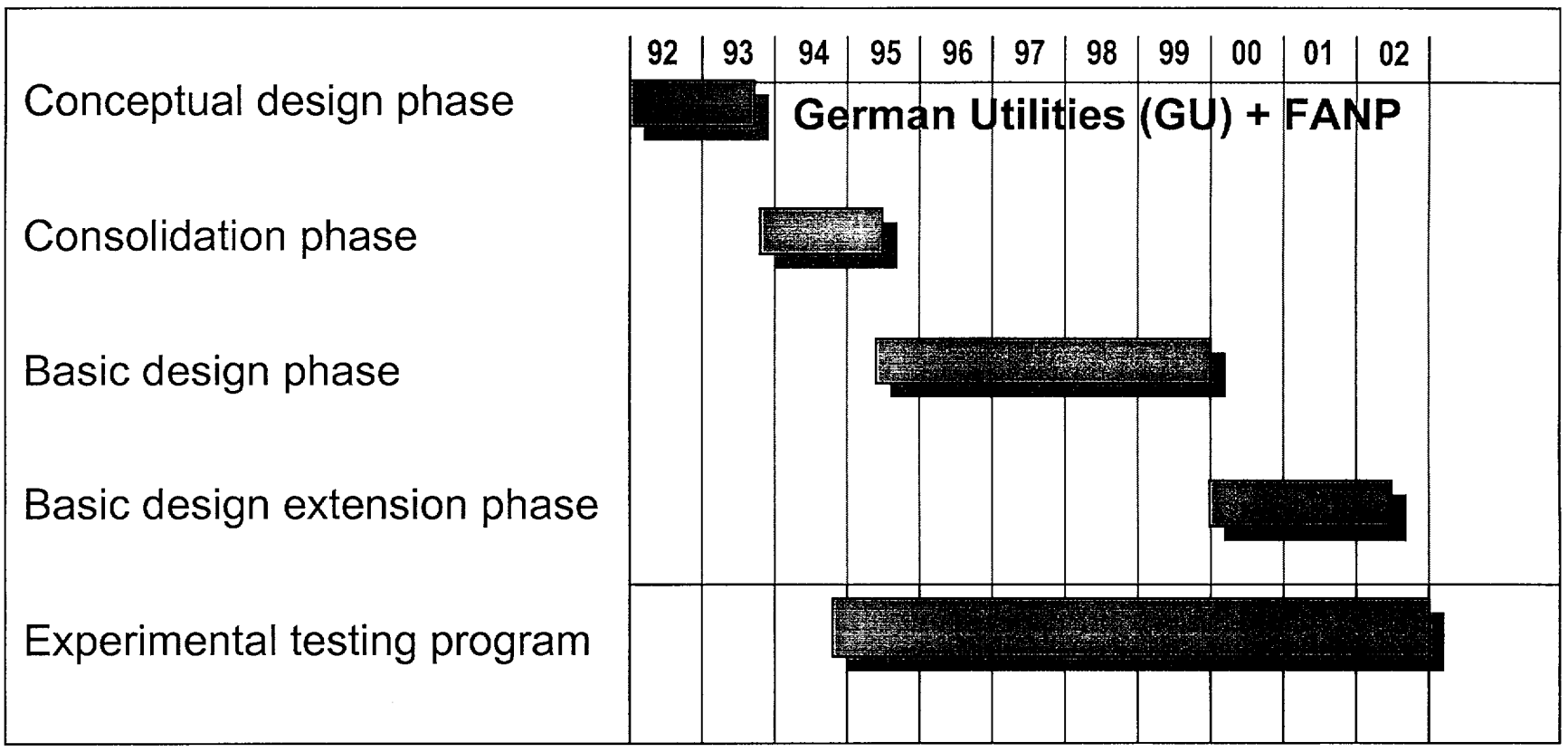
1984/85



Gundremmingen B and C

- FMCRD
- Internal recirculation pumps
- Three train full-range RHR system
- Cylindrical prestressed concrete containment

Project History - SWR 1000 Development



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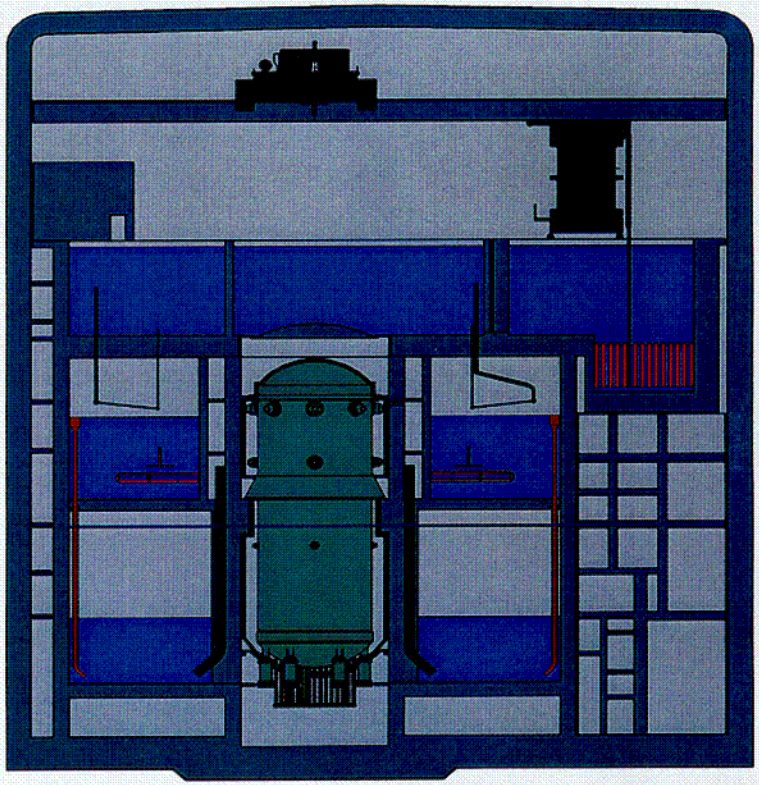
Major Development Objectives

- **Improved Safety**
- **Economic Feasibility**

Thermal power	2,778	MW
Gross power output	~1,000	MW
Reactor Pressure	70.6 bar (1010 psig)	
Type of fuel assemblies	ATRIUM 12	
Number of fuel assemblies	624	
Number of control rods	145	
Length of active core	2.8 m. (9.2 ft.)	
Max. accident pressure of containment	7.5 bar (95 psig)	



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Improved Safety Objective

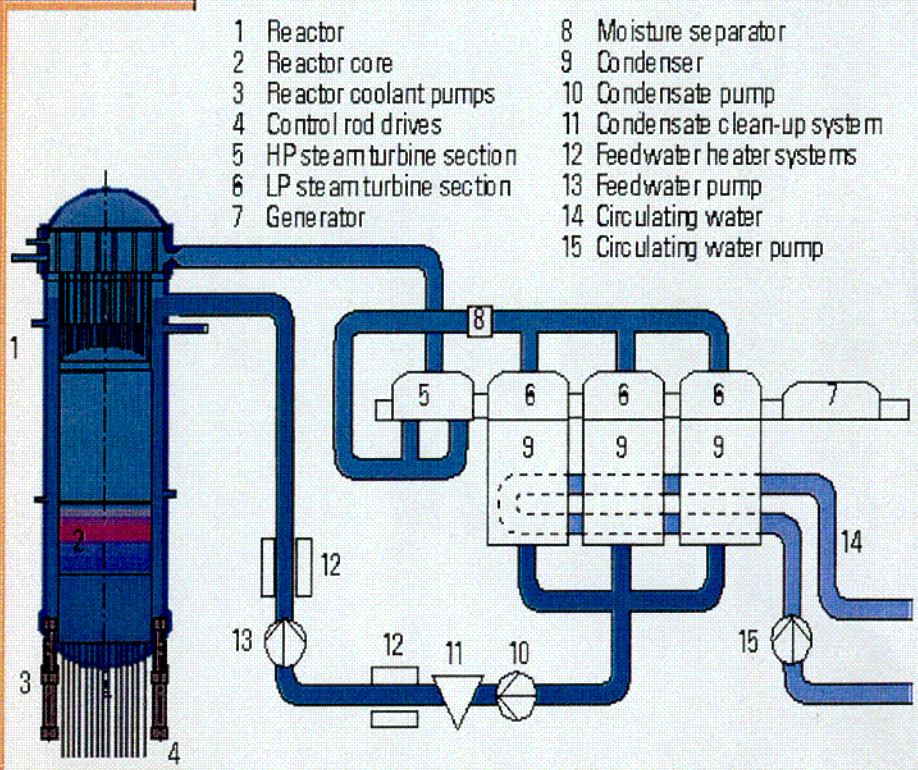
Safety

- Clear and simple system design
- Increased safety margins
- Reduction of core damage frequency
- Limiting the effects of core melt accident to plant itself
- Passive safety systems (Diversity and redundancy)
- Minimization of human error impact
- Grace period (> 3 days)

Improved Economic Objective

Operation & Economics

- Use of existing technology
- High plant availability
- Low maintenance
- Flexible fuel cycle length (12 to 24 m)
- High fuel burn-up (65 GWd/t)
- Reduction of process waste
- Design life of 60 years
- Competitive power production cost



Basic Diagram of SWR 1000

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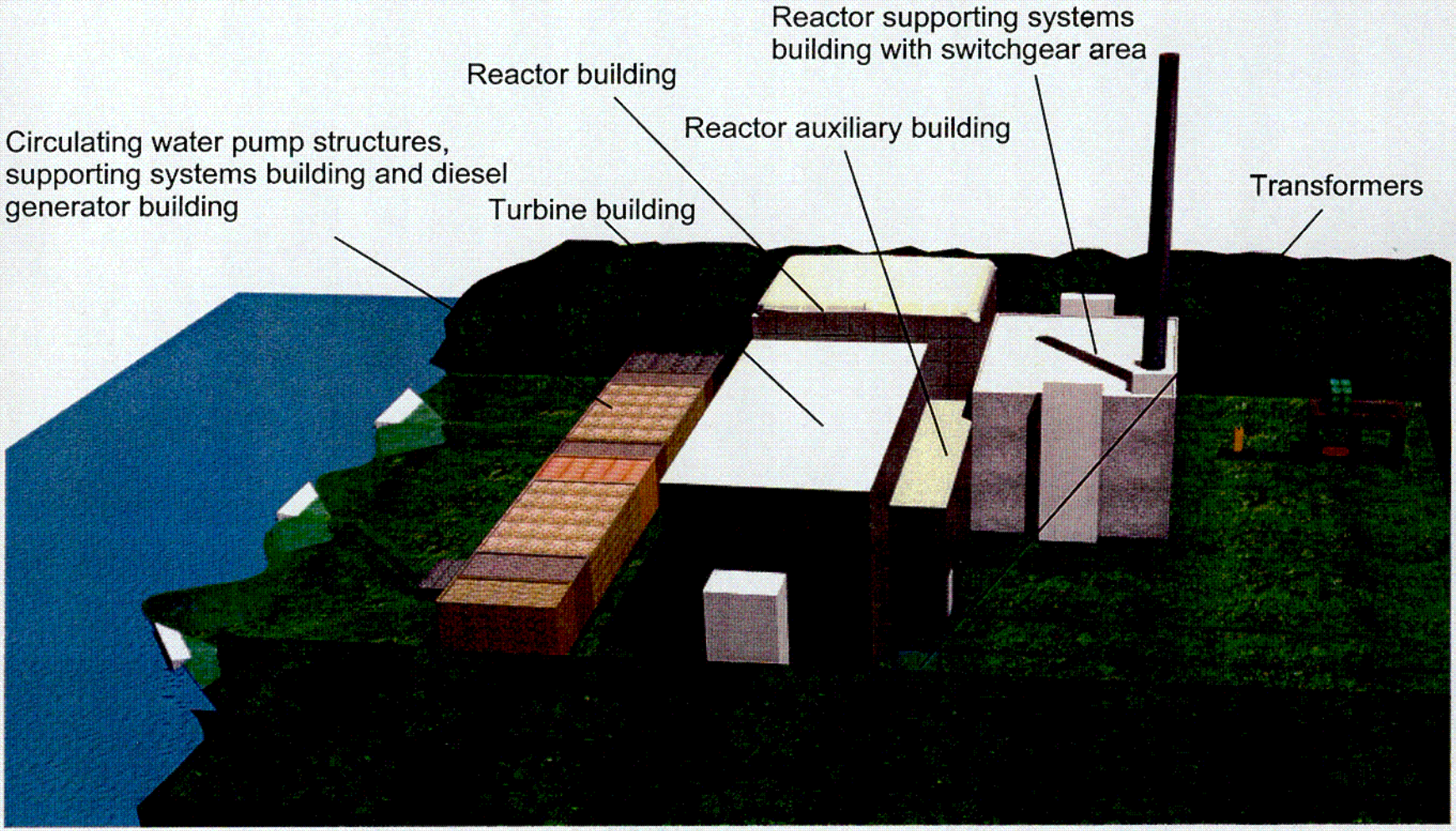
C06

Typical Plant Site Layout



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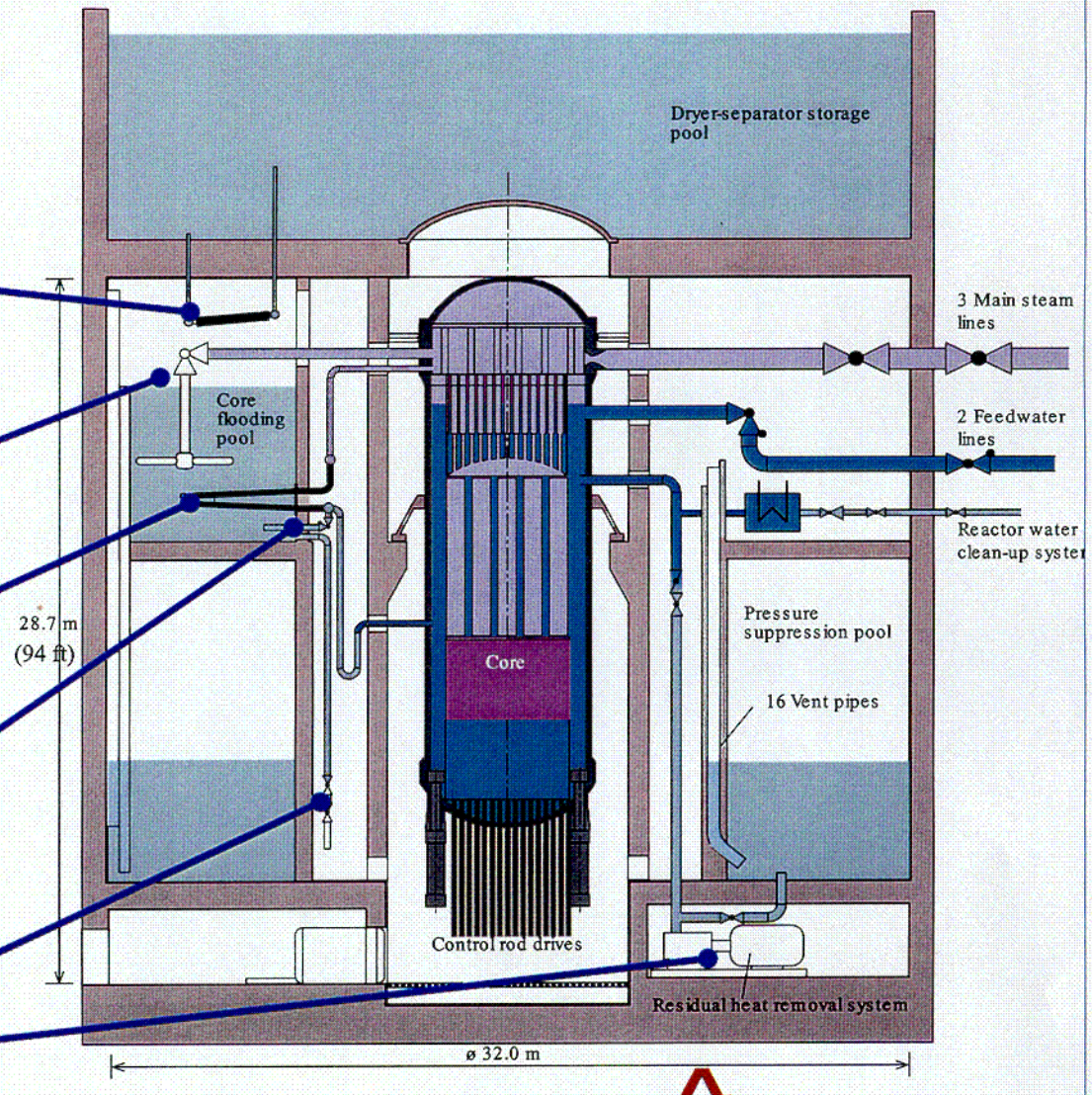
SWR 1000 Design

- All active systems have passive Safety Related backup to perform nuclear safety functions
- SWR 1000 Defense-in-Depth design incorporates Safety Related passive systems that are designed to meet all nuclear safety criteria without reliance on active systems

SWR 1000 Safety Concept

- Containment cooling condensers for containment heat removal
- SRV for reactor over-pressure protection and reactor depressurization
- Emergency condensers for heat removal from the RPV
- Flooding lines for passive core flooding in the event of LOCA
- Drywell flooding line (event of a core melt accident)
- LPCI / RHR systems



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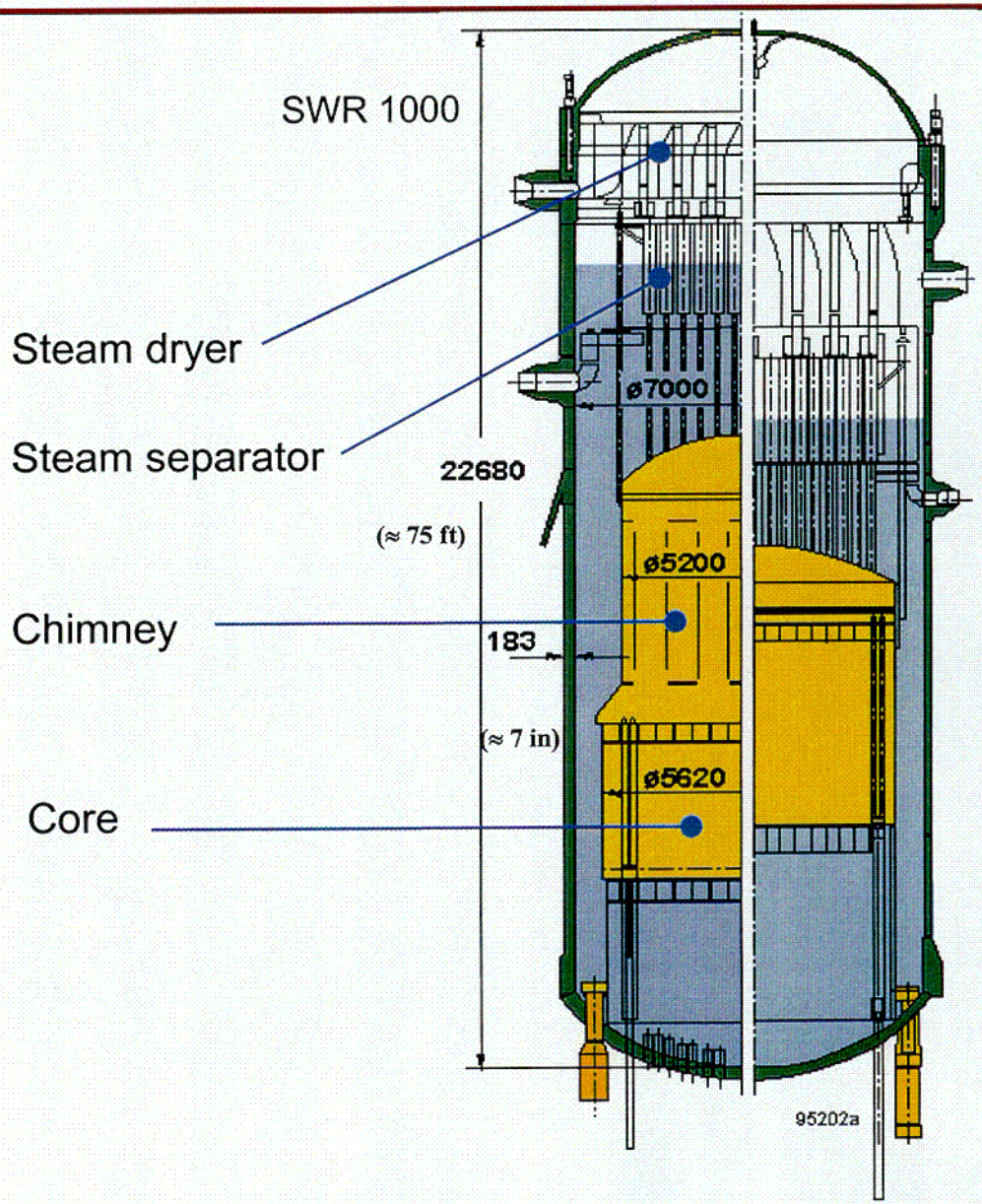
RPV Comparison: SWR 1000 & NPP Krümmel



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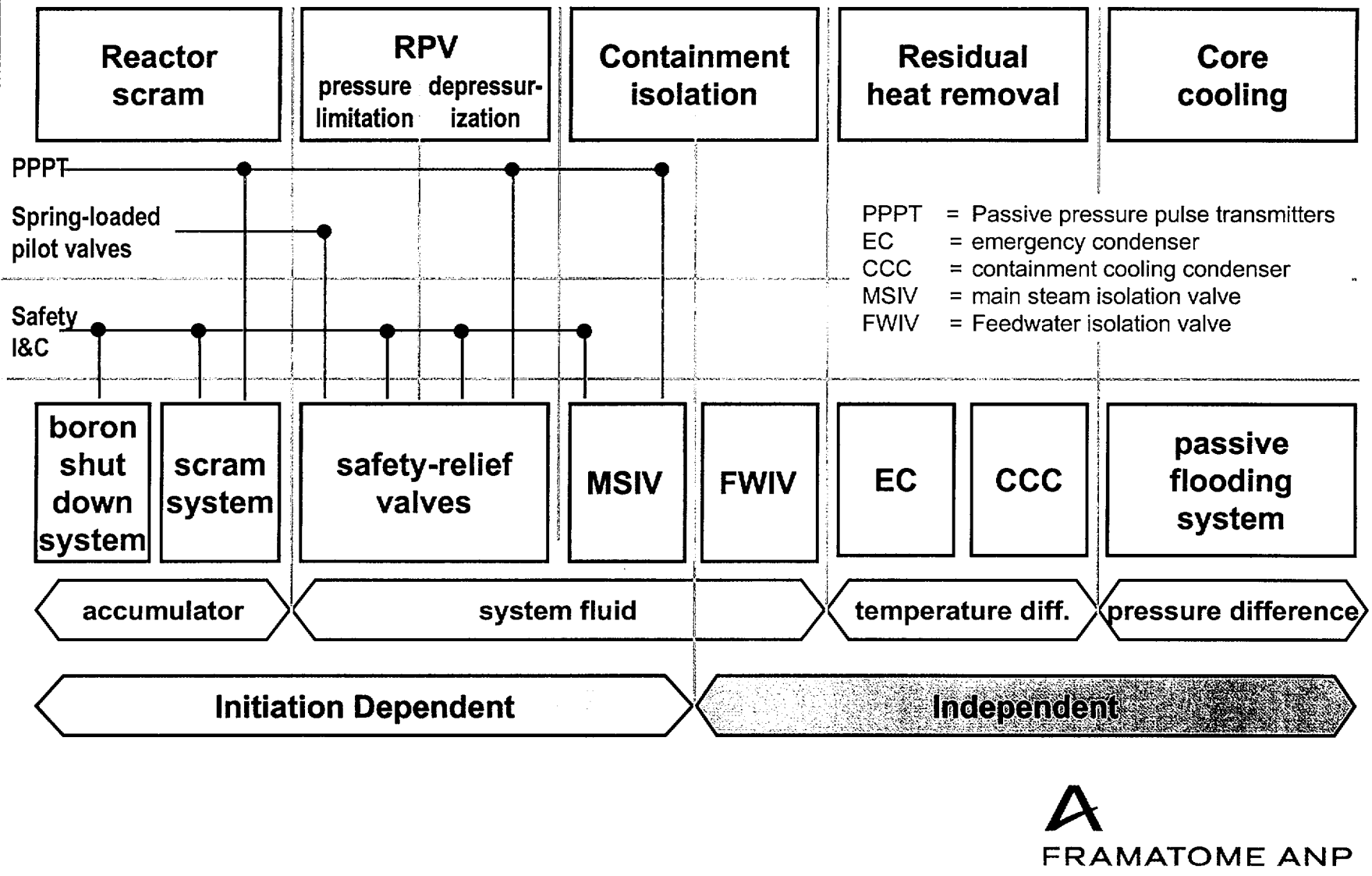
Defense in Depth Safety Concept

Safety Levels	Previous Nuclear Plants	SWR 1000
1st level	High-quality design, construction and operation to prevent off-normal operating conditions and accidents	Maintained
2nd level	Reliable control and limitation equipment for preventing off-normal operating conditions from developing into accidents	Proven technology utilized **Plus Lower core power density, and Large water volume in RPV**
3rd level	Safety systems for accident control and limitation of fuel cladding damage	Proven technology partially utilized **Plus** ■ **Diverse passive system for activation of safety systems** ■ **Passive safety systems** ■ **Large water reservoirs for long grace period**
4th level	Beyond DBA	**Equipment and provisions for control of a core melt accident so that NO offsite emergency response actions are necessary**

Passive Safety Systems



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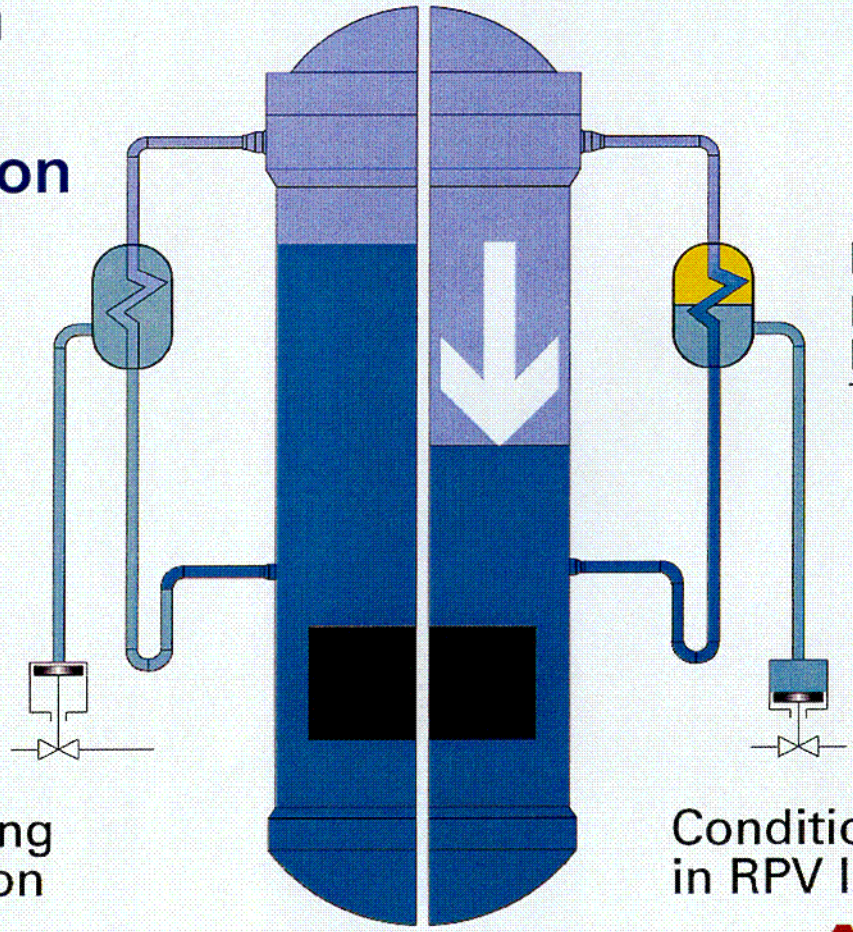
Passive Pressure Pulse Transmitter: Passive Safety System Actuation Device (Patented)

PPPT actuates

- **Reactor Scram**
- **MSIV**
- **Depressurization**



Passive pressure pulse transmitter

Pilot valve

Condition during power operation

Condition after drop in RPV level

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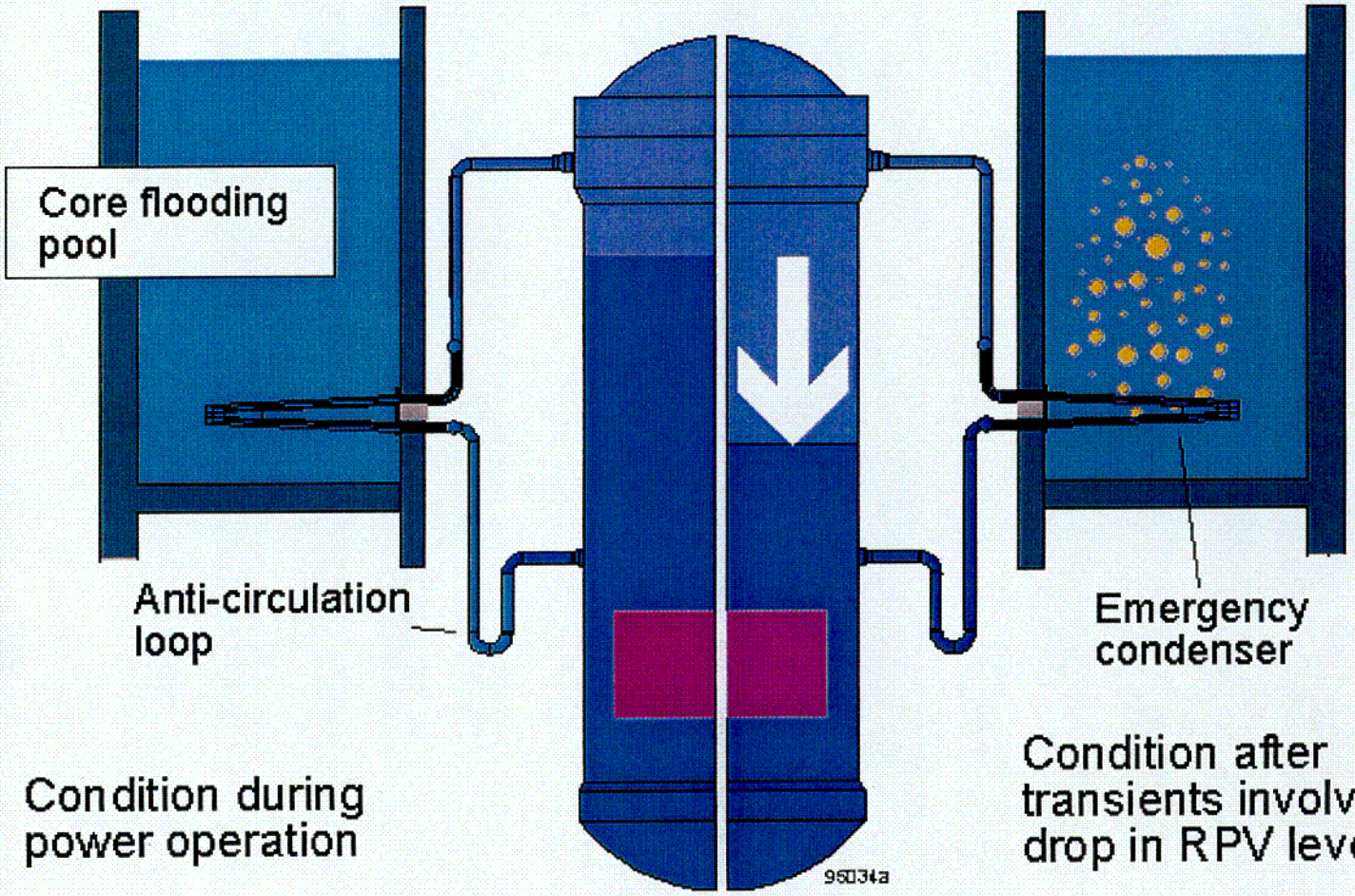
C10

Passive Safety Systems: Emergency Condenser



Condition during power operation

Condition after transients involving drop in RPV level

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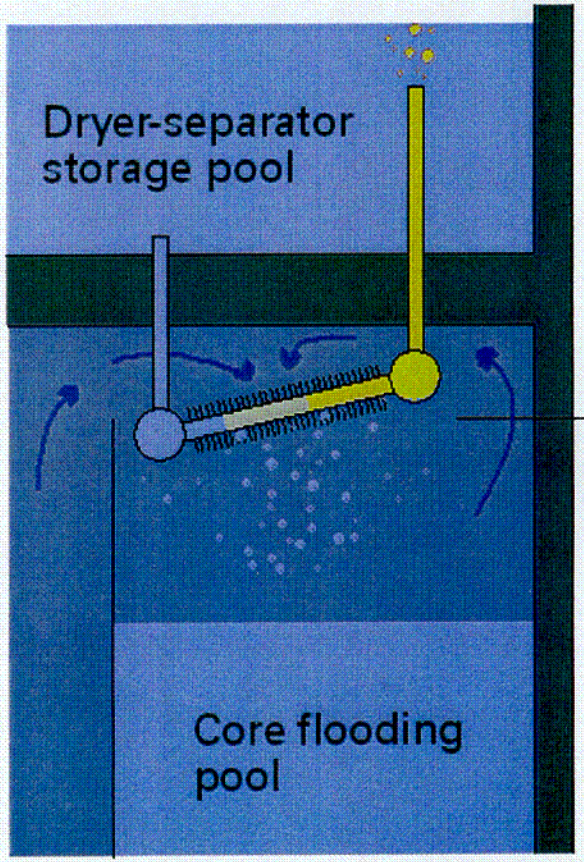
Passive Safety Systems: Containment Cooling Condenser



Containment Cooling Condenser

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LOCA Events Core Flooding Redundancy

SF ... Single failure CF ... Conseq. failure	Active Systems		Passive Systems				Effective Capacity
Core flooding upon LOCA	2 RHR/LPCI systems		4 Flooding lines				
	100%	100%	100%	100%	100%	100%	
Feedwater line break	CF	Maintenance	SF	✓	✓	✓	300%
Core flooding line break	Maintenance	SF	CF	✓	✓	✓	300%
	Maintenance	✓	CF	SF	✓	✓	300%
Leak below core (15 cm^2)	Maintenance	SF	50%	50%	50%	50%	200%

200 - 300% Core Flooding Capacity without Active Systems and one Core Flood Line Unavailable

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Containment Heat Removal Capacities

SF ... Single failure	Active Systems		Passive Systems				Effective Capacity
Heat removal from containment	2 RHR systems		4 containment cooling condensers				
	100%	100%	50%	50%	50%	50%	
Failure assumptions	SF	Maintenance	✓	✓	✓	✓	200%

200% Containment Heat Removal Capacity without Active Systems

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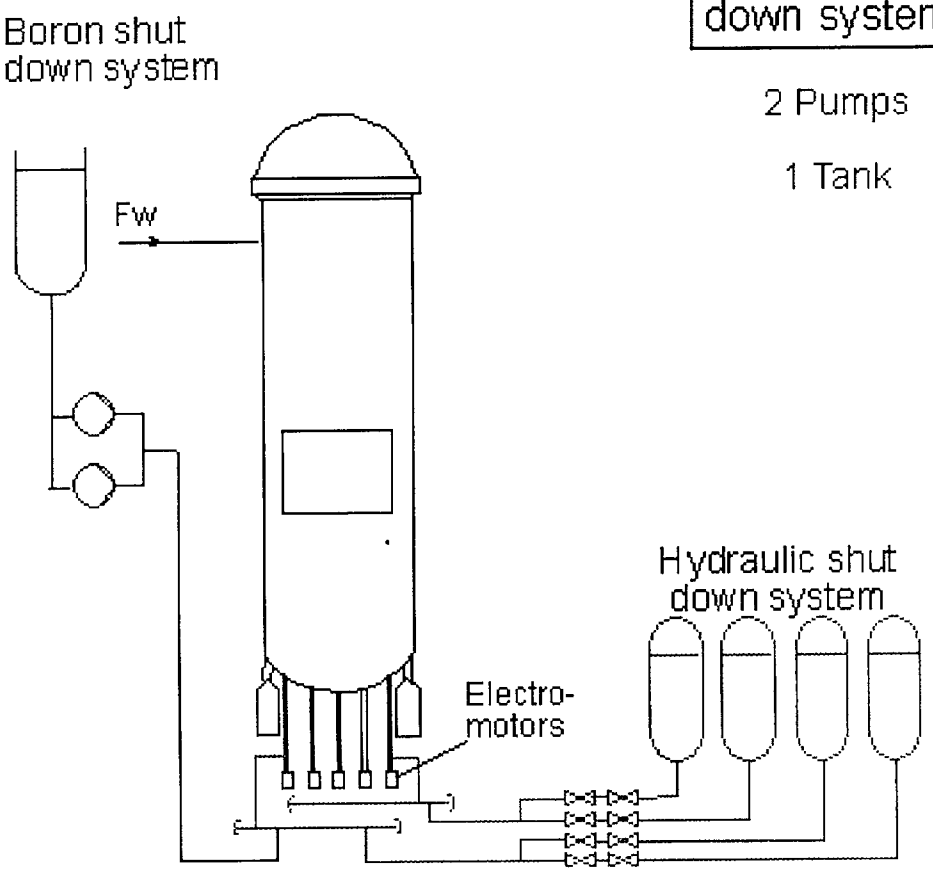
Diverse Shut Down Systems



Boron shut down system

2 Pumps

1 Tank

Hydraulic shut down system

Control rods

Mechanical drive

Hydraulic drive

Electromotor

Hydraulic shut down system

98013a

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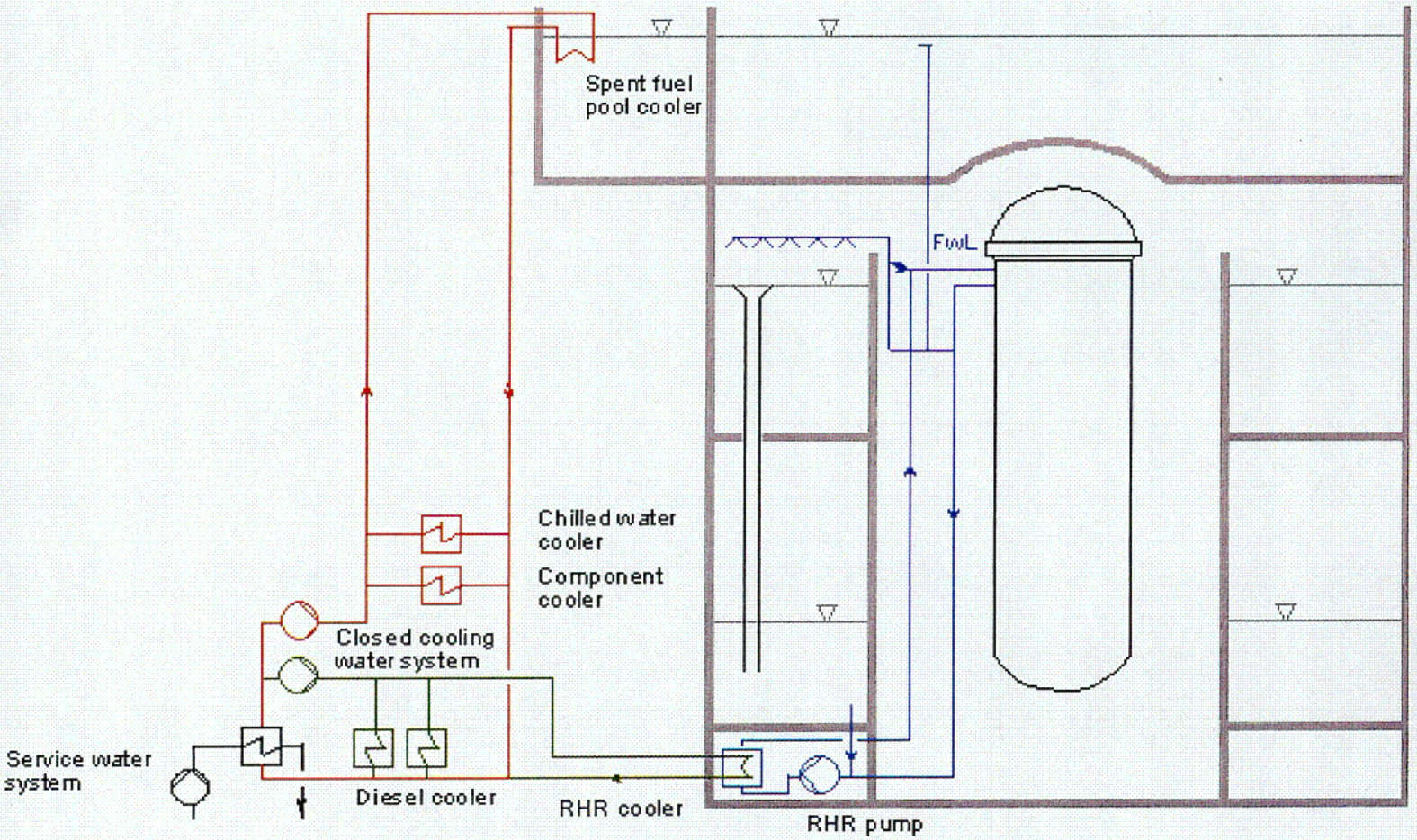
LPCI/Residual Heat Removal Systems



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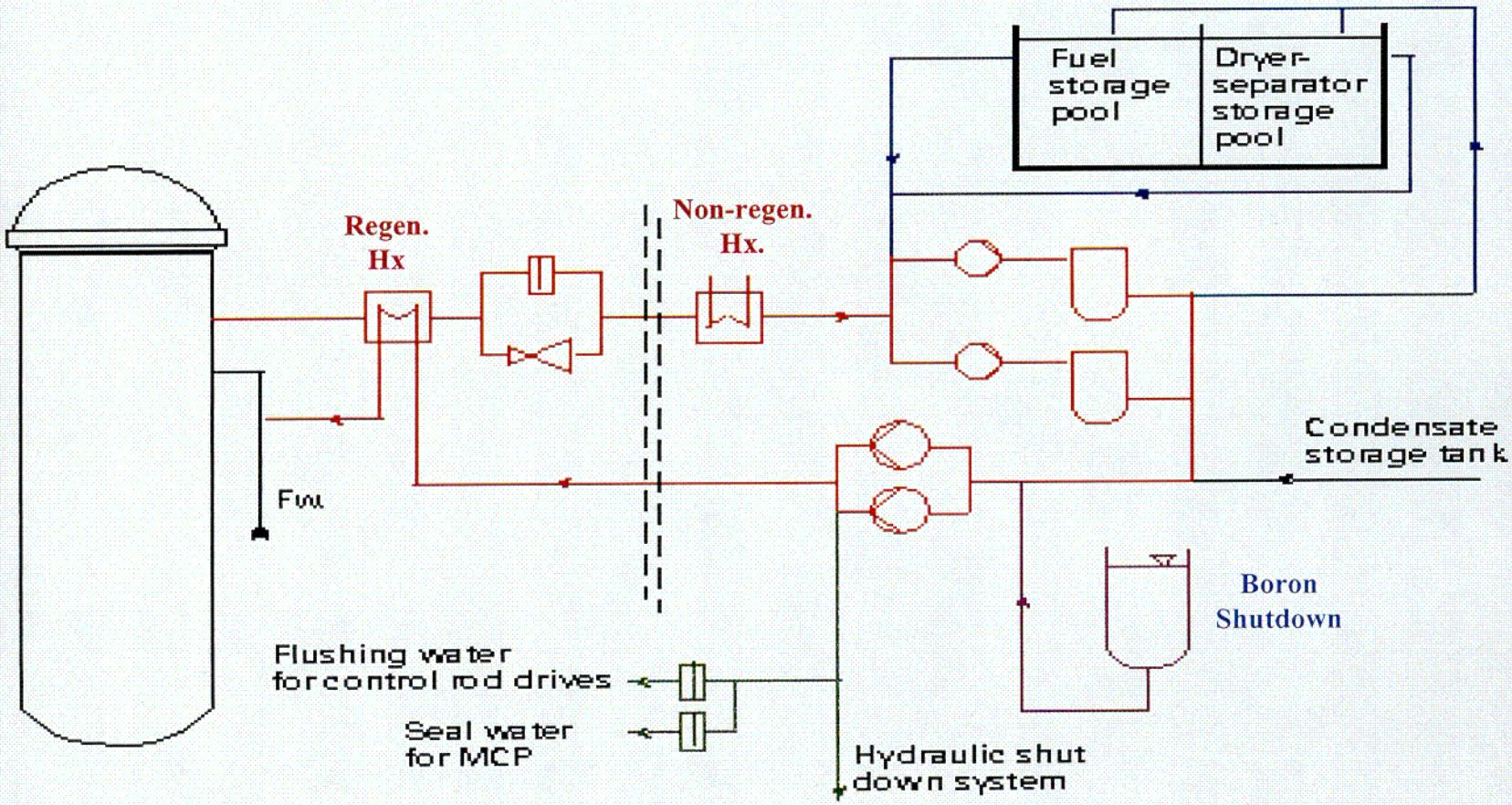
Reactor Water and Fuel Storage Pool Clean-Up Systems



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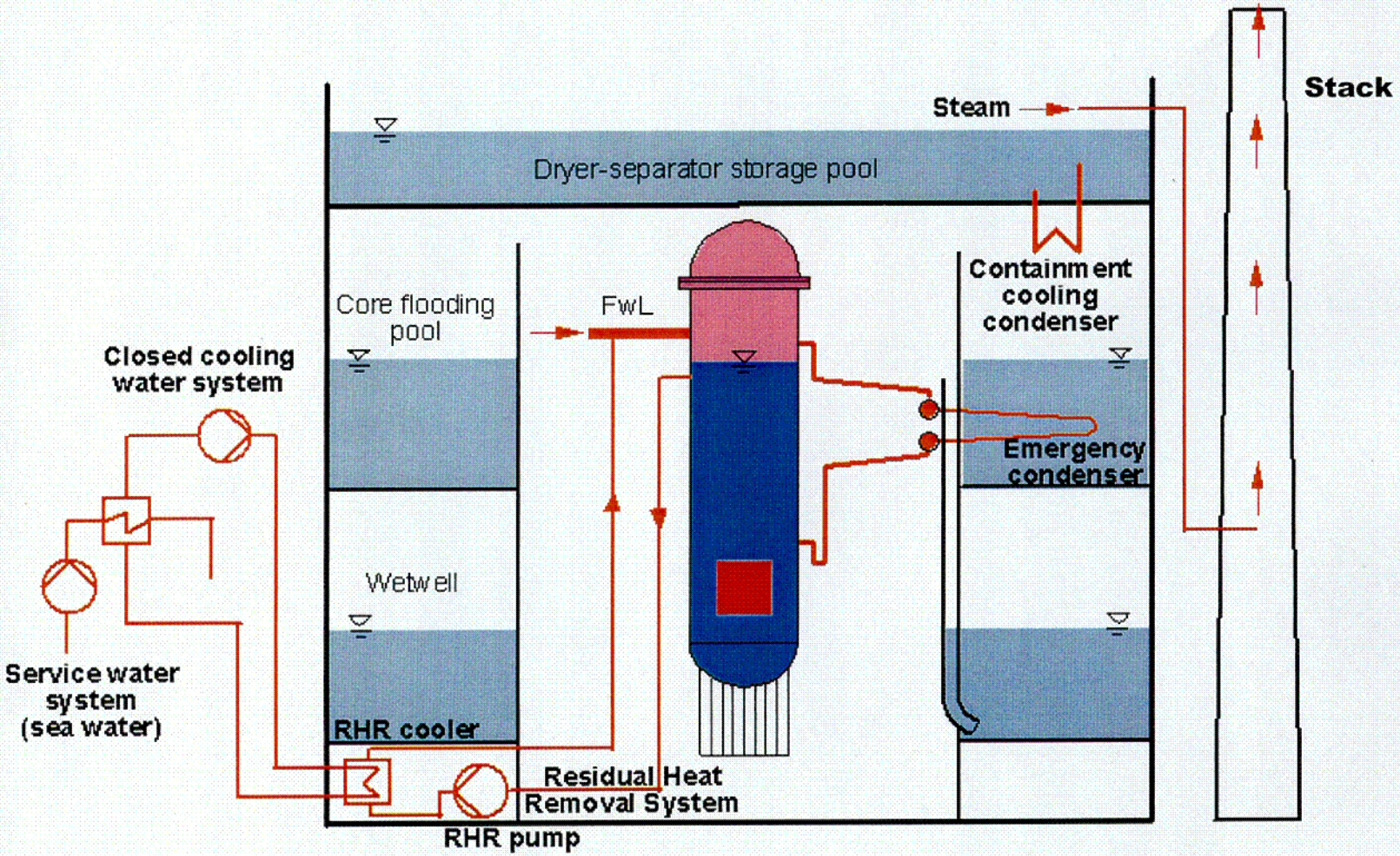
Residual Heat Removal Heat Sink Diversity



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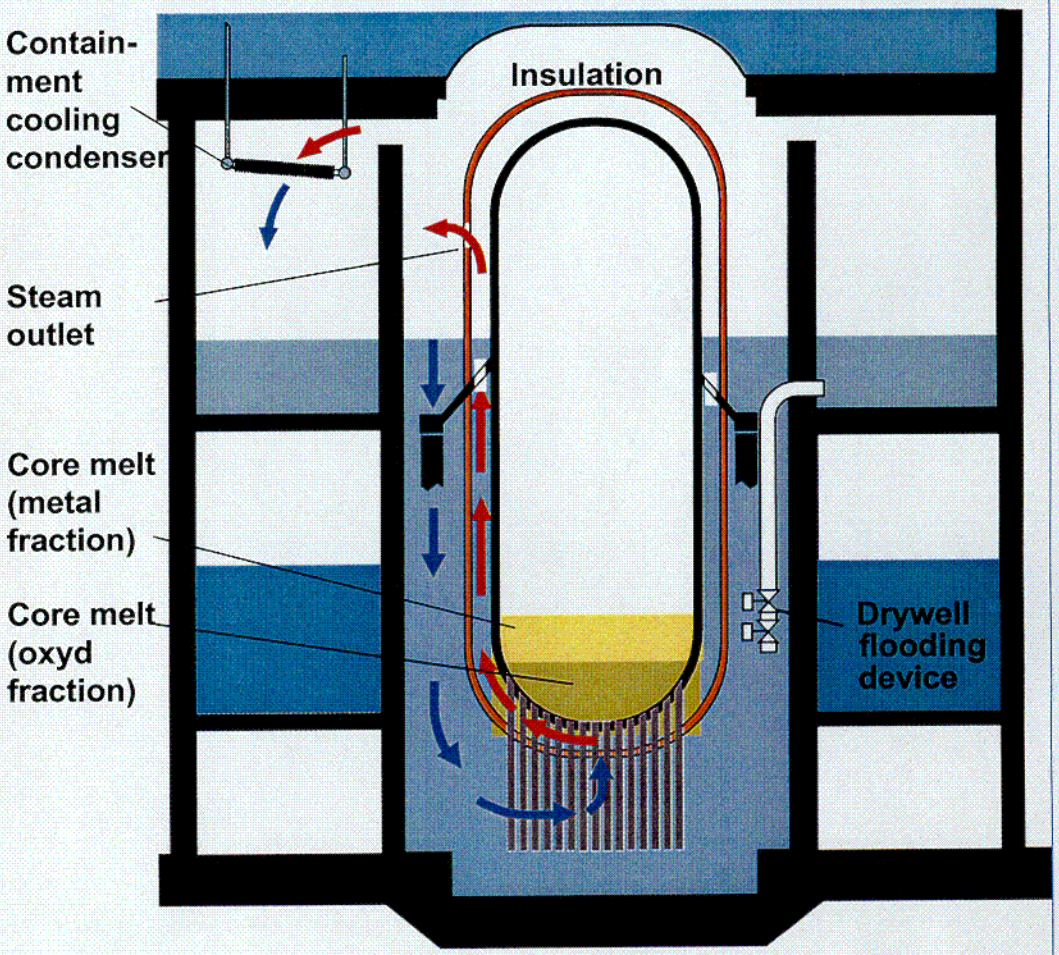
SWR 1000 - Severe Accident Control
Core-Melt Retention in the RPV

- External cooling of Reactor Pressure Vessel (RPV)
- Inerted containment
- Max. Containment pressure 95 psig (100% zirc-water)
- Passive heat removal from containment
- Containment vent to condenser off-gas



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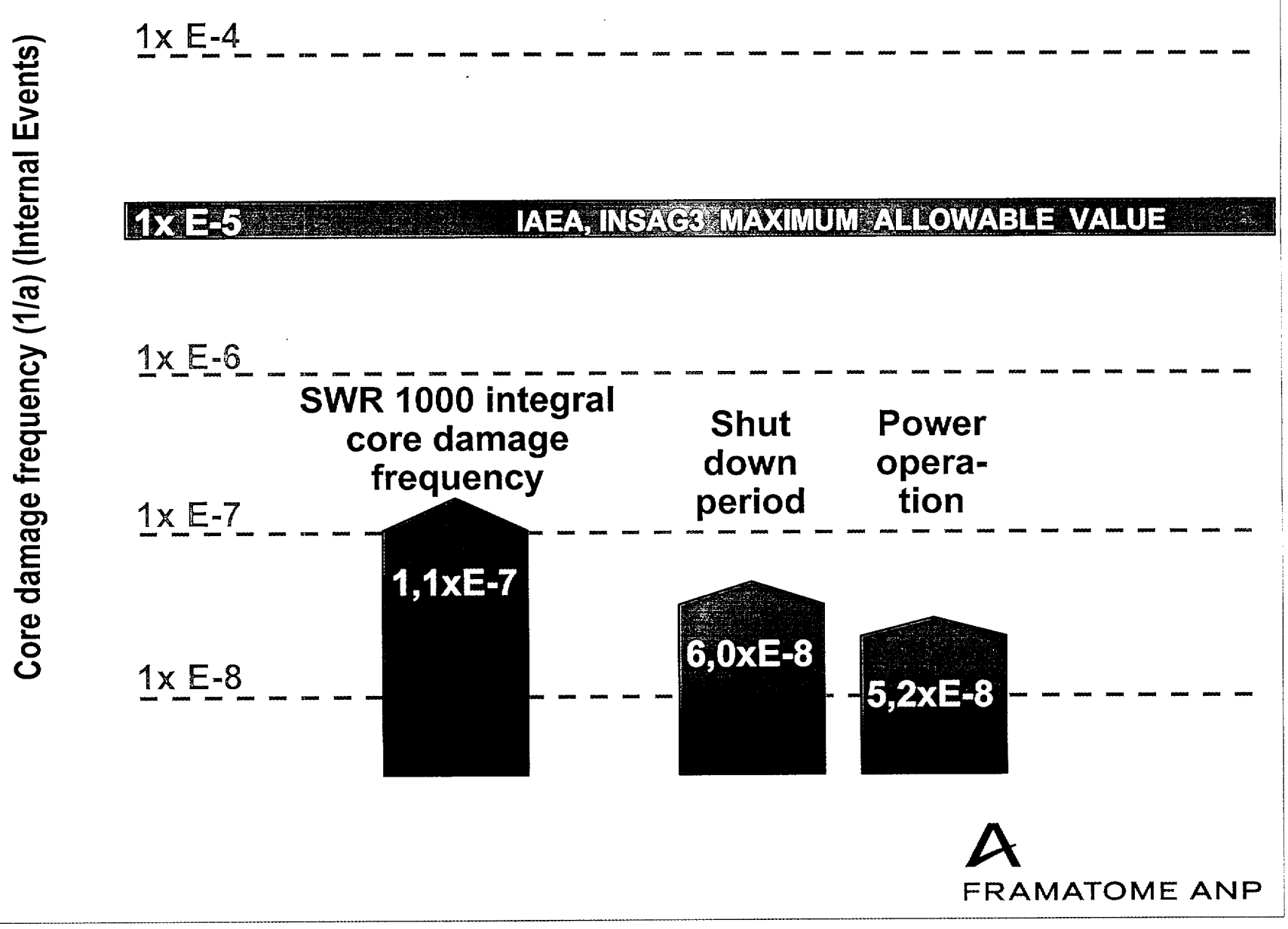
Probabilistic Safety Assessment



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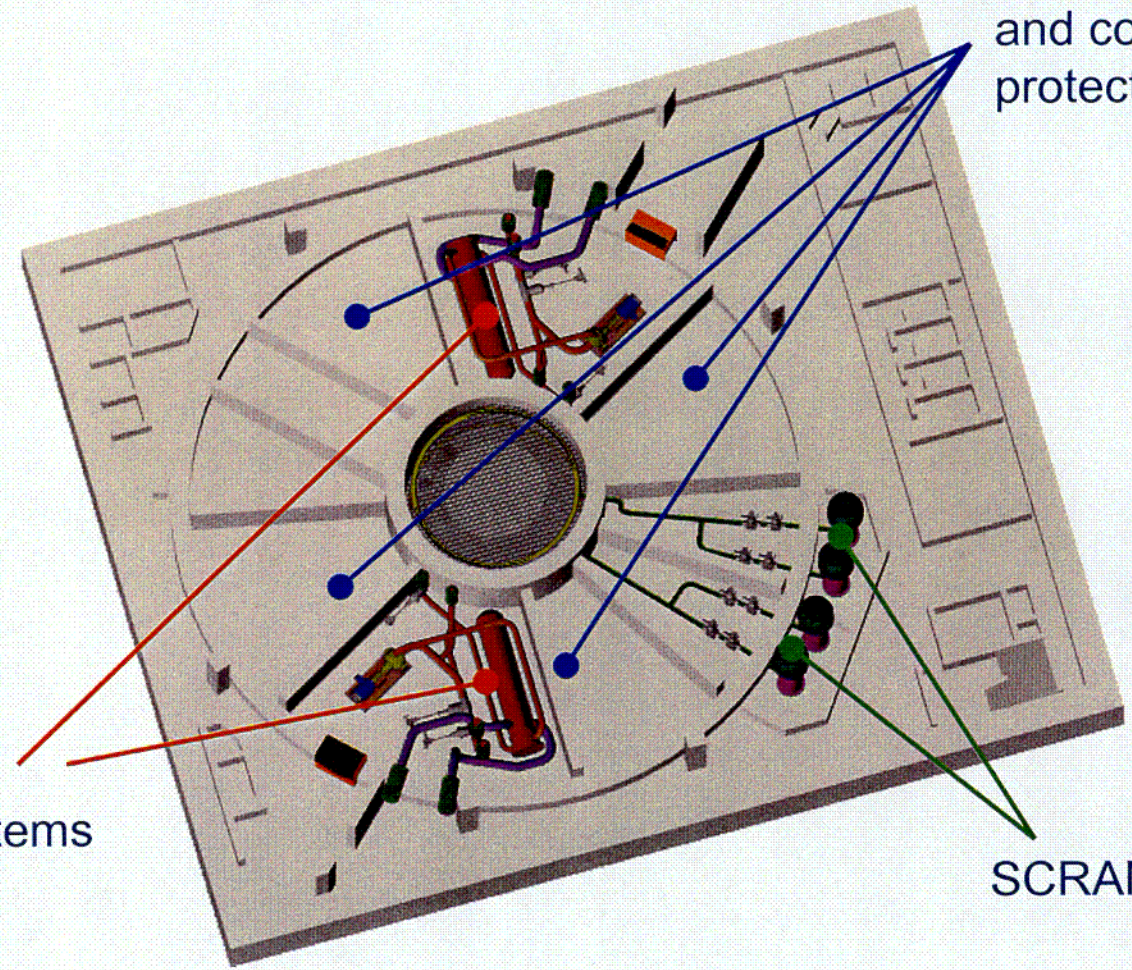
Physical Separation of Safety Systems



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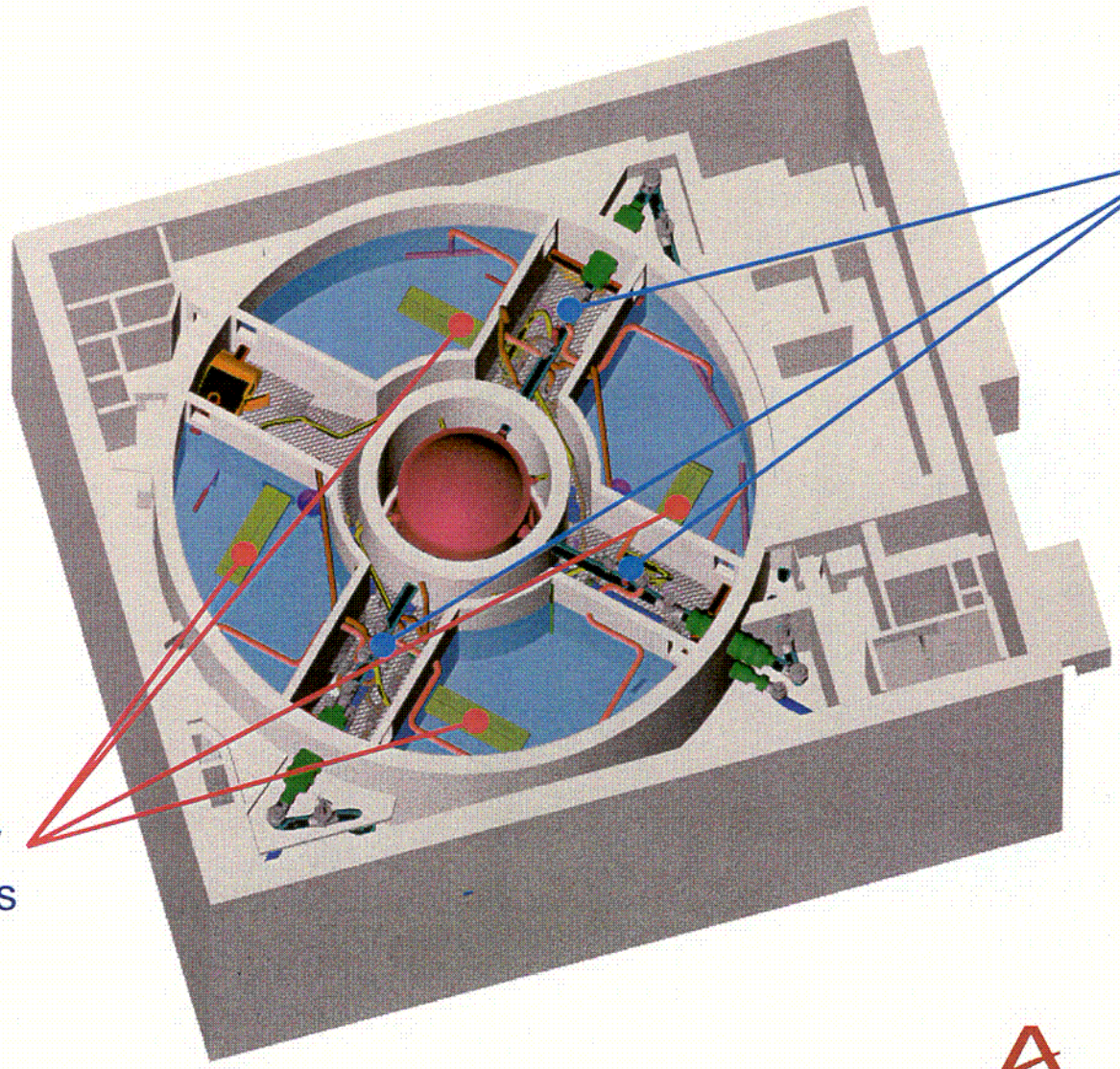
Physical Separation of Safety Systems



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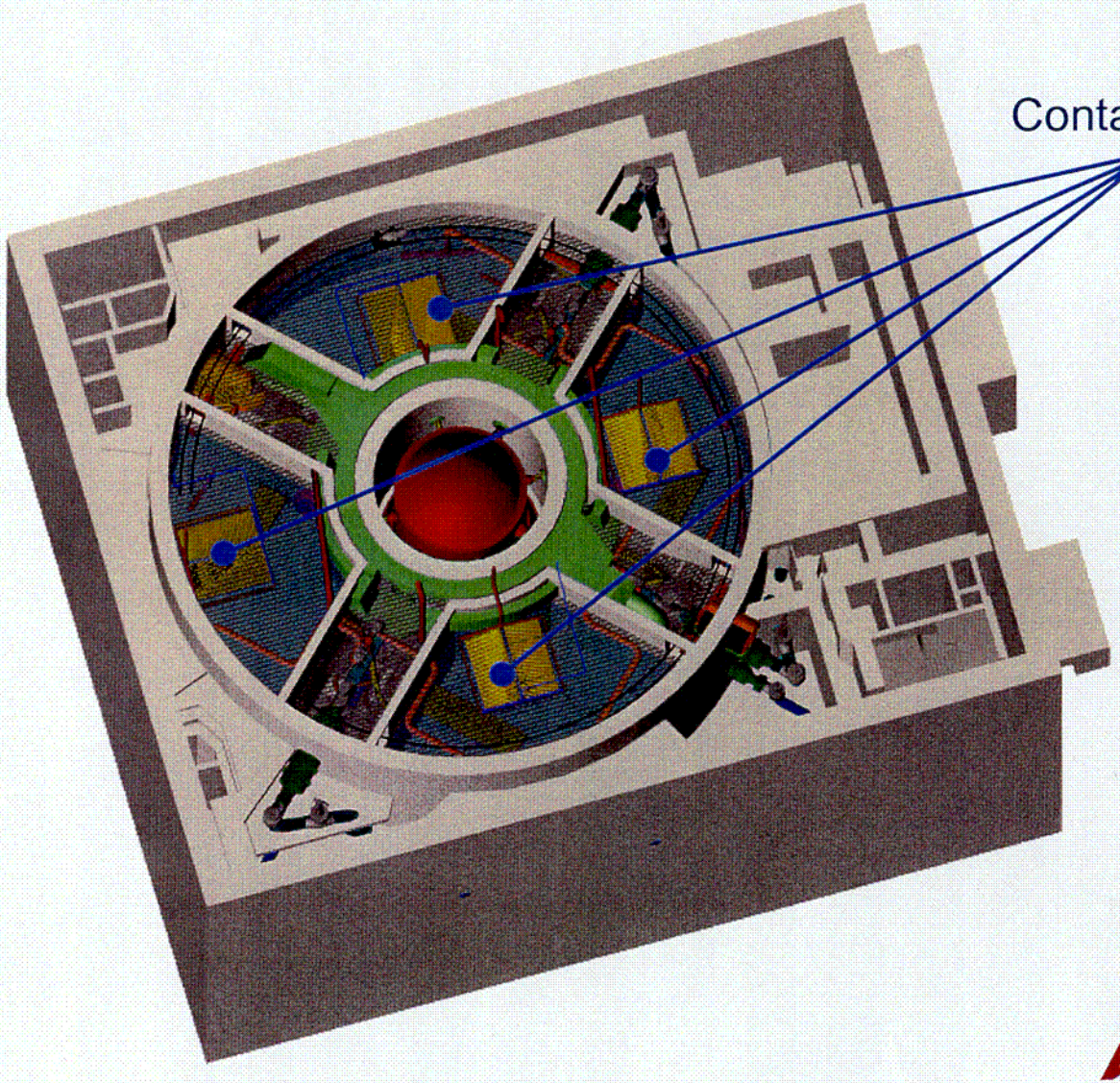
Physical Separation of Safety Systems



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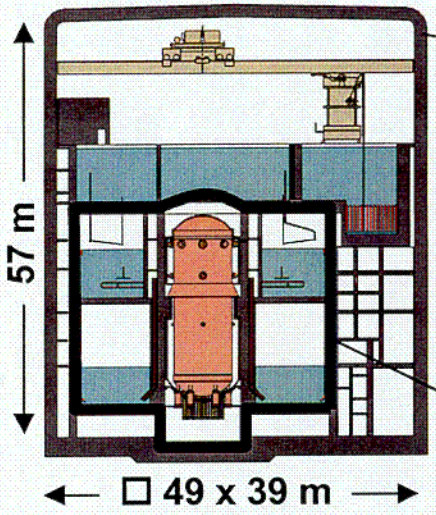
SWR 1000 Reactor Building and Containment



Reactor building

Designed against external loads

- Earthquake
- Military airplane crash
- Explosion pressure wave

Containment

- Reinforced concrete with steel liner, designed against severe accident pressure (7.5bar, 95psig)
- Inert (nitrogen) atmosphere during operation

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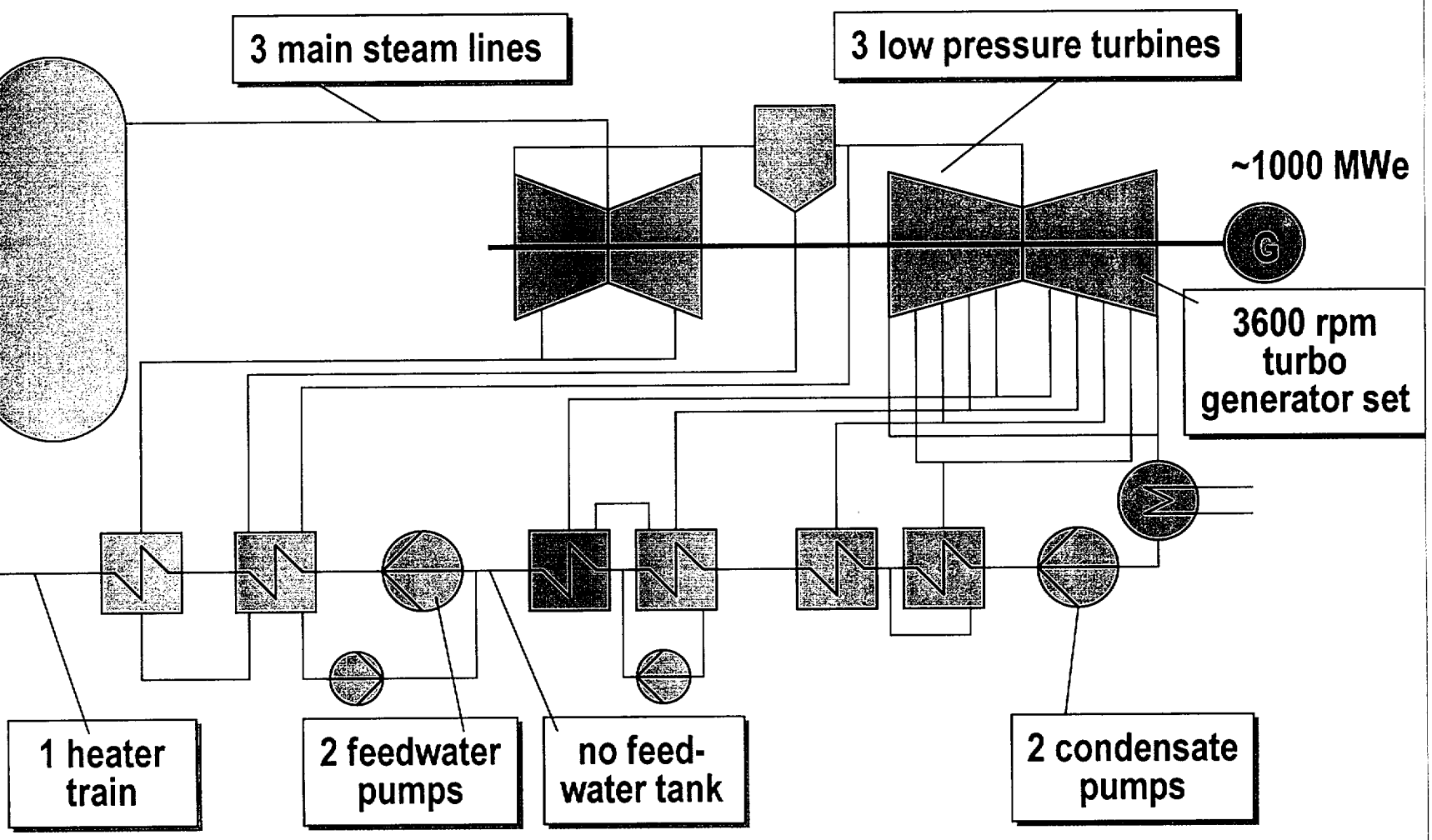
Steam, Condensate and Feedwater Cycle



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Simplified Systems Design

System	SWR 1000	1100 MWe BWR
Emergency condenser		-
HPCI-system		3 x 100%
Spent fuel pool cooling system	Cooler inside fuel pool	3 x 100%
LPCI-system	2 x 100%	3 x 100%
Reactor water cleanup system		2 x 100%
MCP-sealwater system	2 x 100%	3 x 100%
CRD-purging system	combined system	2 x 100%
Boron injection system		2 x 100%
Main steam lines	3	4
Feedwater lines	1/2	2/4
Feedwater heater train	single train	double train
Electrical- / I&C-system	double train (+ passive systems)	3 trains

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Current Status

- Basic design has been completed
- A preliminary safety analysis report has been completed
- The new passive safety systems features have been tested, other testing continues
- The SWR 1000 is one of the innovative options being considered for a 5th unit in Finland

SWR 1000 Design

- All active systems have passive Safety Related backup to perform nuclear safety functions
- SWR 1000 Defense-in-Depth design incorporates Safety Related passive systems that are designed to meet all nuclear safety criteria without reliance on active systems
- Framatome ANP believes the SWR 1000 is an Evolutionary BWR design

Specific Objectives

- **We Seek Clear Policy Statements on the Following:**
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  - NRC position on the treatment of passive systems
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