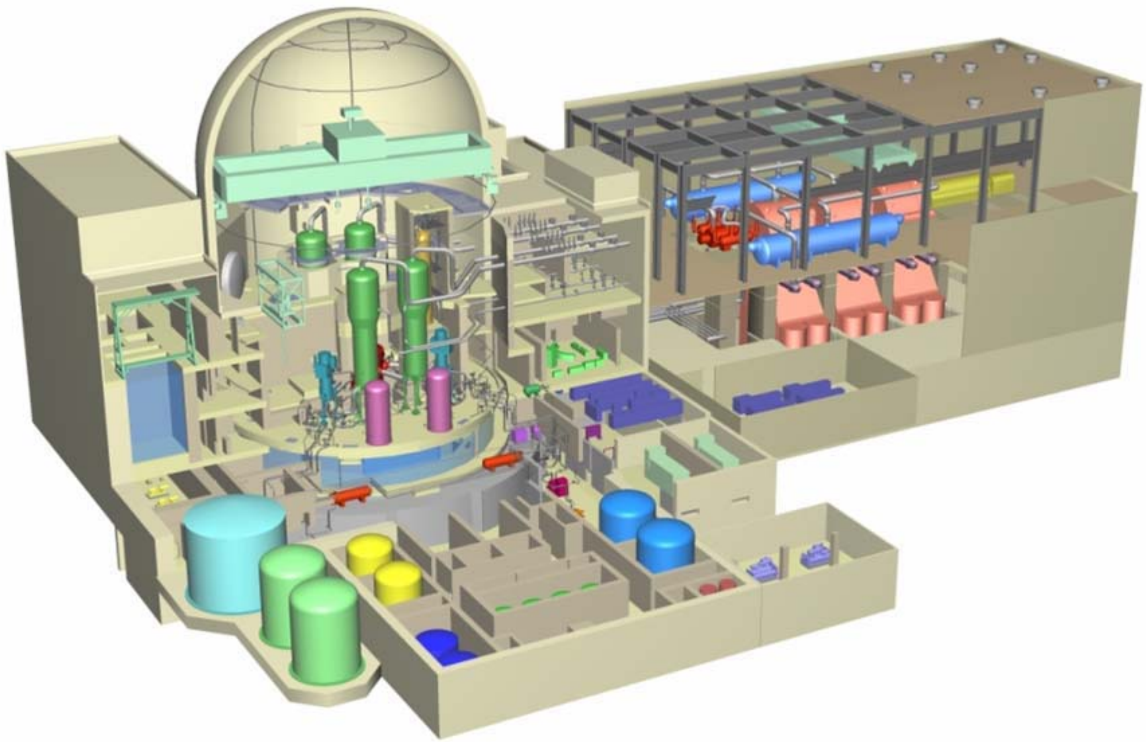
MITSUBISHI

US-APWR

Overview



June 29, 2007

Contents

1.What is US-APWR

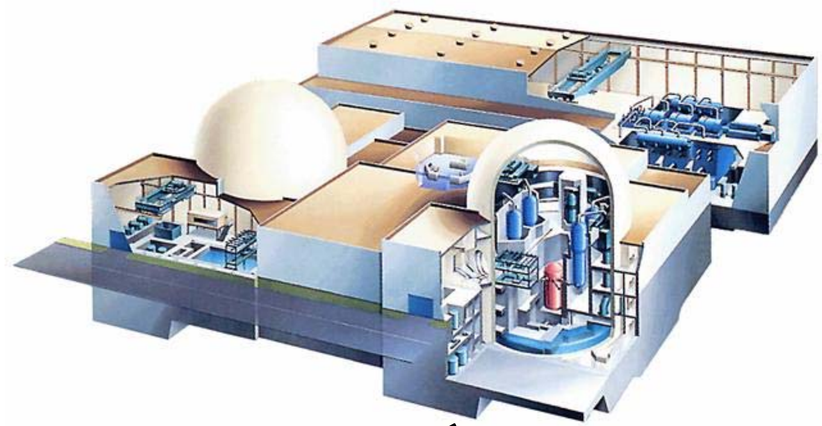
US-APWR satisfies U.S. customers requirements with the best performance for *Safety*, *Economy*, *Operation*, and *Maintenance!*

1. What is US-APWR (cont'd)

- US-APWR design is based on Japanese APWR.
- New technologies of APWR are fully tested, well-verified and established.
- US-APWR is slightly modified
  - ✓ to increase electric out put
  - ✓ to comply with the U.S. regulations
  - ✓ to meet the U.S. utilities requirements

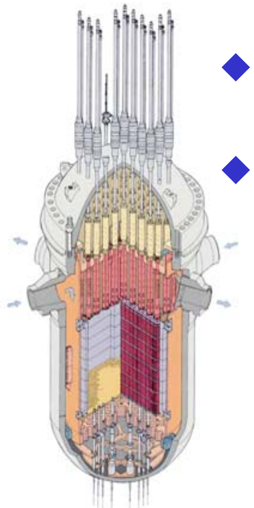
The First APWRs (Tsuruga3/4)

- ➢**First Concrete Pouring Date:**
  October, 2010
- ➢**Commercial Operation**
  Unit 3 : 2016
  Unit 4 : 2017



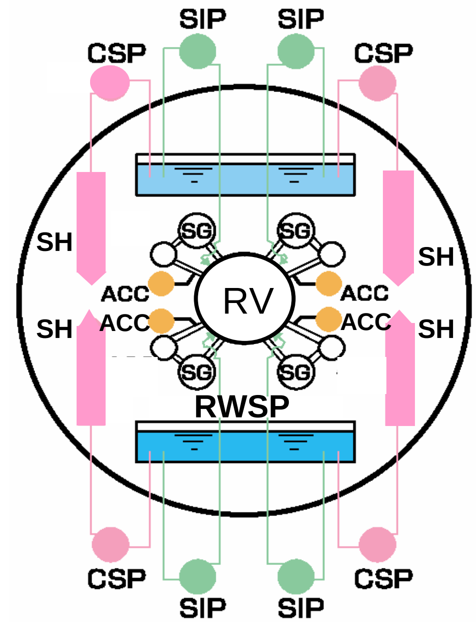
APWR's advanced technology

Reactor



- ◆1500 MWe class large capacity
- ◆Neutron reflector

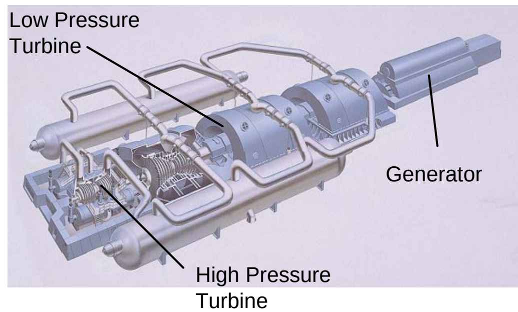
Engineering Safety Features



- ◆Simplified configuration with 4 mechanical sub-systems
- ◆In-containment RWSP
- ◆Advanced accumulator

Turbine

- ◆54 inch-length blades in LP turbine
- ◆Fully integrated LP turbine rotor



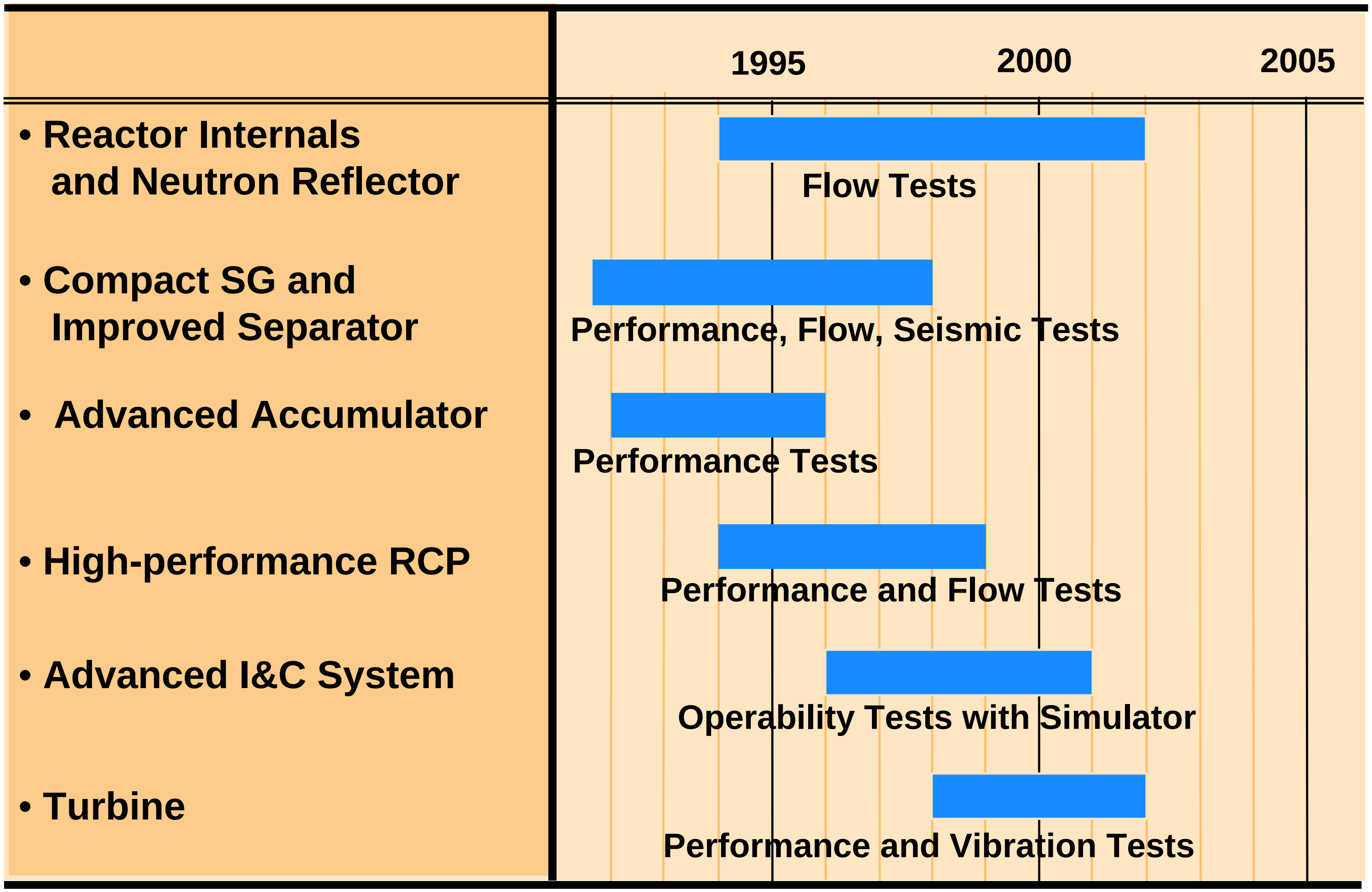
Steam Generator

- ◆High performance separator
- ◆Increased capacity with compact sizing

I & C

- ◆Digital control & protection systems
- ◆Compact console

Verifications for Advanced Designs



Reactor Flow Test

SG Separator Test

LP Turbine Test

2. Development of US-APWR

US-APWR is developed to consider with the following items

- **Correspondence to electric power demand increase in the U.S.**
- **Comply with U.S. regulations**
- **Meet the U.S. Utilities requirements such as URD**

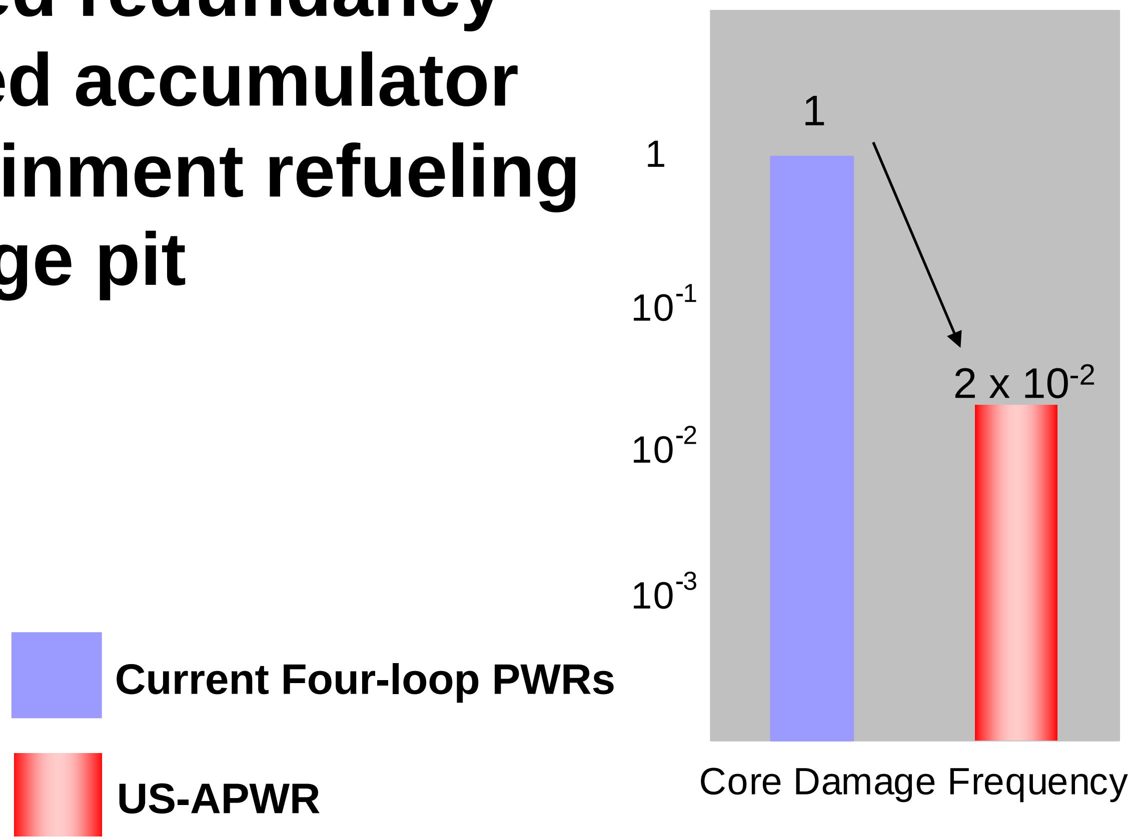
3. US-APWR main concepts

Evolutionary (not "Revolutionary") Design

- **Similar to standard 4-loop PWR design currently in operation in the U.S.**
- **Based on APWR design currently under licensing process in Japan**
- **Fully verified new technologies to enhance safety, reliability, economy and operability**

Enhanced Safety

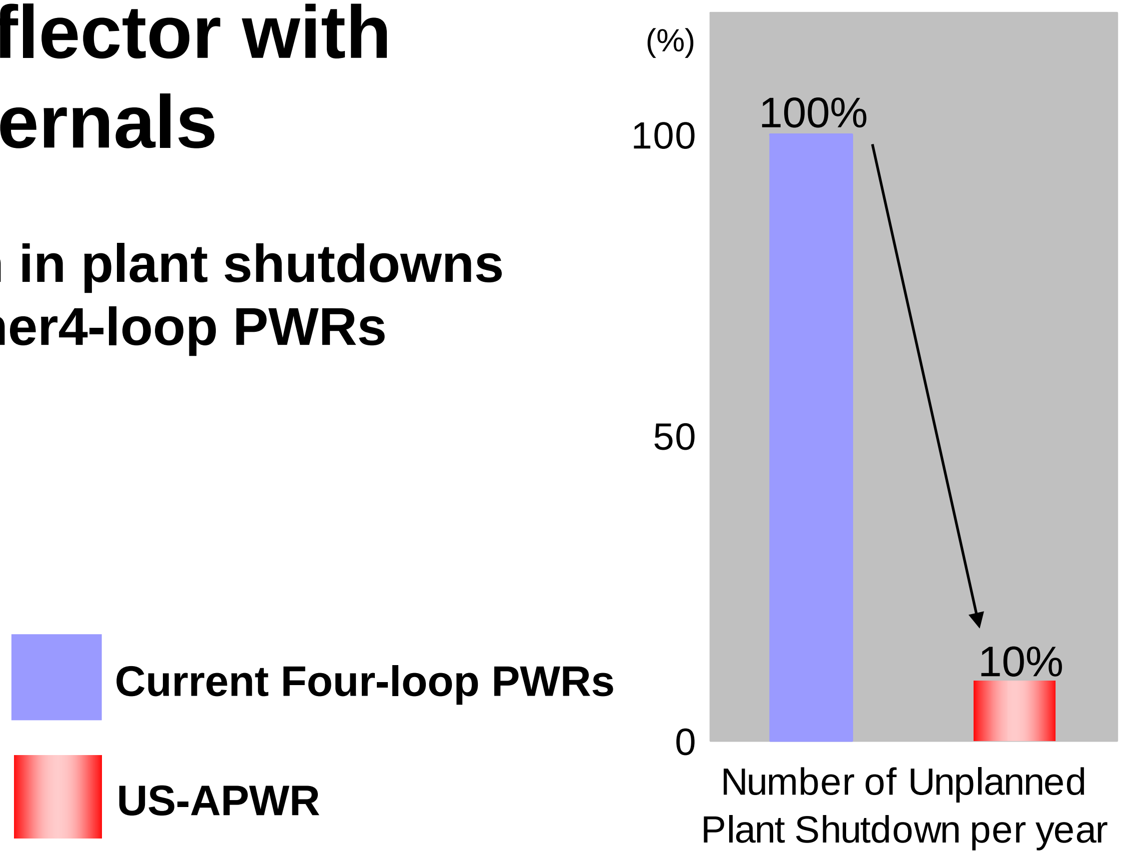
- A four-train safety systems for enhanced redundancy
- An advanced accumulator
- An in-containment refueling water storage pit



Enhanced Reliability

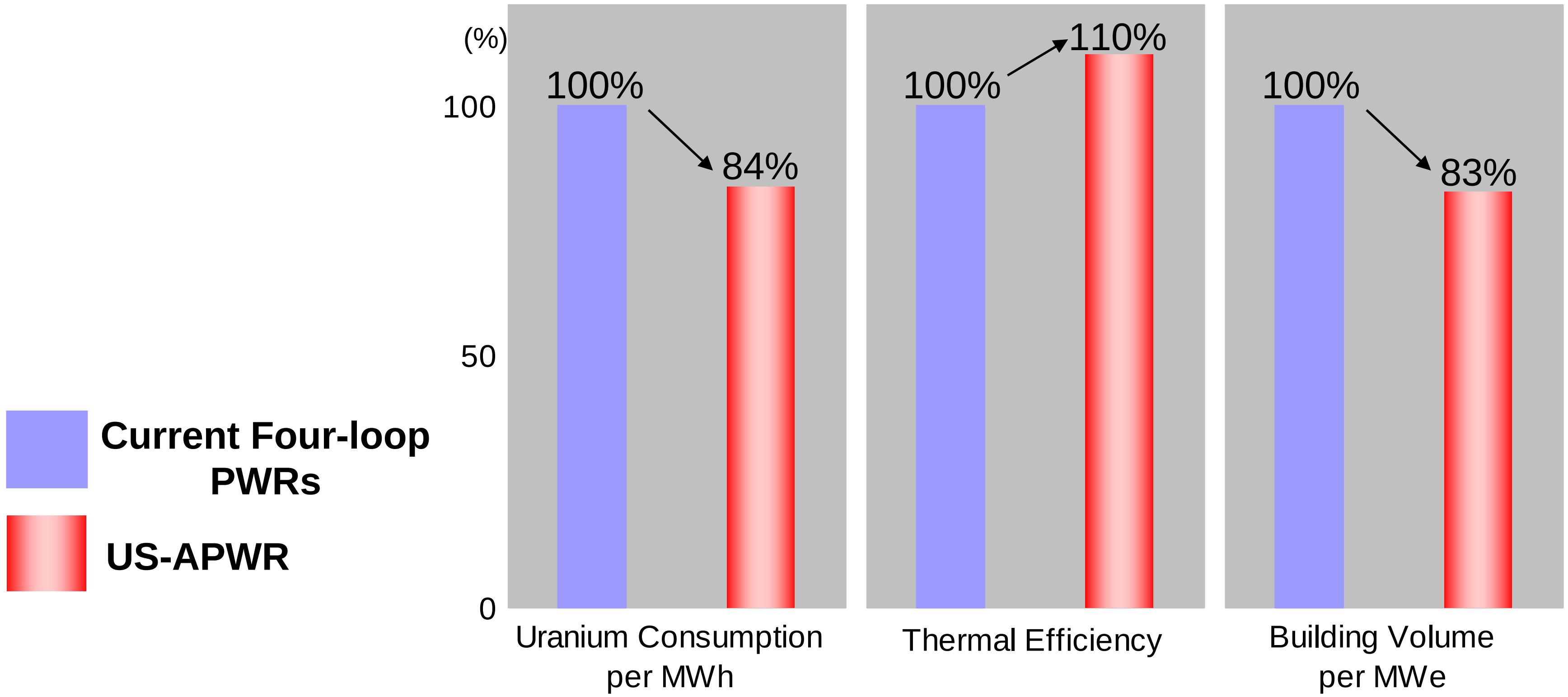
- A stem generator with high corrosion resistance
- A neutron reflector with improved internals

A 90% reduction in plant shutdowns compared to other4-loop PWRs



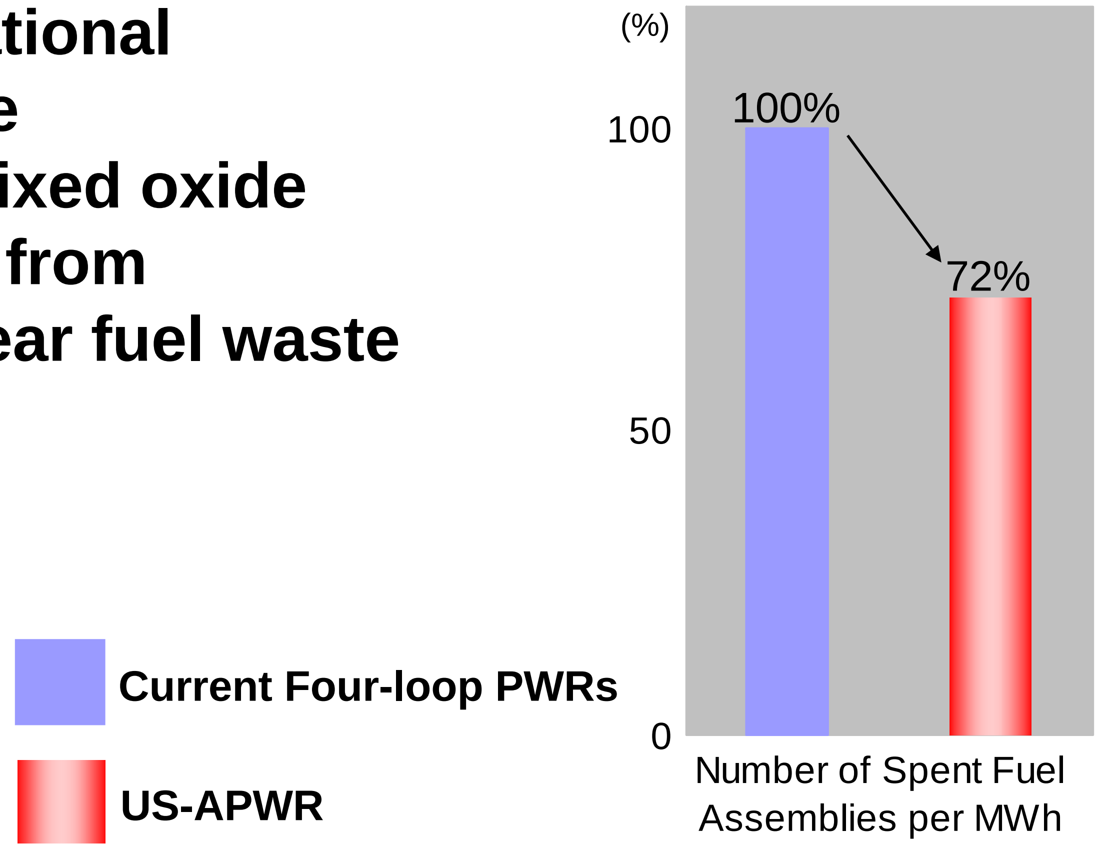
Attractive Economy

- **A large core with a thermal efficiency of 39%**
- **Building volume per MWe that is four –fifths that of other 4-loop PWRs**



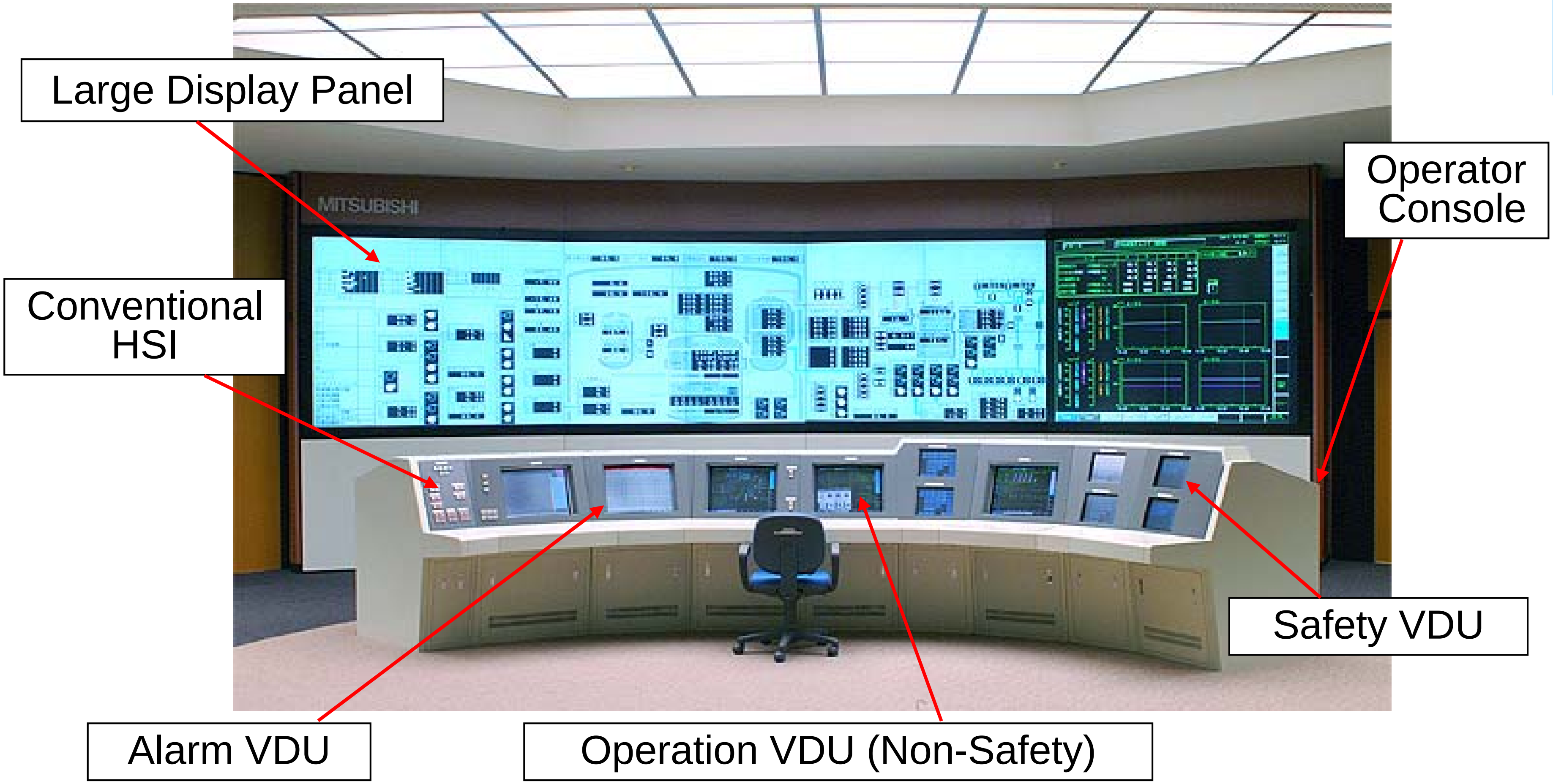
More Environmentally Friendly

- A 28% reduction in spent fuel assemblies per MWh compared to other four-loop PWRs
- Reduction occupational radiation exposure
- Capacity to use mixed oxide (MOX) fuels made from reprocessed nuclear fuel waste



Improved Operability

■ **Fully digital control and protection systems**



Comparison of Output & Main Components

		U.S. Current 4 Loop	APWR	US-APWR
Electric Output		**1,180 MWe**	**1,538 MWe**	**1,700 MWe Class**
Core Thermal Output		**3,411MWt**	**4,451 MWt**	**4,451 MWt**
Steam Generator	**Model**	**54F**	**70F-1**	**91TT-1**
	Tube size	**7/8”**	**3/4”**	**3/4”**
Reactor Coolant Pump	**Model**	**93A-1**	**100A**	**100A**
Turbine	**LP last-stage blade**	**44 inch**	**54 inch**	**70 inch class**

- **APWR**
  - ✓**1538MWe output is achieved by large capacity core and large capacity main components such as SG, RCP, turbine, etc.**
- **US-APWR**
  - ✓**1700MWe class output is achieved from a 10% higher efficiency than APWR.**
    - **Same core thermal output with APWR**
    - **High-performance, large capacity steam generator**
    - **High-performance turbine**

Comparison of Fuel, Core & Internals

		U.S. Current 4 Loop	APWR	US-APWR
Core Thermal Output		3,411MWt	4,451 MWt	4,451 MWt
Core and Fuel	NO. of Fuel Assem.	193	257	257
	Fuel Latice	17 x 17	17 x 17	17 x 17
	Active Fuel Length	12ft	12ft	14 ft
Reactor internals		Baffle/former structure	Neutron Reflector	Neutron Reflector
In-core Instrumentation		Bottom mounted	Bottom mounted	Top mounted

- **APWR**
  - ✓ Large capacity core by increasing number of fuel assemblies
  - ✓ Installation of neutron reflector to enhance reliability and fuel economy
- **US-APWR**
  - ✓ Low power density core using 14ft. fuel assemblies with the same reactor vessel as APWR to enhance fuel economy for 24 months operation
  - ✓ Enhanced reliability and maintainability of reactor vessel by top mounted ICIS

Comparison of Systems, CV and I&C

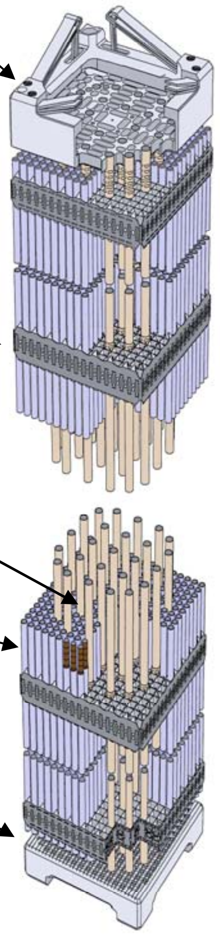
			U.S. Current 4 Loop	APWR	US-APWR
Safety Systems	Trains	Electrical	2 trains	2 trains	4 trains
		Mechanical	2 trains	4 trains	4 trains
	Systems	HHSI pump	100% x 2	50% x 4(DVI)	50% x 4(DVI)
		LHSI pump	100% x 2	-	-
		ACC	4	4 (Advanced)	4 (Advanced)
	RWSP		Outside CV	Inside CV	Inside CV
Containment Vessel			PCCV	PCCV	PCCV
I & C	Control Room		Conventional	Full Digital	Full Digital
	Safety I&C		Conventional		
	Non-Safety I&C		Full Digital		

- **APWR**
  - ✓ **Enhanced safety by simplified and reliable safety systems**
    - **Mechanical 4 train systems with direct vessel injection design**
    - **Elimination of LHSI pump by utilizing advanced accumulators**
    - **Elimination of recirculation switching by In-containment RWSP**
- **US-APWR**
  - ✓ **Enhanced safety by 4 train safety electrical systems**
  - ✓ **Enhanced on line maintenance capability**

4. Key Design Features

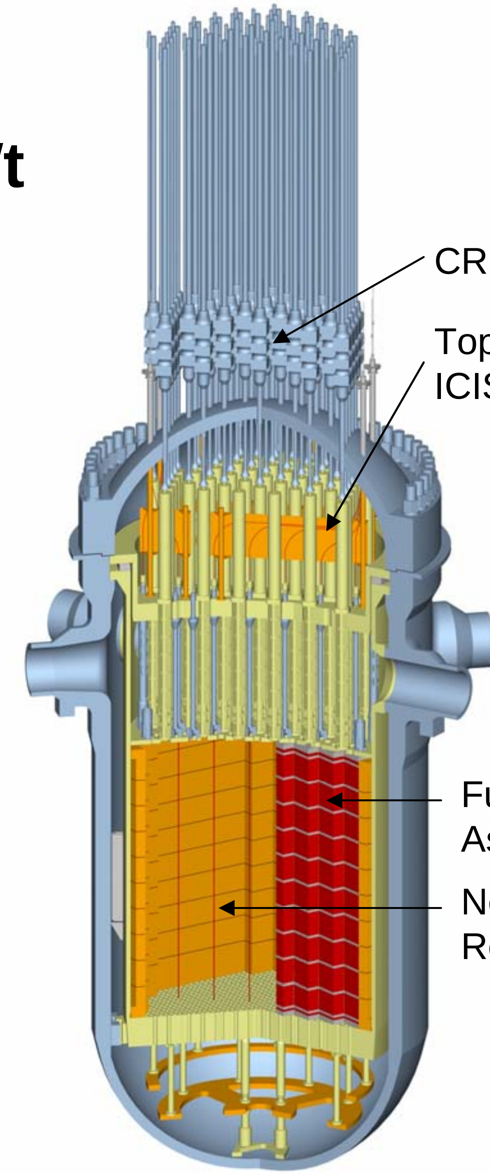
Fuel

- **Low power density core using 14ft. FAs for 24 months operation**
- **Higher Density Pellet (97%T.D.)**
- **Grid Fretting Resistant Design (Shorter Span Length with 11 grids & Grid Spring Design)**



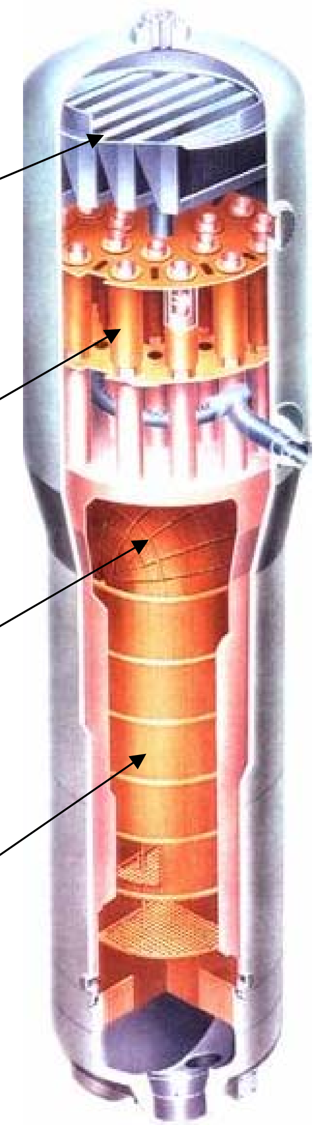
Reactor Vessel

- **Core thermal output: 4,451MWt**
- **14 feet fuel length**
- **RV size is same as APWR**
- **Eliminate the bottom mounted ICIS**



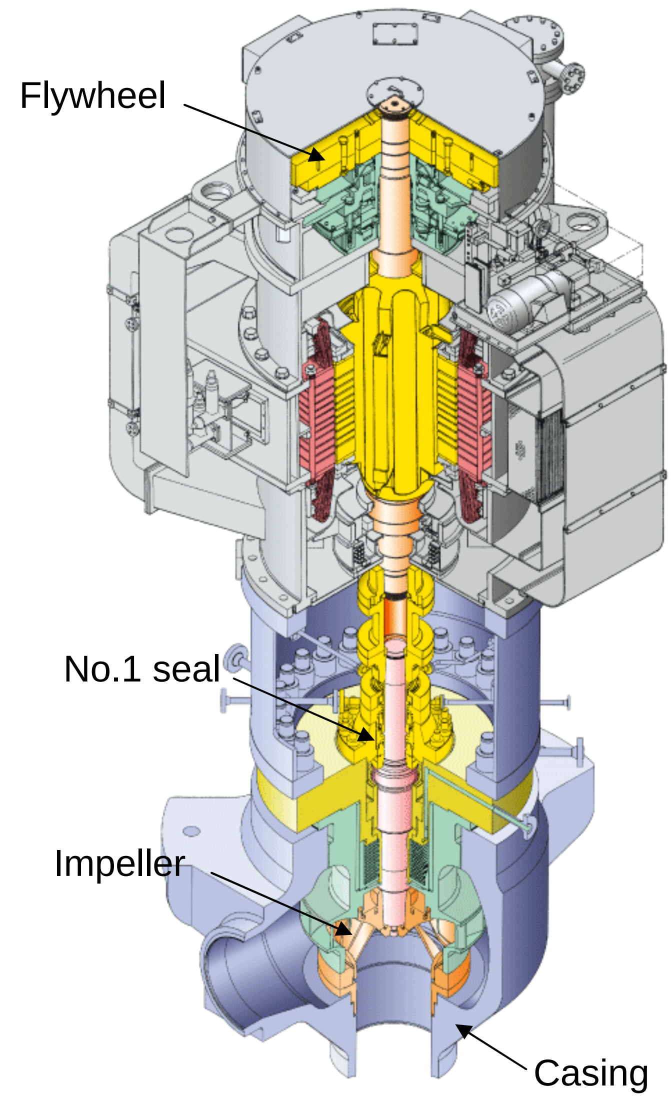
Steam Generator

- High Performance Separator
- Increased Capacity with Compact Sizing
- High Corrosion Resistance Tubes



Reactor Coolant Pump

- **Improved Hydraulic performance**
- **Advanced Seal**
  -Improved Seal Characteristic and Durability



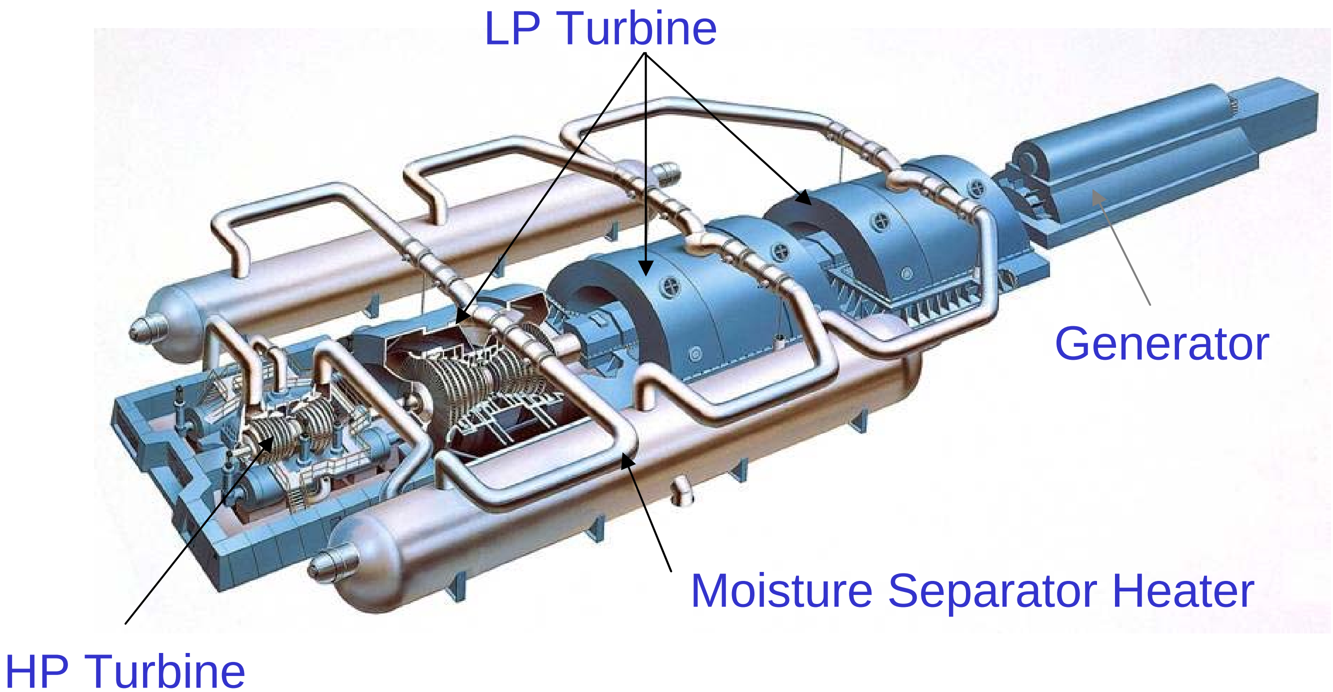
Turbine Generator

➢Higher Efficiency

• **Two Stage Reheat MSR High Efficiency Reaction Blades**

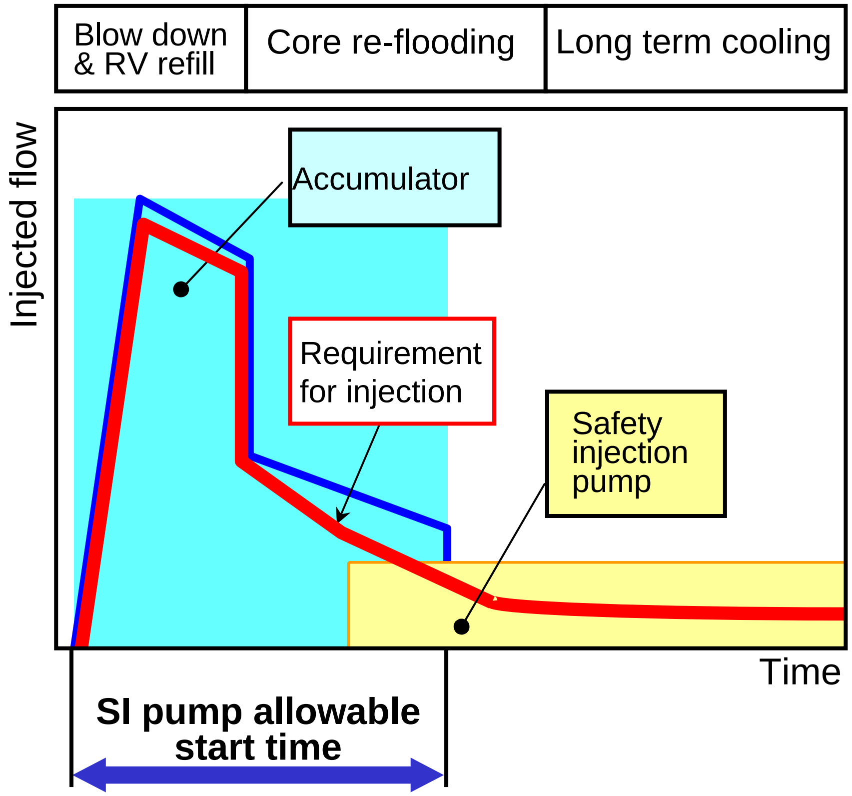
➢Higher Reliability

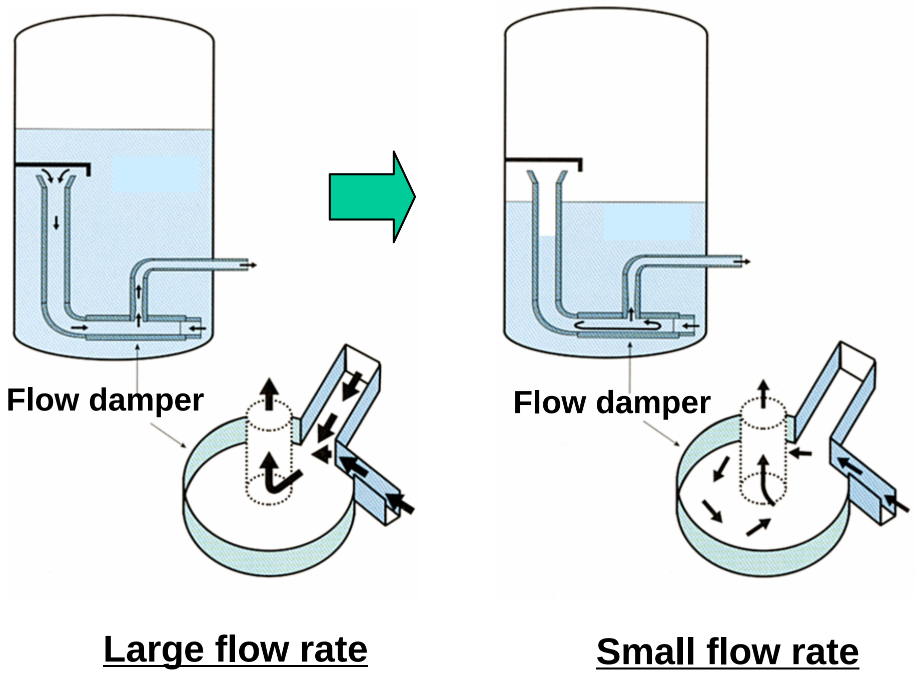
• **Integral Shroud LP End Blade - ISB Monoblock LP Rotor**



Advanced Accumulator

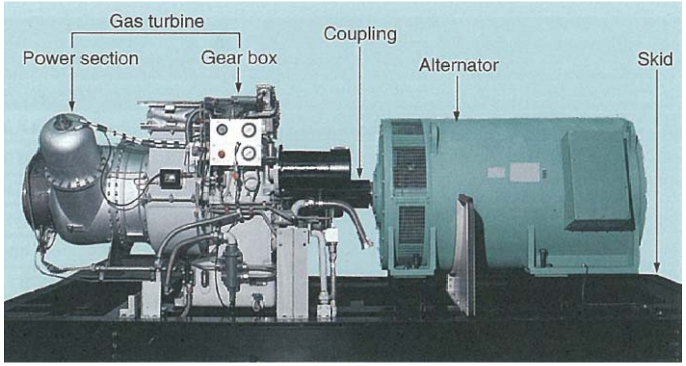
- Automatic switching of injection flow rate by flow damper
- Integrated function of low head injection system
- Long accumulator injection time allows more time for safety injection pump to start





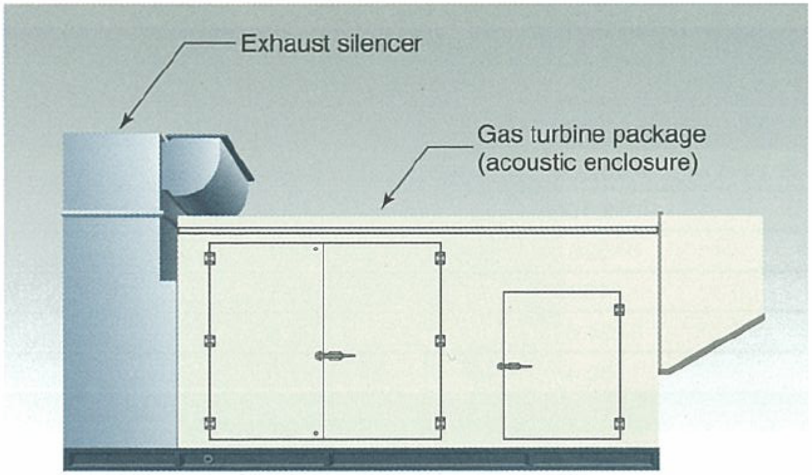
Gas Turbine Generator for EPS

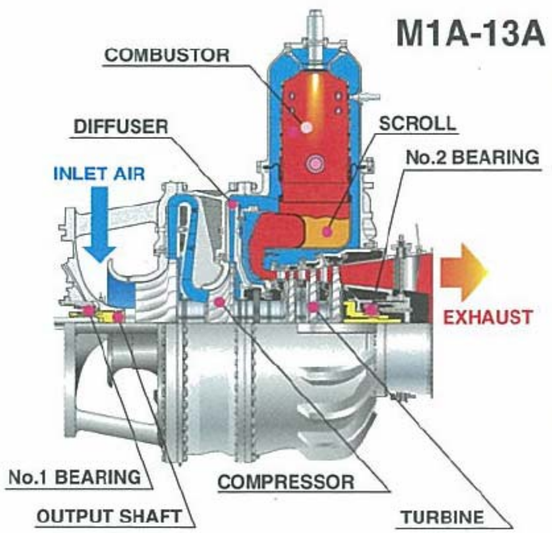
- Gas-Turbine Generators are applied to the Emergency Power Source
- Gas-Turbine Topical Report will be submitted NRC by the end of 2007



- The Gas Turbine is a very simple rotating engine with few components
- A water cooling system is not required

Gas turbine package with exhaust silencer



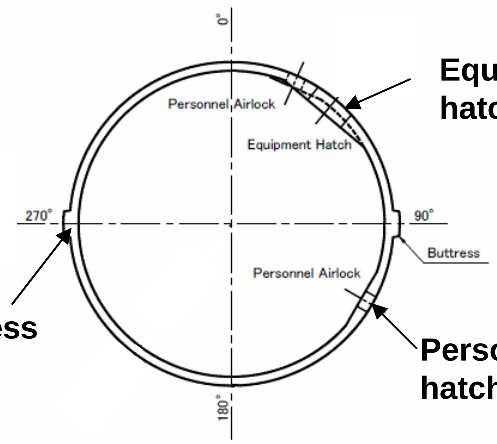


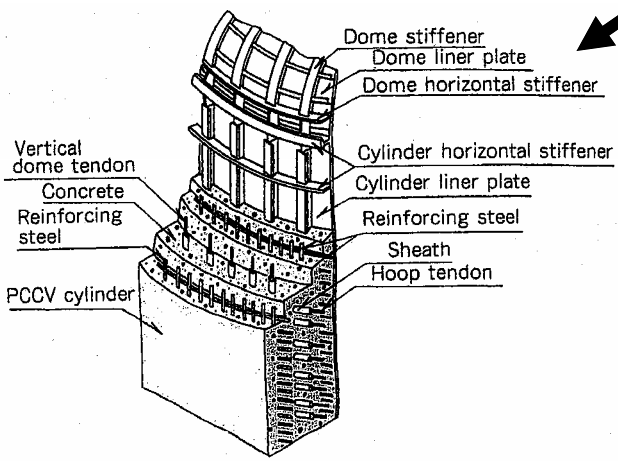
Gas Turbine Generator for AAC

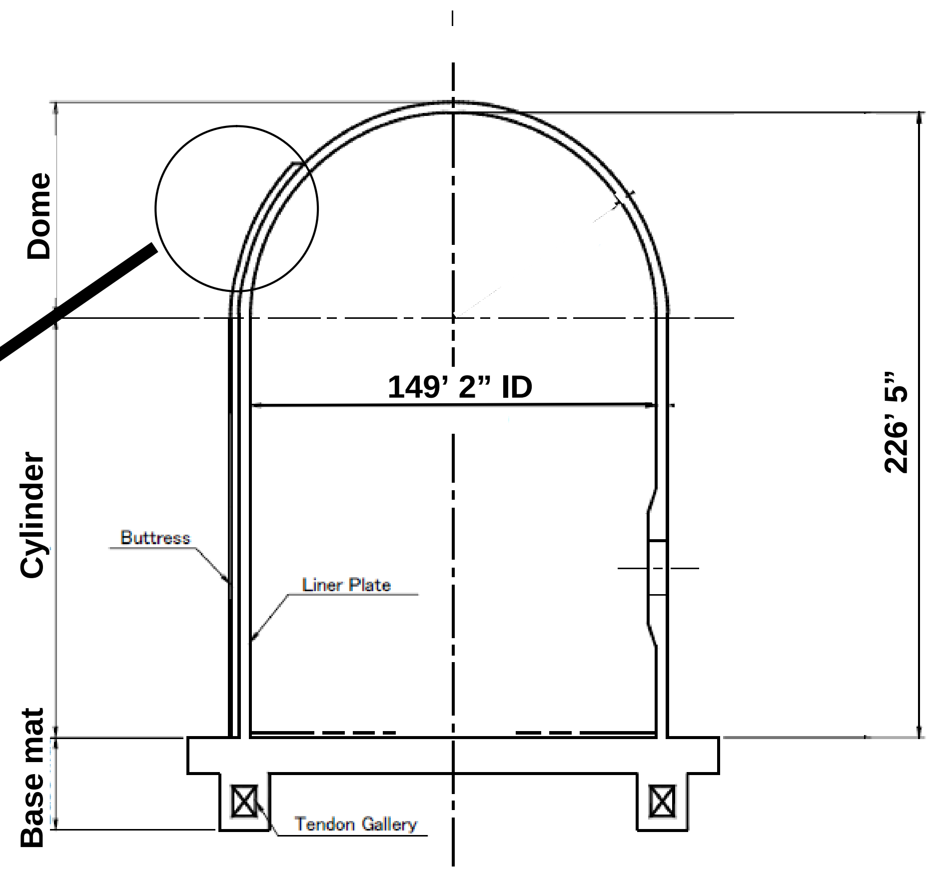
- Gas-Turbine Generators also are applied to the Alternate AC power source
- Gas-Turbine Generators of AAC are provided different type (Starting System, Capacity etc.) from Gas-Turbine Generators of EPS to minimize the potential for the common mode failure

PCCV

- **Robust and reliable Pre-stressed Concrete Container Vessel with steel liner is applied to US-APWR**







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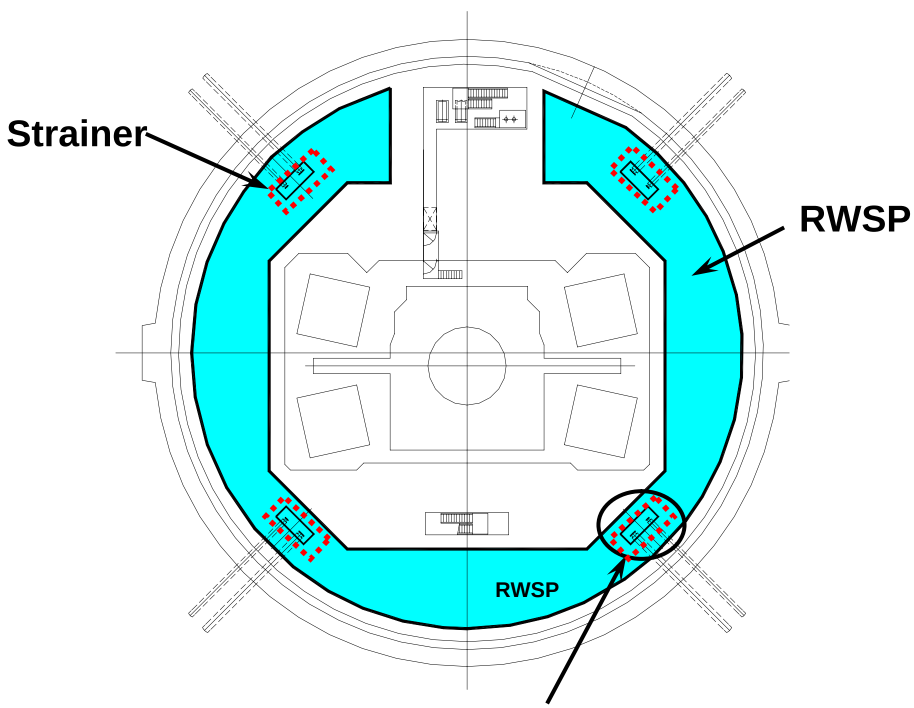
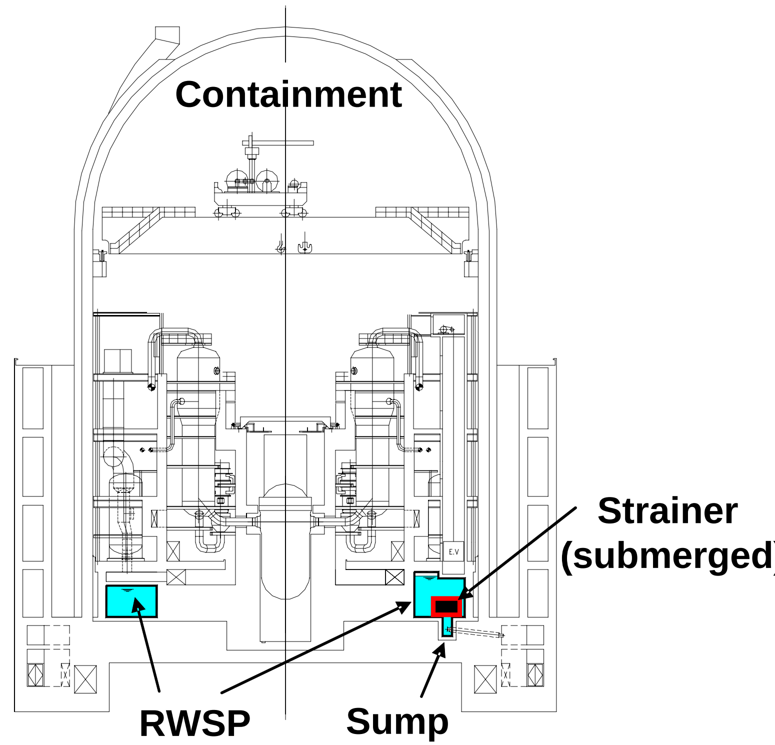
RWSP

- RWSP is installed inside containment vessel
- Easy to meet the GSI-191 because the surface area of strainer can be increased easily

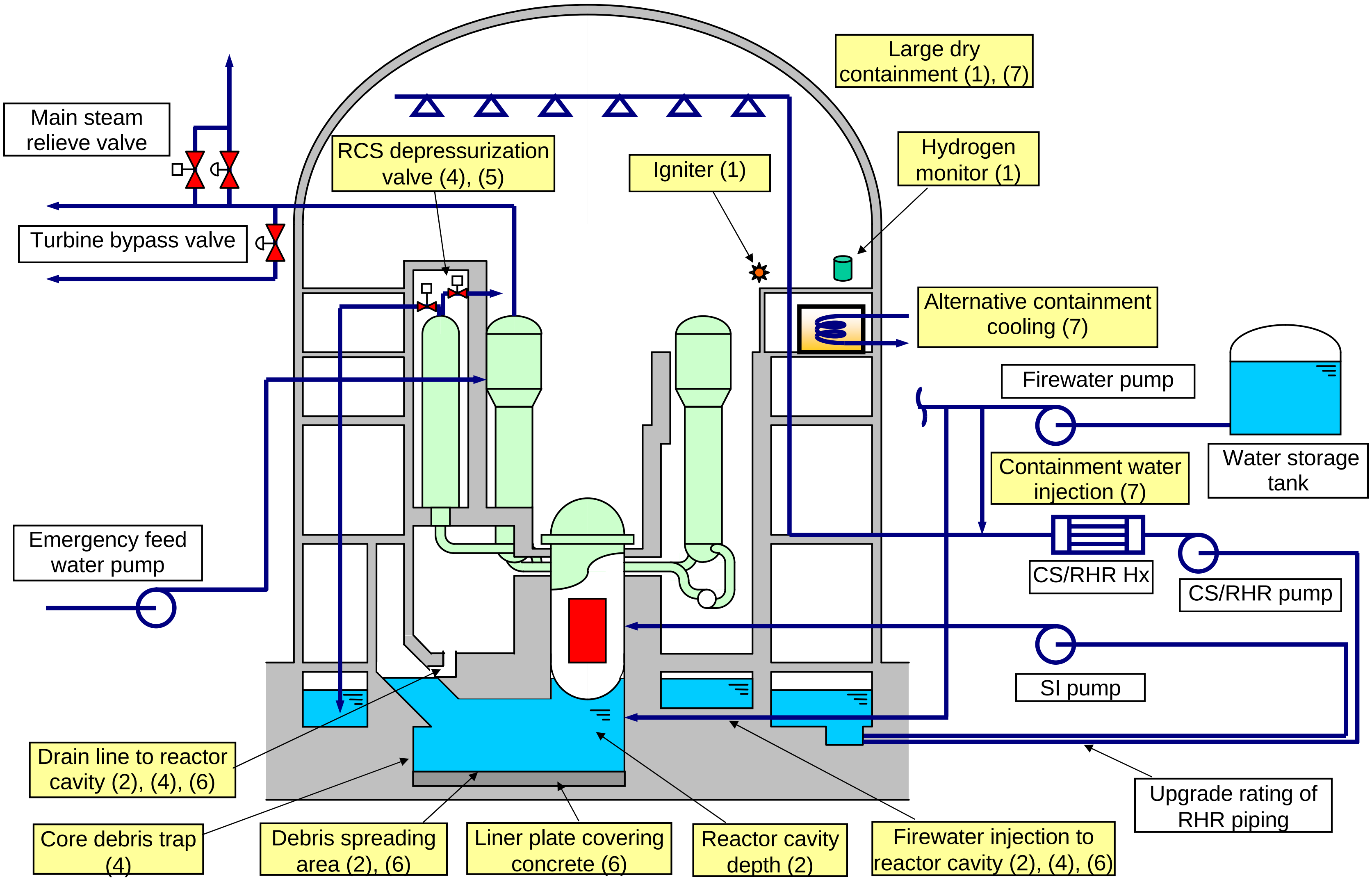




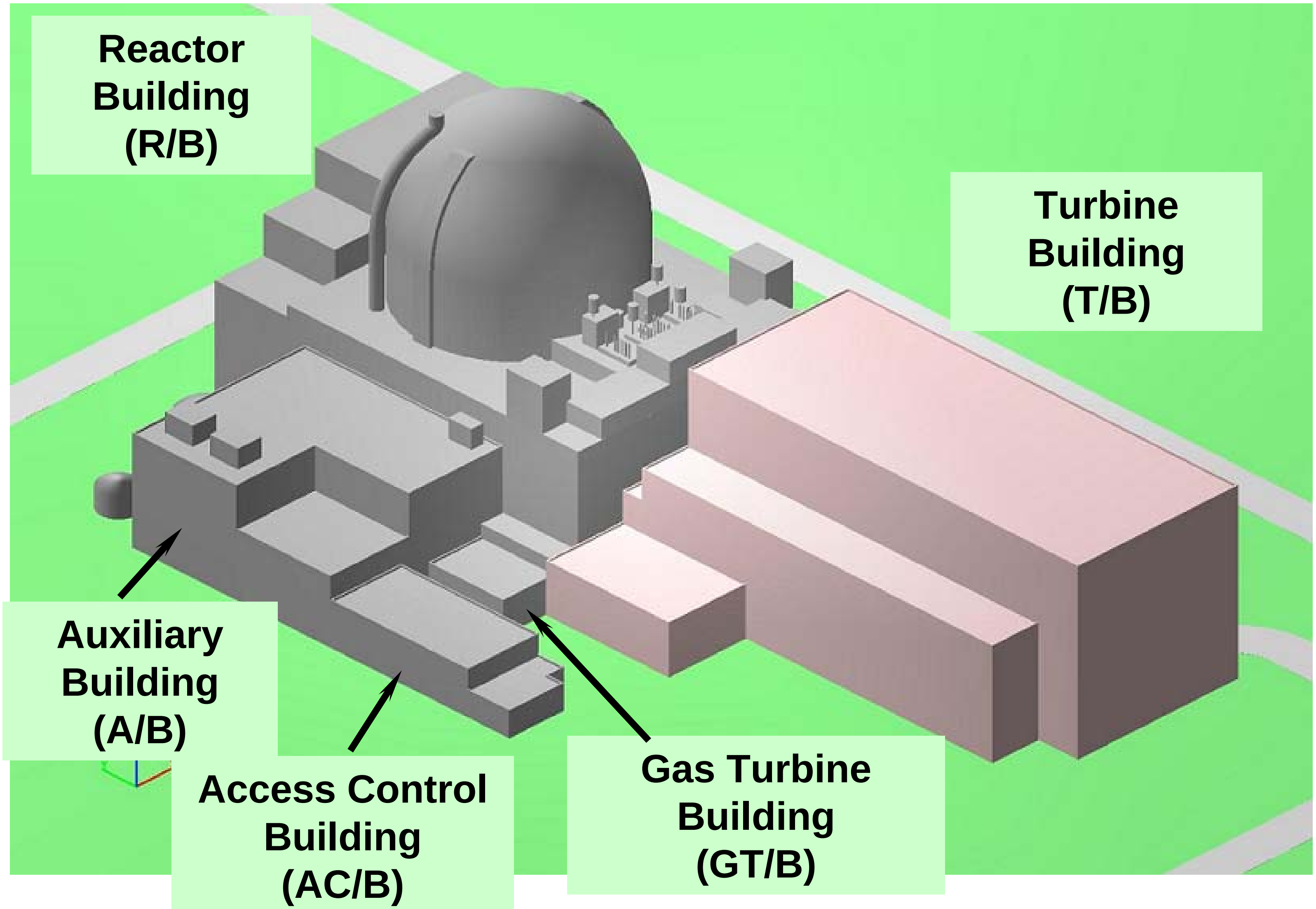
Countermeasure of SA

- **US-APWR achieves higher safety to comprehensively address severe accident and mitigate consequences**
  - ✓ Demonstrate compliance with current NRC regulations including TMI requirements for new plants
  - ✓ Demonstrate technical resolution of the applicable unresolved safety issues (USI), and the medium and high-priority generic safety issues (GSI) discussed in NUREG-0933

Countermeasure of SA (cont’d)



Arrangement of Main Power Block

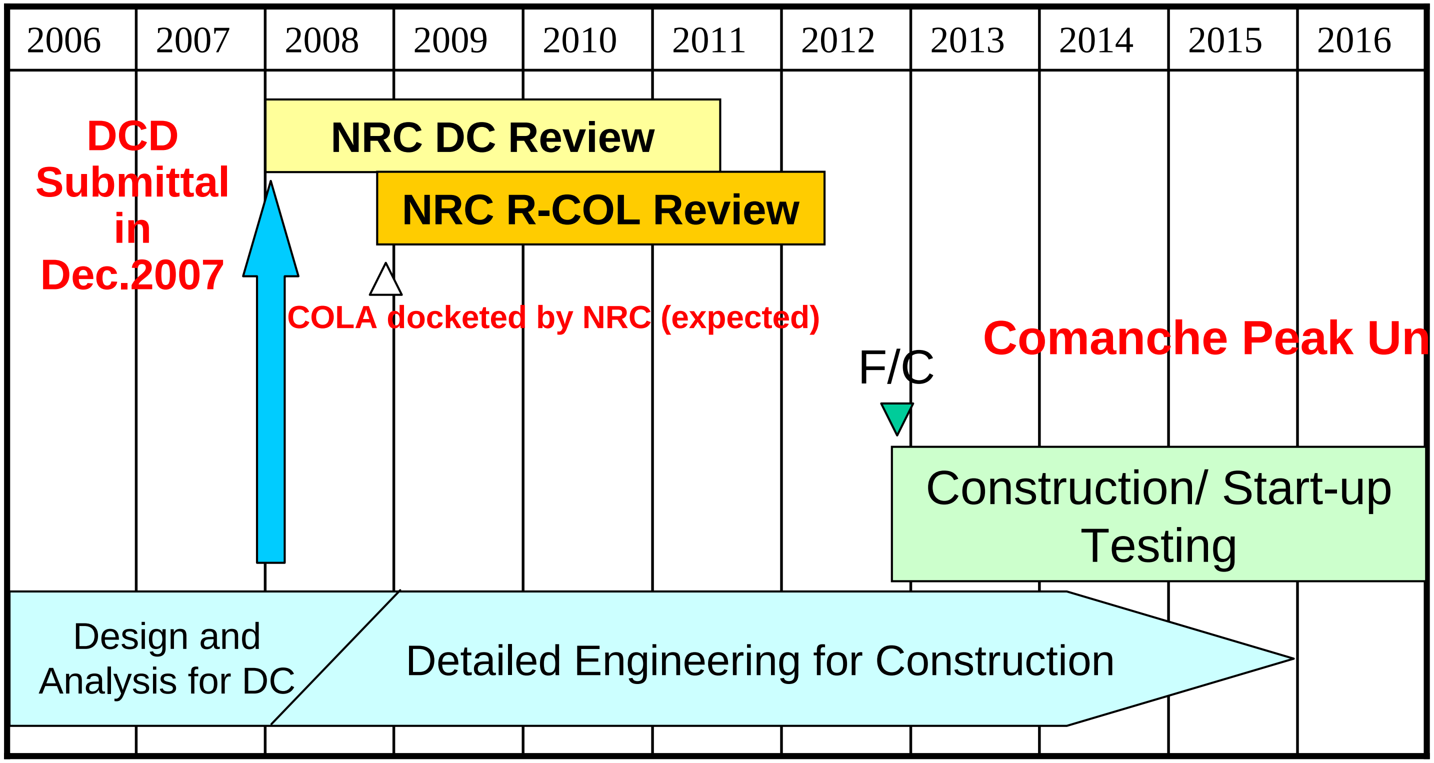


5. Key Plant Parameters

	APWR	US-APWR
Electric Output	1,538 MWe	1,700 MWe Class
Core Thermal Output	4,451 MWt	4,451 MWt
Core	12 ft Fuel 257Assem.	14 ft Fuel 257 Assem.
SG Heat Transfer Area per SG	70,000 ft^2	91,500 ft^2
Thermal Design Flow rate per loop	113,000 GPM	112,000 GPM
Turbine	54 inch blades	70 inch class blades
Containment Vessel	PCCV	PCCV
Safety Systems	Electrical 2 trains Mechanical 4 trains	Electrical 4 trains Mechanical 4 trains
	HHSI x 4 Advanced Accumulator x 4 Elimination of LHSI	HHSI x 4 Advanced Accumulator x 4 Elimination of LHSI
I&C	Full Digital	Full Digital

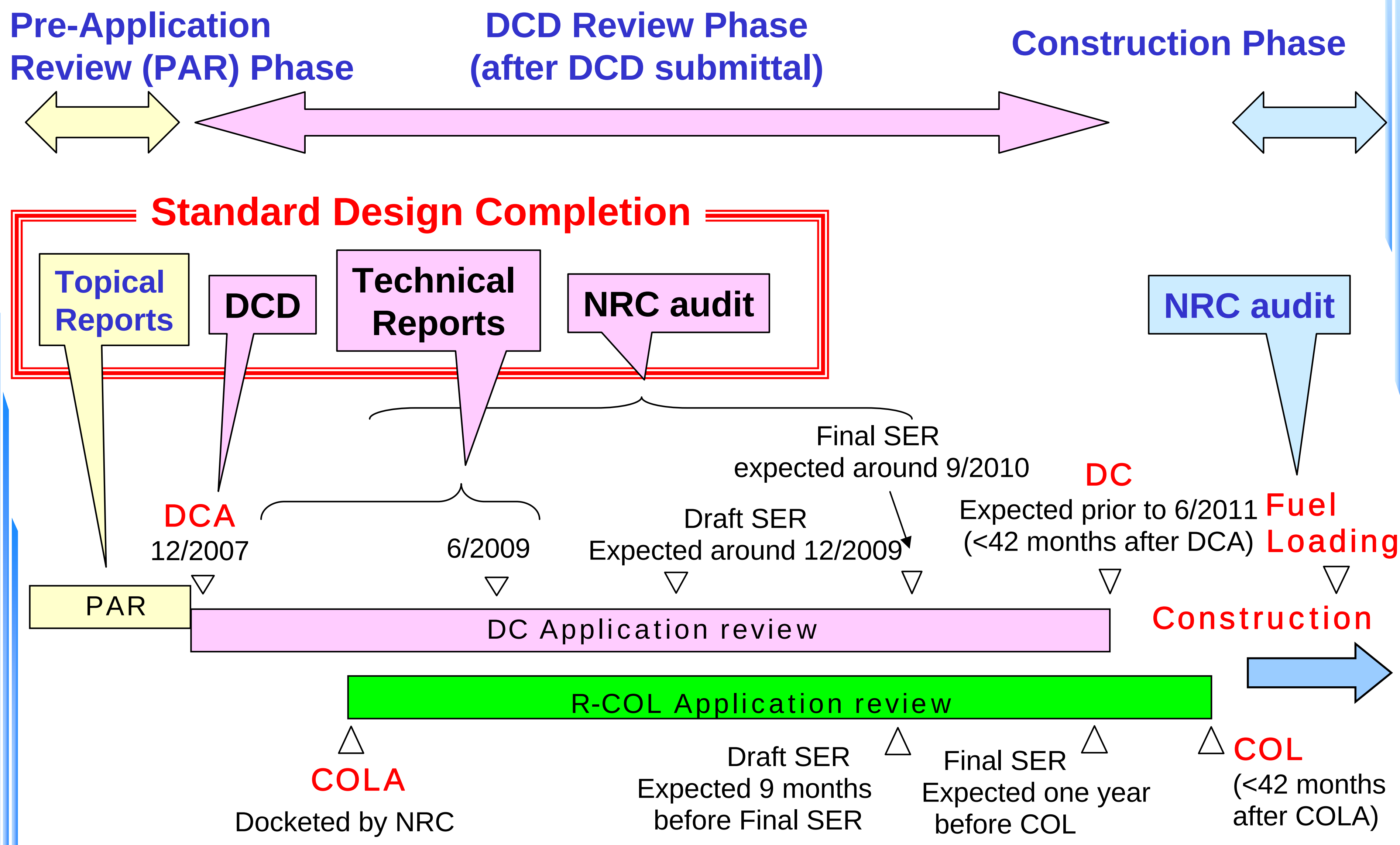
6. Submittal of DC and COL

- DC will be submitted at December in 2007
- COL will be submitted at December in 2008
- First Concrete will be poured at October in 2012



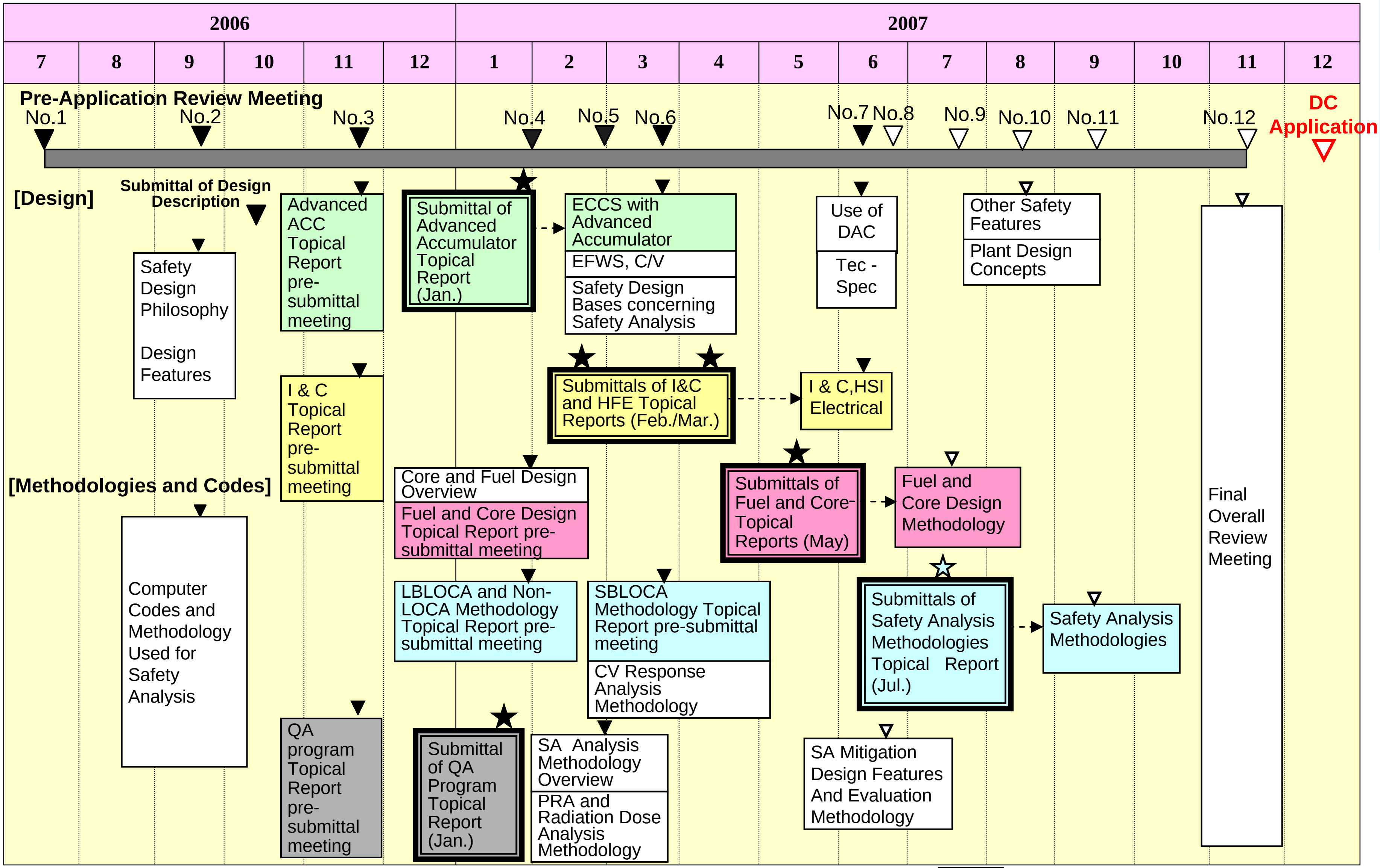
(Notes) F/C: First Concrete

US-APWR Design Process and Time-line



Detail schedule of PAR

US-APWR



: Meeting Subjects
: Submittal of Topical Report

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Submittal Plan of TR during PAR

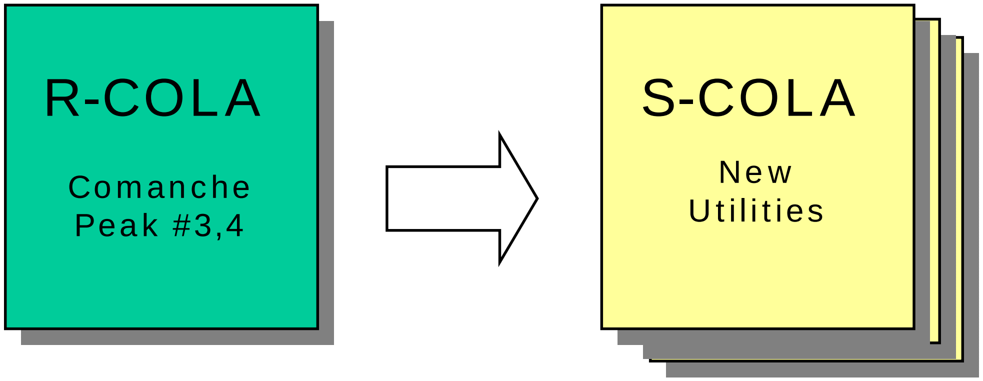
Category	Topical Report to be referred in DCD	Submittal Date
Quality Assurance (Ch. 17)	Quality Assurance Program Description for Design Certification of the US-APWR	January 2007 (Submitted)
ESF (Ch.6)	Advanced Accumulator	January 2007 (Rev.0) March 2007 (Rev.1) (Submitted)
I & C (Ch. 7)	Safety System Digital Platform –MELTAC-	March 2007 (Submitted)
I & C (Ch. 7)	Safety I&C System Design Process and Description	March 2007 (Submitted)
I & C (Ch. 7)	Defense-in-Depth and Diversity	April 2007 (Submitted)
HFE (Ch. 18)	HSI System Description and HFE Process	April 2007 (Submitted)
Reactor (Ch. 4)	Fuel System Design Criteria and Methodology	May 2007 (Submitted)
Reactor (Ch. 4)	Thermal Design Methodology	May 2007 (Submitted)
Accident Analyses (Ch. 15)	Safety Analysis Methodology (LBLOCA, SBLOCA)	July 2007
Accident Analyses (Ch. 15)	Safety Analysis Methodology (Non-LOCA)	July 2007

Submittal Plan of Technical Reports during DCD Application Review

Category	Technical Reports to be referred in DCD	Submittal Date
SSCs (Chapter3)	Emergency Power Building design result	Dec. 2008
	Reactor Internal stress summary report	June 2009
	Pressurizer surge line stress summary report	
	MS line stress summary report	
Fuel Assemblies (Chapter 4)	Fuel Assemblies design evaluation summary report for seismic and postulated accidents	
RV (Chapter 3&5)	Reactor Vessel stress summary report	
Electric Power (Chapter 8)	Gas turbine generator design, qualification and test plan report	Nov. 2007
HFE (Chapter18)	US operator V&V summary report	Dec. 2008
PRA (Chapter19)	PRA Level 3 result (already discussed in 5th PAR in Mar. 2007)	Mar. 2008

Design Centered Working Group

- The first DCWG was held on June 19th in 2008
- The Reference COLA(R-COLA) is Comanche Peak #3,4
- The subsequent COLAs (S-COLA) are expected by new utilities



7. QA

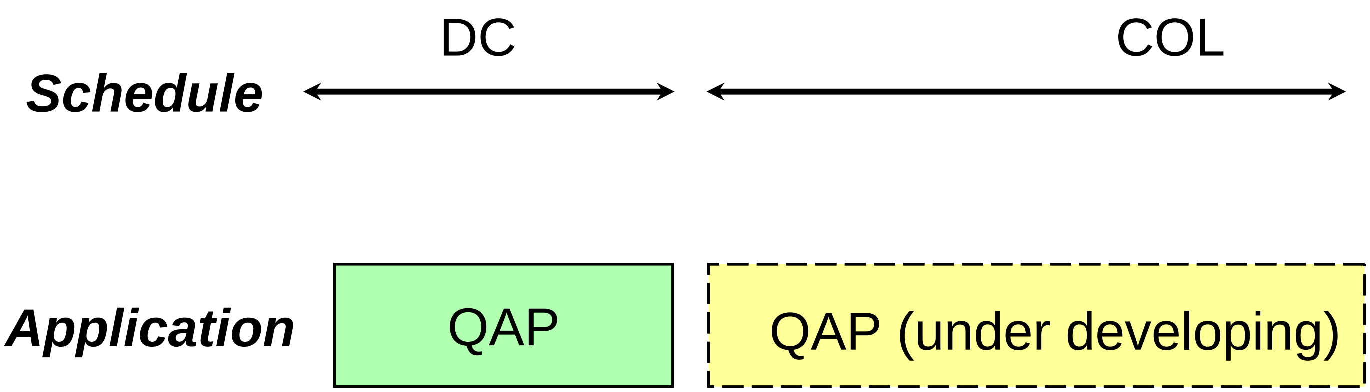
QA policy for DC application

QA program complies with :

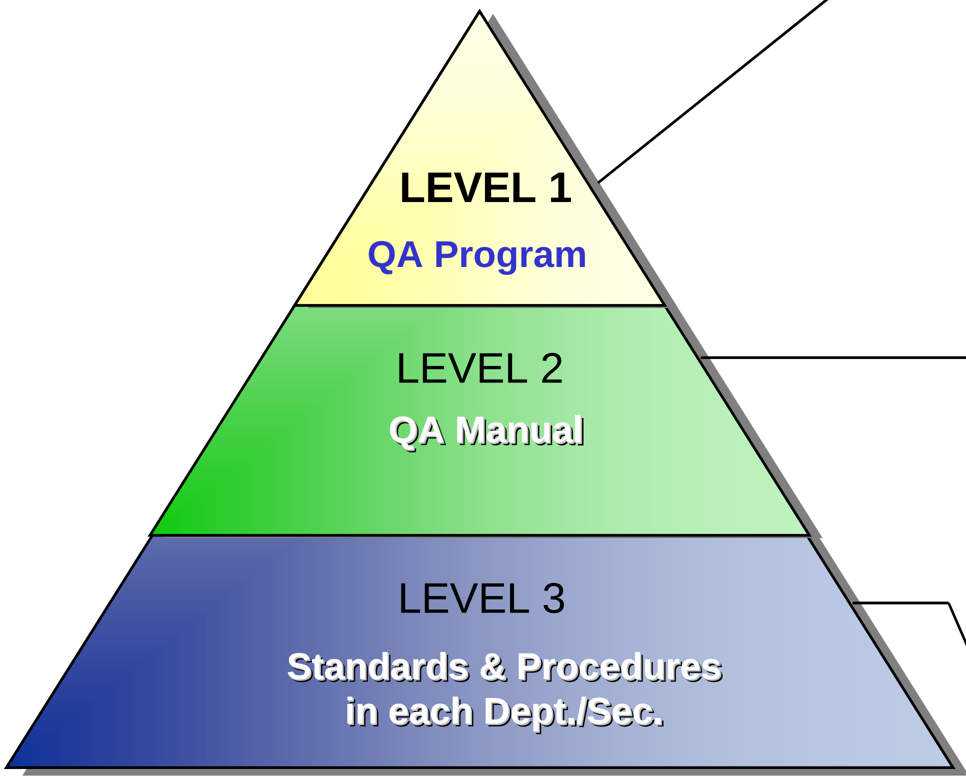
- 10 CFR 50 Appendix B and the additional guidance of Standard Review Plan NUREG-800 Section 17.5
- ASME NQA-1-1994
  - ✓ PART I, including supplements with clarifications and exceptions proposed by NEI
  - ✓ PART II Subpart 2.7 “Quality Assurance Requirements of Computer Software for Nuclear Facility Applications”

7. QA (cont'd)

- SRP section 17.5 allows QAP to be submitted for both DC and COL, or separately
- MHI has established QAP for DC Application
- QAP for COL Application is under developing



Structure of QA Documents on US-APWR Project



QA Program for US-APWR

N-Center QA Manual

- ✓ Document Control
- ✓ Design Control
- ✓ Design Interface Control
- ✓ Design Verification Control
- ✓ Computer Software Control
- ✓ Qualification Procedure of personnel responsible for management of the implementation of the QAP
- ✓ Procurement Control
- ✓ Control of Nonconformance
- ✓ Corrective Action
- ✓ Control of QA Record
- ✓ Audits etc.

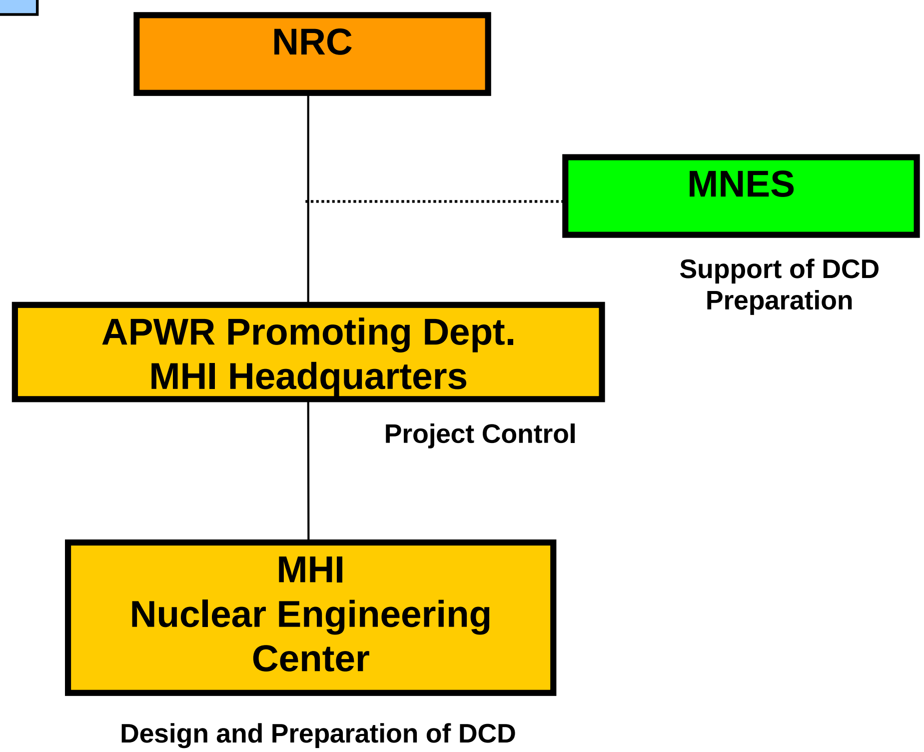
Dept. / Sec. Standards & Procedures

- ✓ Control of Computer Software Code and Verification Control
- ✓ Qualification & Certification Procedure of Lead Auditor
- ✓ Auditor Qualification Procedure, etc

8. Deployment Organization

US-APWR

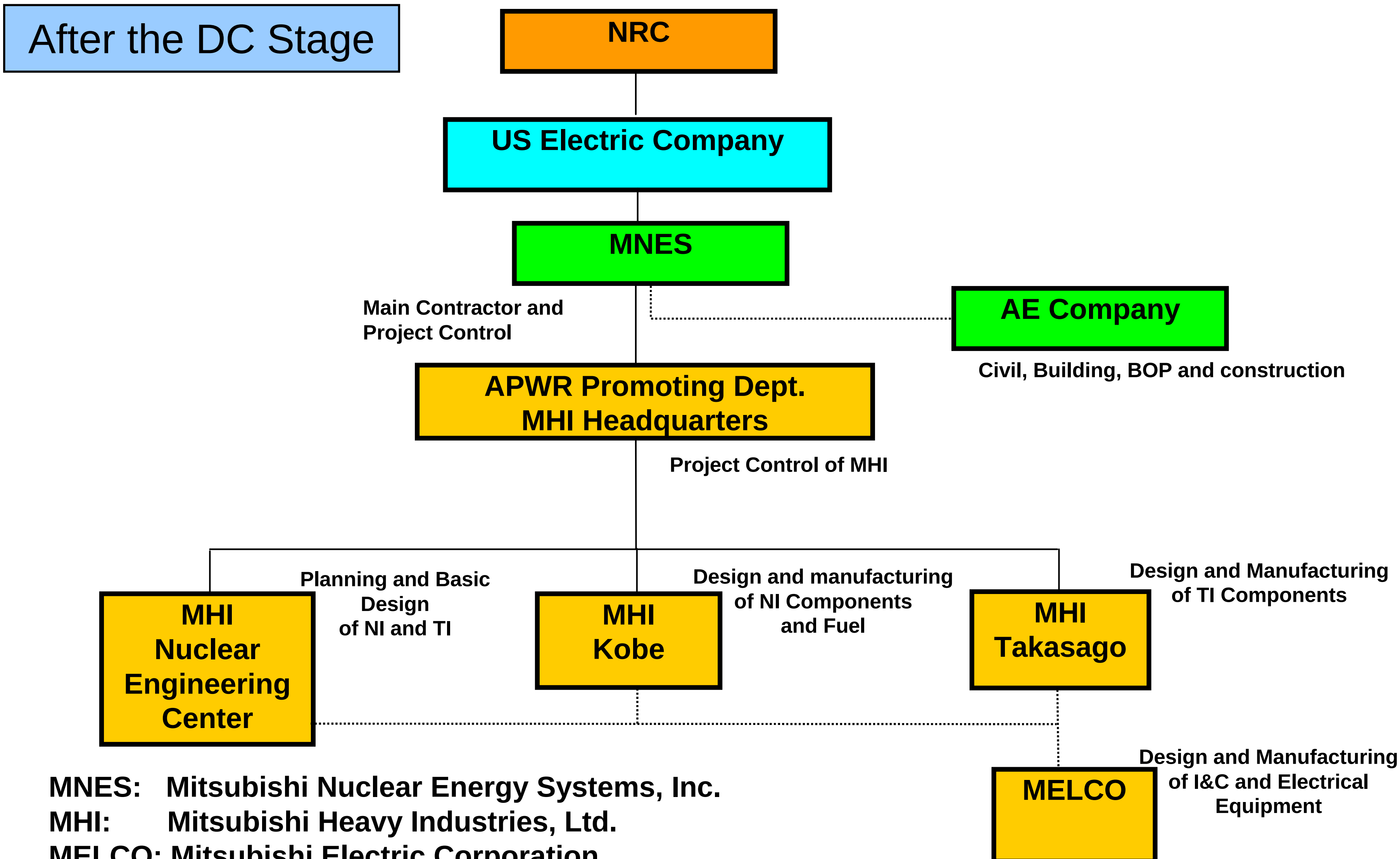
At the DC Stage



MNES: Mitsubishi Nuclear Energy Systems, Inc.
MHI: Mitsubishi Heavy Industries, Ltd.

8. Deployment Organization (con't)

US-APWR



MNES: Mitsubishi Nuclear Energy Systems, Inc.
MHI: Mitsubishi Heavy Industries, Ltd.
MELCO: Mitsubishi Electric Corporation

9. Conclusion

- US-APWR design is based on Japanese APWR and is modified to meet the U.S. utility's requirements
- US-APWR is 1700MWe class large NPP and high performance efficiency
- US-APWR is currently under PAR stage. DCD will be submitted in the end of 2007 and also COLA will be docketed in the end of 2008