Development of Medium and Small Reactors: DMS

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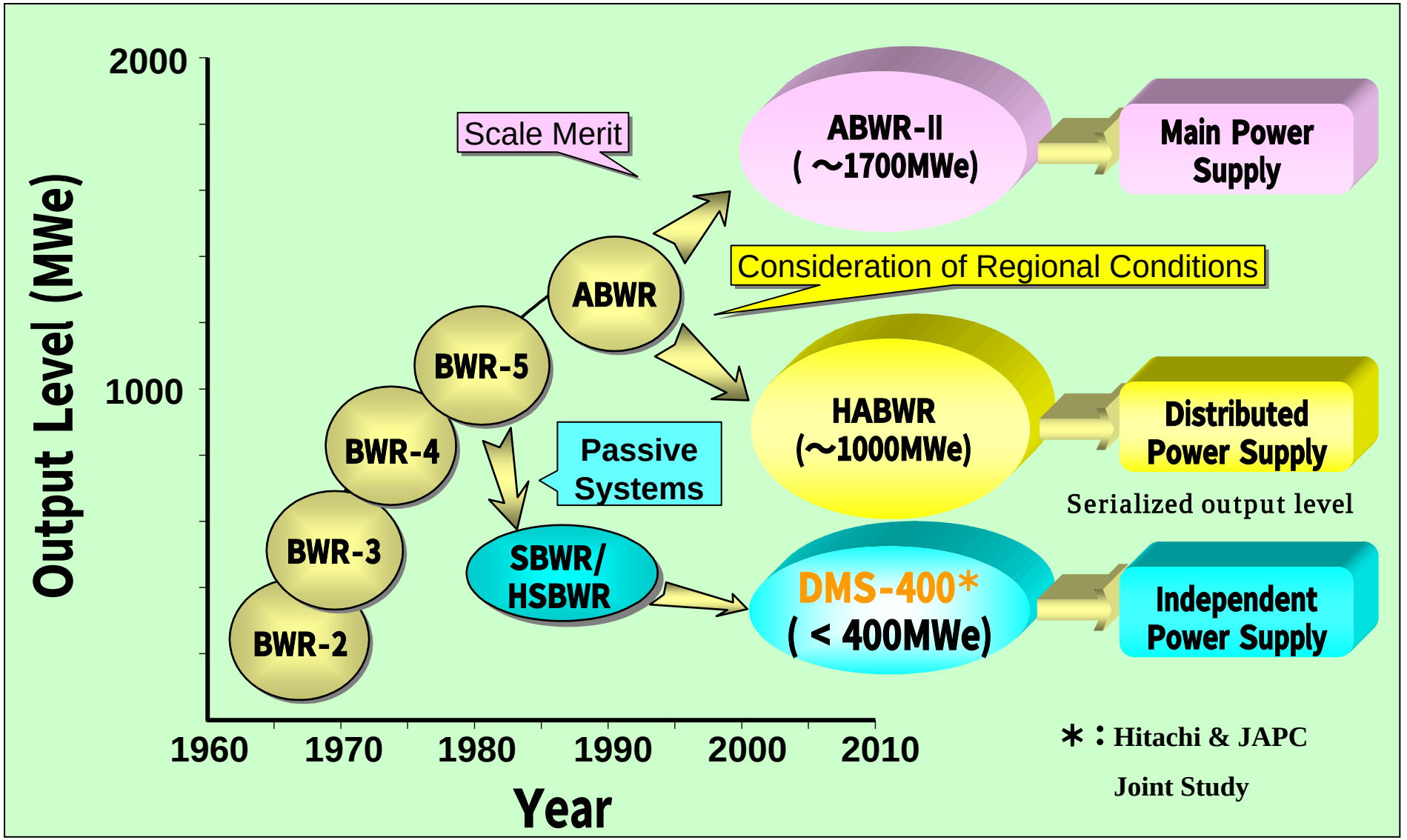
1. Introduction(1/4)



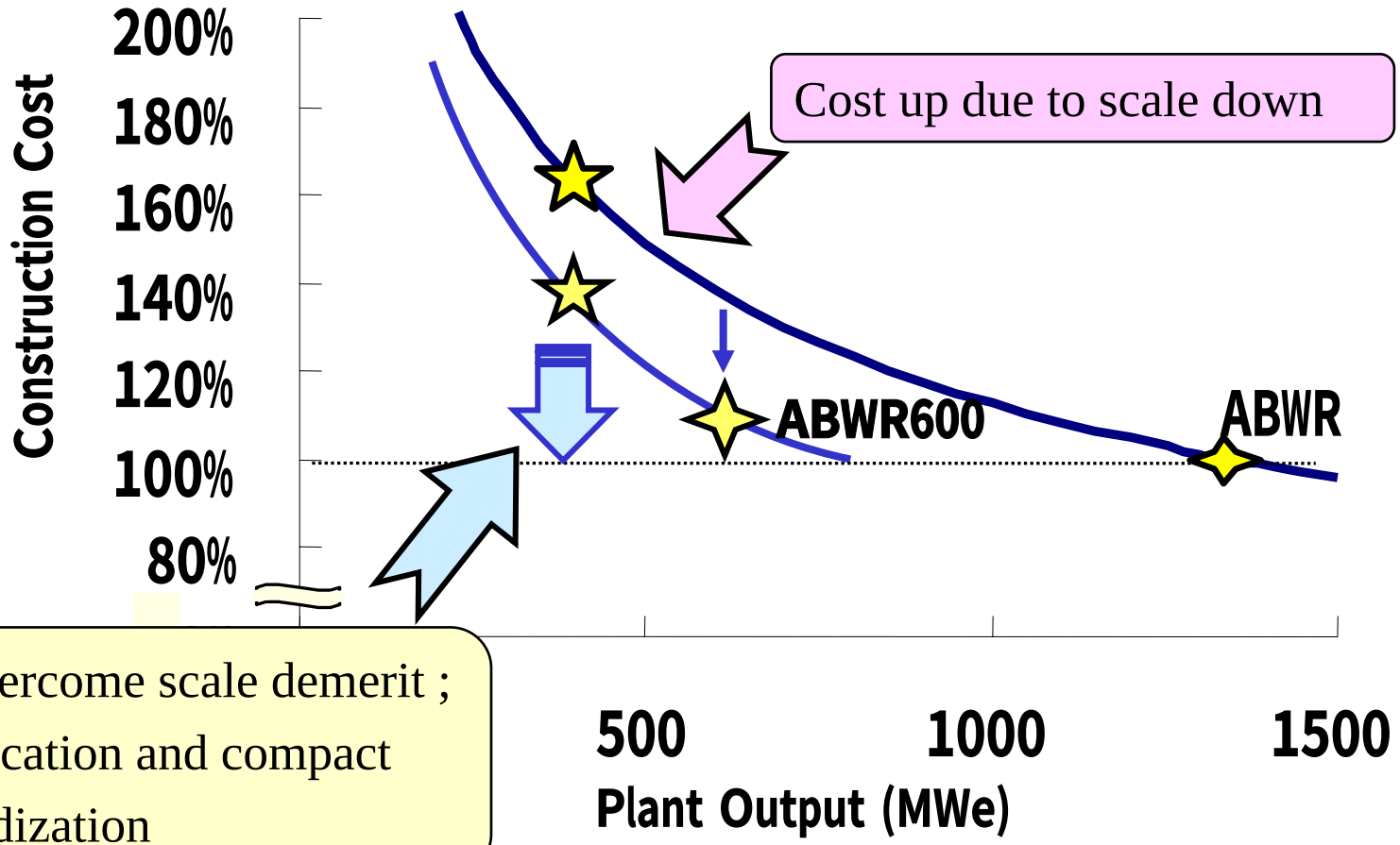
BACKGROUND

- The needs of the suitable output level for slow increment of power demand in JAPAN.
- The needs of short payback period and reduction of investment burden under liberalized market

PURPOSE

- In order to fulfill market needs, DMS-400 has been developed
  - to achieve early deployment with proven technologies.
  - with medium sized output power (400MWe)

1. Introduction(3/4)



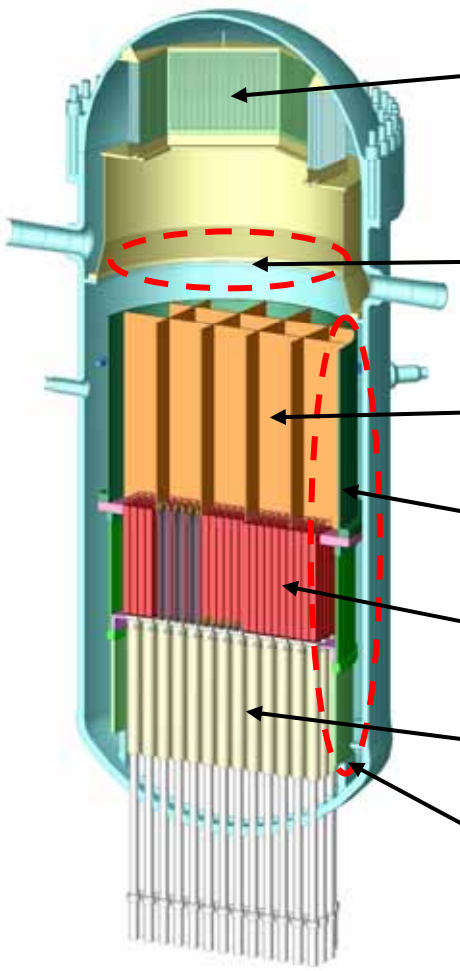
How to overcome scale demerit ;

- Simplification and compact
- Standardization

BASIC PLANT TARGET

- **OUT PUT : Power output range is determined to be 300 to 400 MWe.**
- **ECONOMY : Construction cost should be comparable to ABWR.**
- **SAFETY : Safety level is as same as the actual plants.**
- **R&D : No large R&D required , to utilize the proven technology.**

Simplified RPV



- **Simplified Dryer**
- **Free Surface Separator (FSS)**
- **Divided Chimney**
- **Chimney**
- **Shortened Fuel**
- **CR Guide Tube**
- **Natural Circulation**

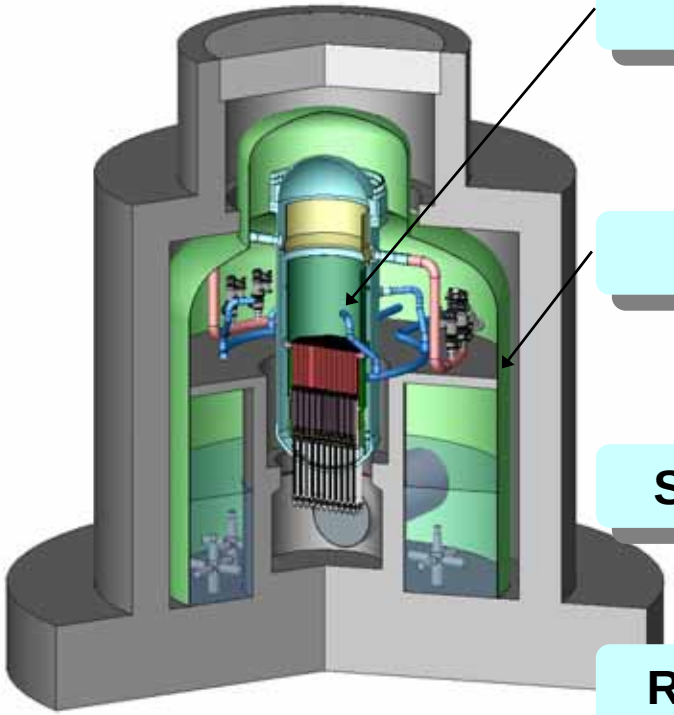
- To enhance core flow by low △P
- To reduce RPV height.
- To reduce annual inspection period.

- To enhance core flow by low △P.
- To keep fuel thermal limitation.

- To keep large core flow due to coolant evaporation at core region.

  (BWR inherent character)

2. Plant Concept and Features(2/2)



Simplified RPV

- Natural Circulation
- Free Surface Separator

Compact PCV

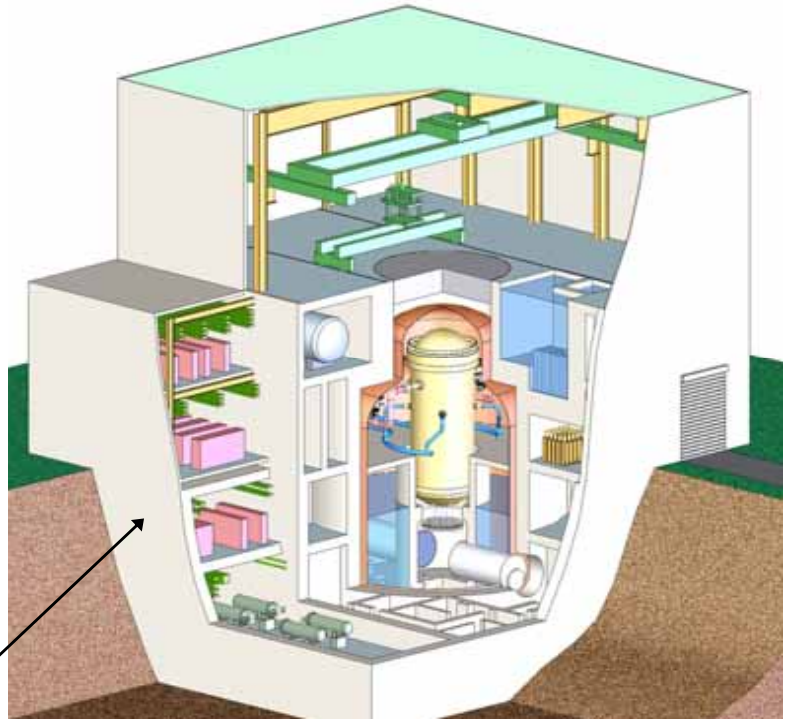
- Eccentric RPV Location
- Free Stamding Steel PCV

Simplified Systems

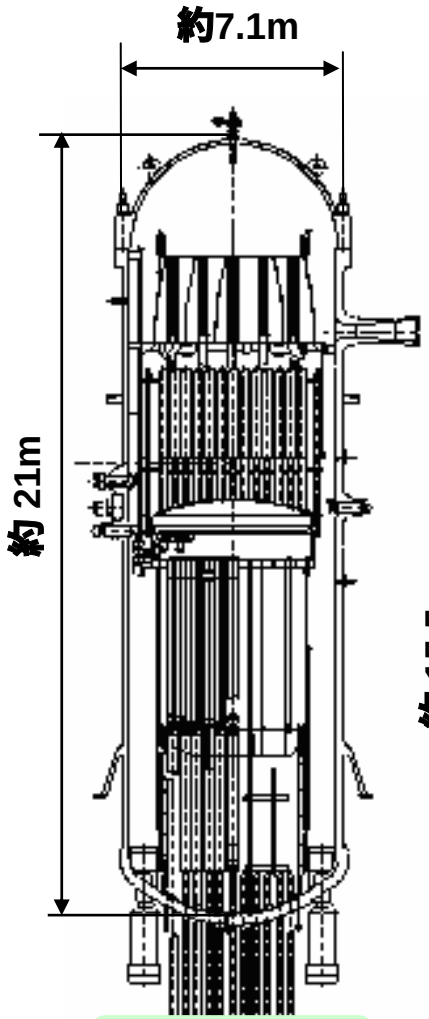
- Rationalized ECCS

Rationalized Layout

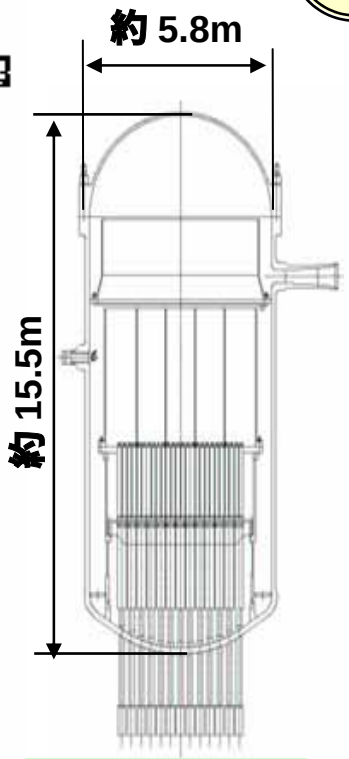
- Compact R/B & T/B



Natural Circulation Reactor and Shortened Fuel



ABWR



DMS-400

Natural Circulation Reactor

To Keep Power Density
To Keep Recirculation Force

Low Core △P

Low System △P

Low Power Density Core

Shortened Fuel

Free Surface Separator

Moderate Steam Evaporation

RPV Height Reduciton

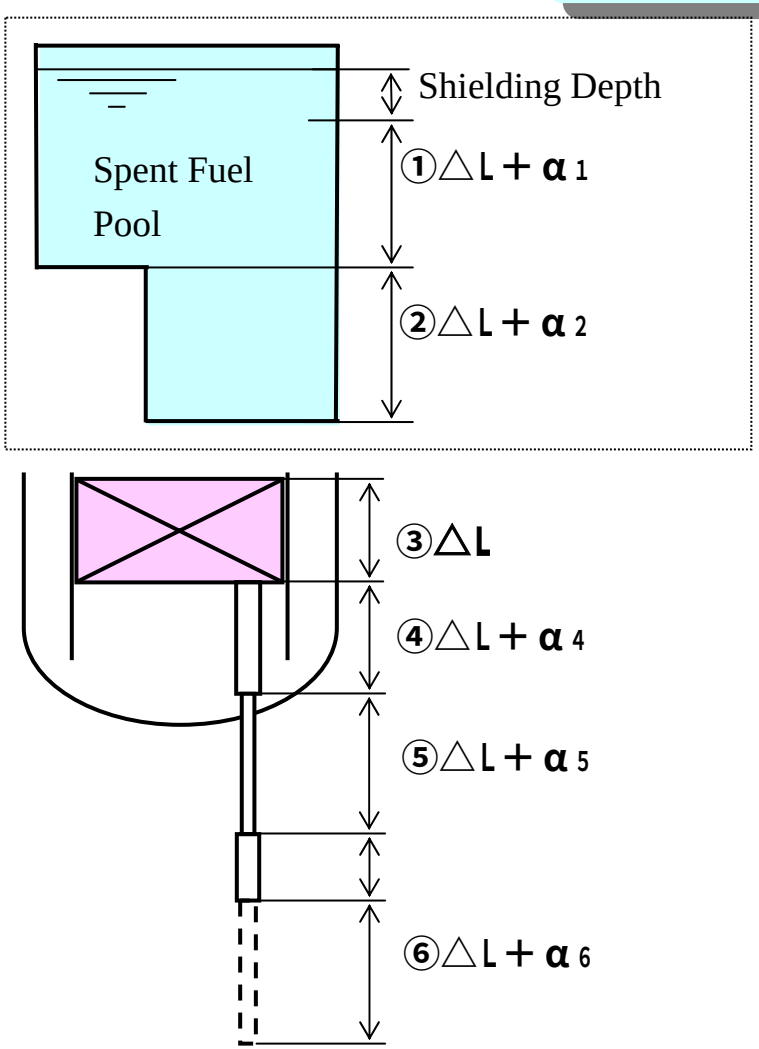
No Separator Removal
No DS Pit Space

24 Month Long Operation Cycle

Compact RPV Compact R/B

Reduced Period Inspection

Shortened Fuel Reduces RPV & PCV & R/B Height



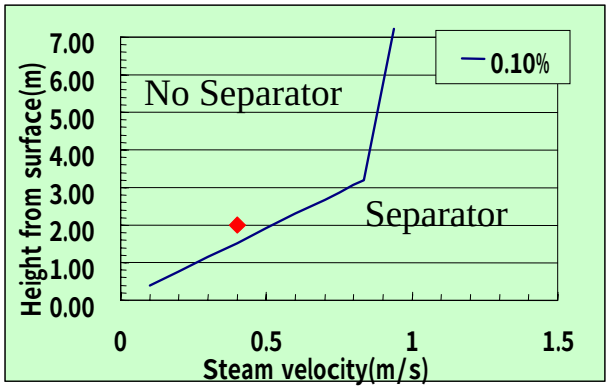
Items		RPV	PCV	R/B
(1) Spent Fuel Pool	①Fuel Handling Space	－	－	△L
	②Spent Fuel Rack	－	－	△L
(2) RPV	③Active Fuel Length	△L	△L	△L
	④CR Guide Tube	△L	△L	△L
(3) Lower Drywell	⑤CR Housing	－	△L	△L
	⑥CR Replacement Space	－	△L	△L
Total		2△L	4△L	6△L

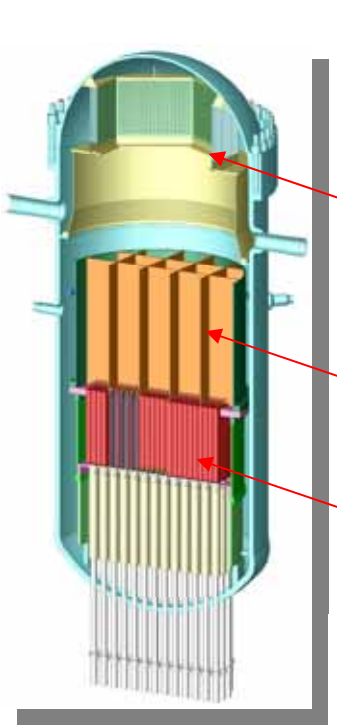
△L：Shortened Fuel Length

Free Surface Separator (FSS)

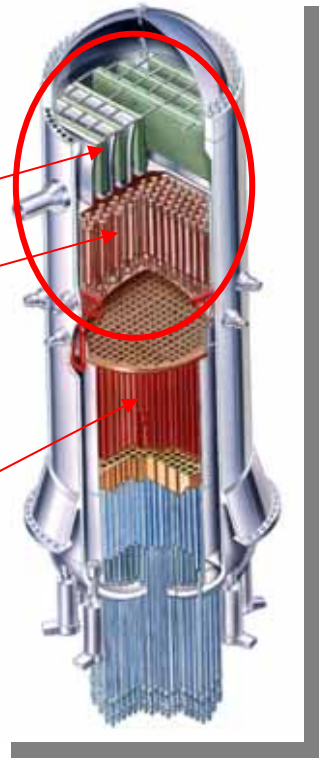
Gravitational steam separation (FSS) is possible for natural circulation reactor, become of its low steam velocity.

- Simplified Core Internals contribute
  - ✧to improve economy.
  - ✧to reduce pressure drop.
  - ✧to reduce annual inspection period.
- Elimination of Dryer/Separator Pit contribute
  - ✧to reduce R/B volume.





DMS-400



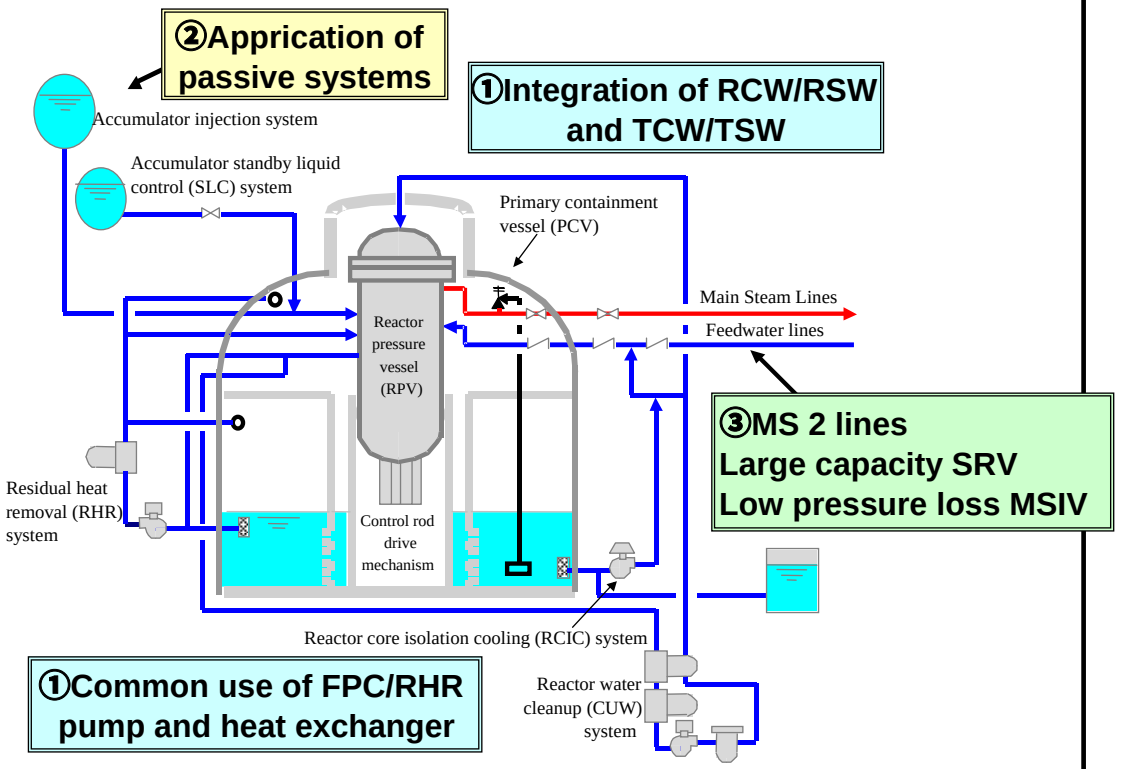
ABWR

Simplified NSS Specification

① System integration for dual functions
② Application of passive systems
③ Reduction of system train number by adopting the large capacity equipment

Items	ABWR	DMS-400	Note
MS Line	700A x 4	500A x 2	③
FW Line	550A x 2	300A x 2	③
SRV	395t/h x 18	460t/h x 5	③
RHR	3	2	①
FPC	1	Common use of RHR	①
RCW/RSW	3	2	①
TCW/TSW	1	Common use of RCW／RSW	①
ACC*	–	1	②

*) ACC: Accumulator injection system

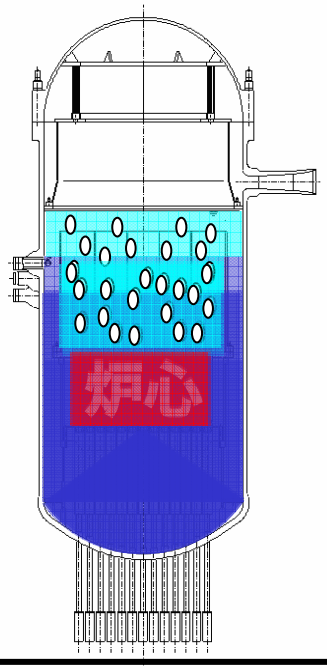


Rationalized ECCS

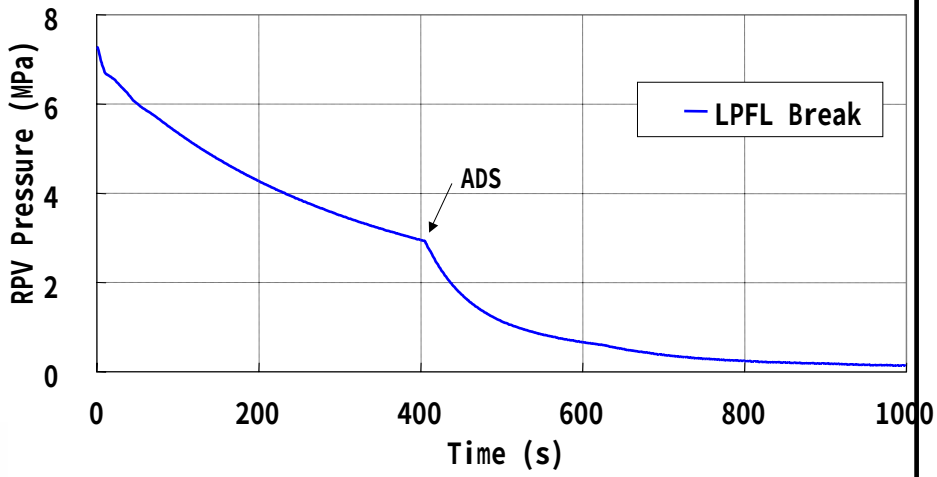
Natural Circulation Reactor gives

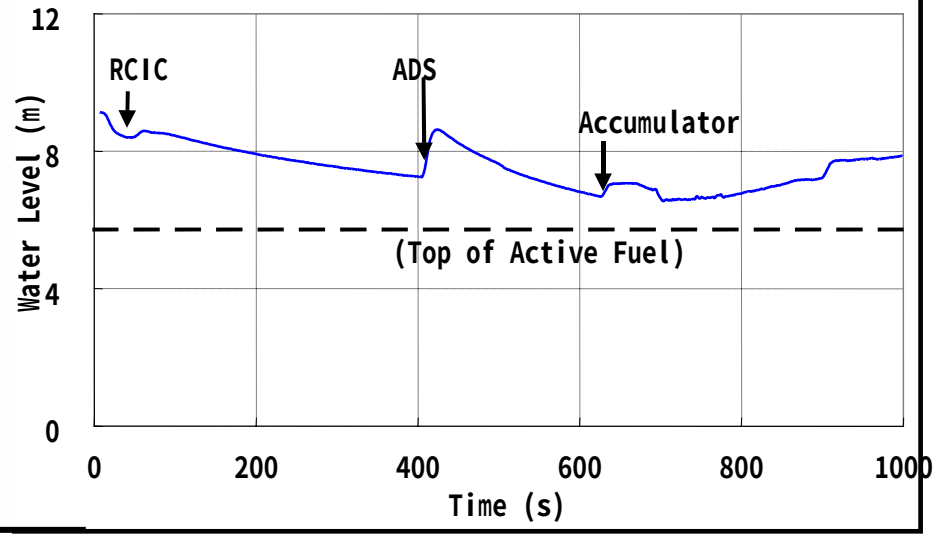
- ✧ Large amount of coolant inventory in RPV
- ✧ Large safety margin at LOCA

Core can be covered with coolant even though the most severe LOCA case.



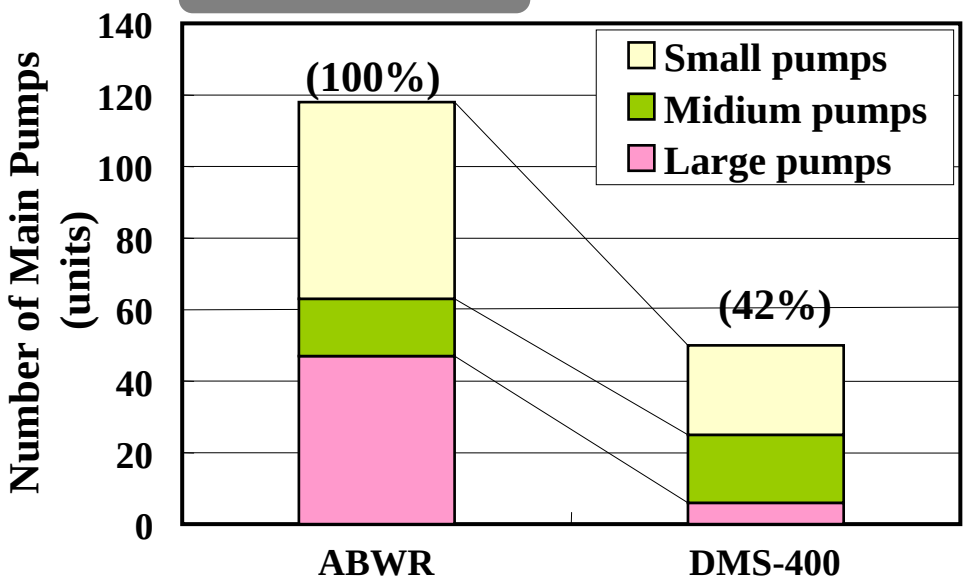
ECCS Analysis



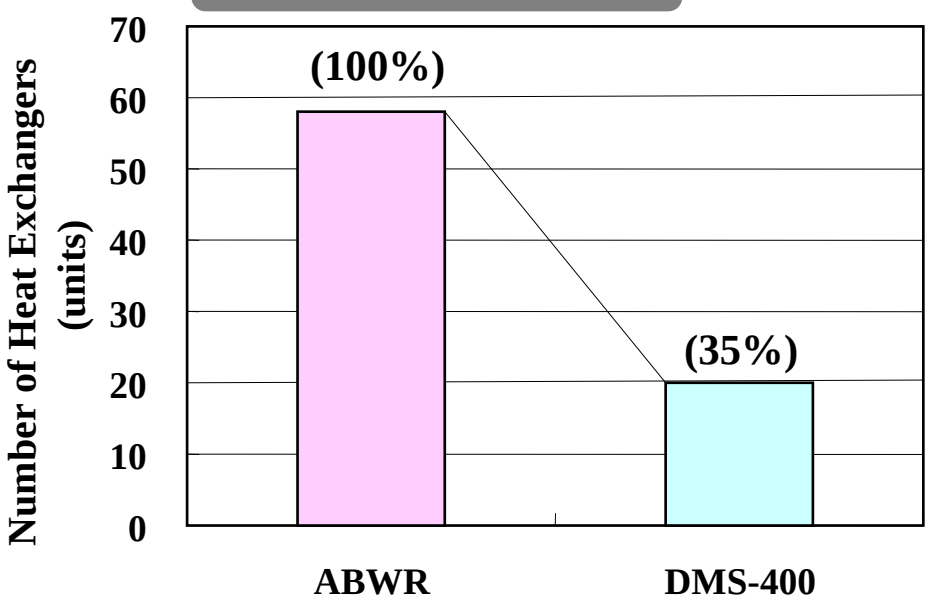


Rationalized Main Equipments

Pump



Heat Exchanger



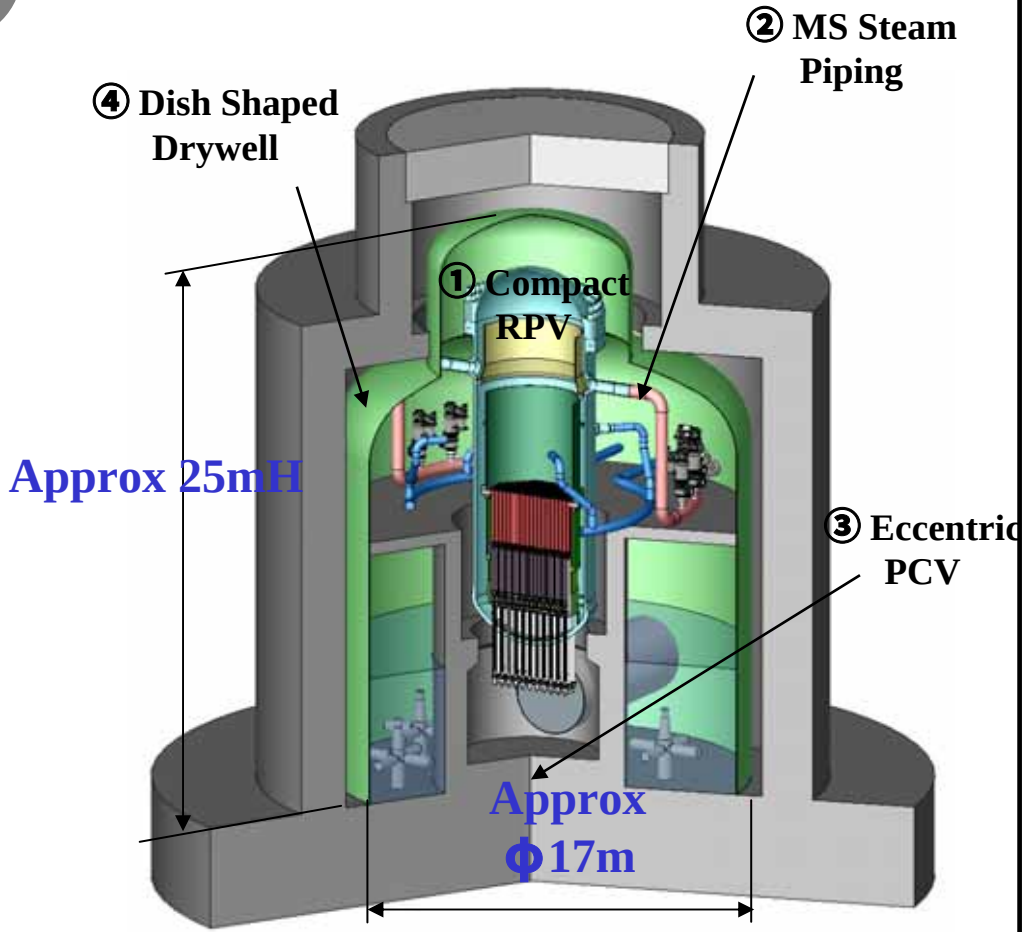
Number of pumps and heat exchanger is reduced as follows

- **Pump : 42%**
- **Heat Exchanger : 35%**

Compact PCV Technologies

① Compact RPV
② Reduction of Number of MS
③ Eccentric PCV
④ Dish shaped Drywell

	ABWR (1356MWe)	DMS (400MWe)
RPV	Φ7.1×21mH	Φ5.8×15.5mH
MS	700A×4	500A×2
PCV	29mΦ×36.2mH	17mΦ×25mH

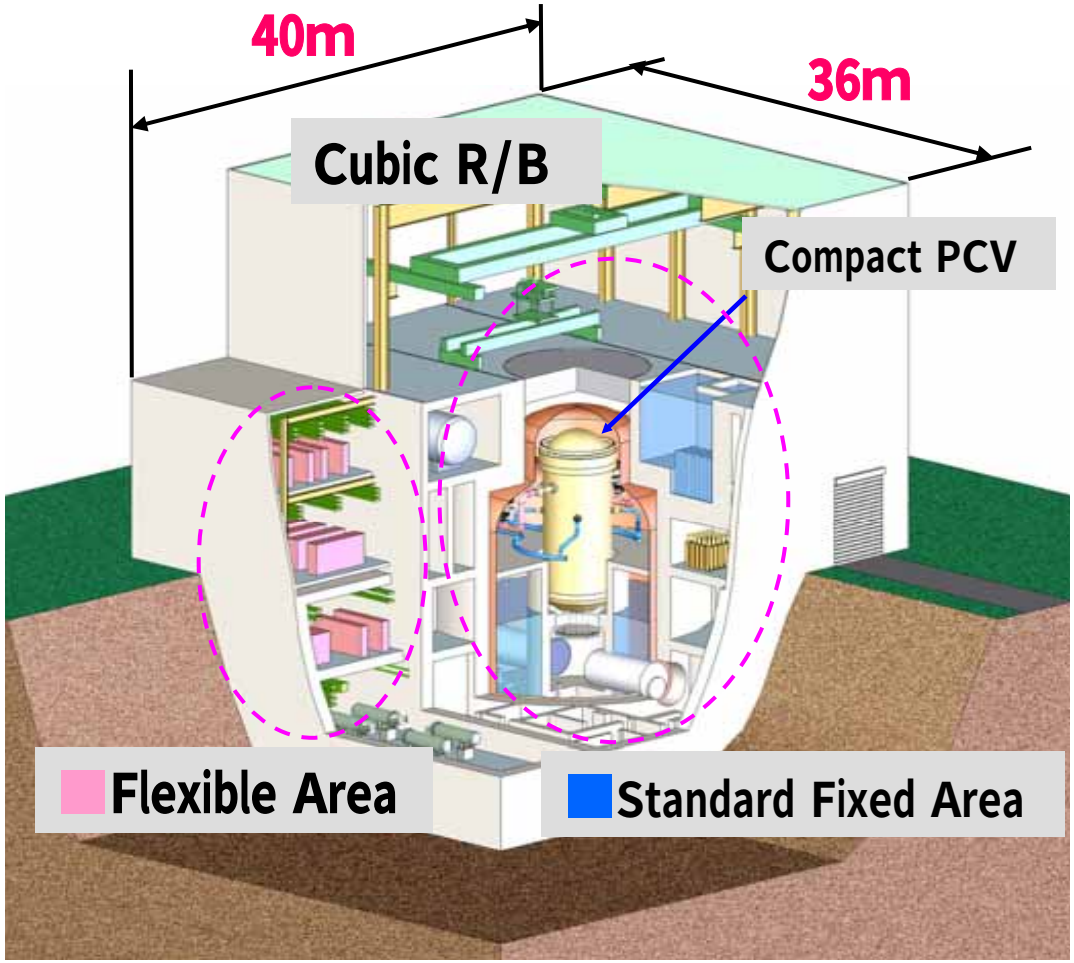


Cut View of Compact PCV

5. Plant Layout Design (2/3)

Hybrid R/B Layout Concept

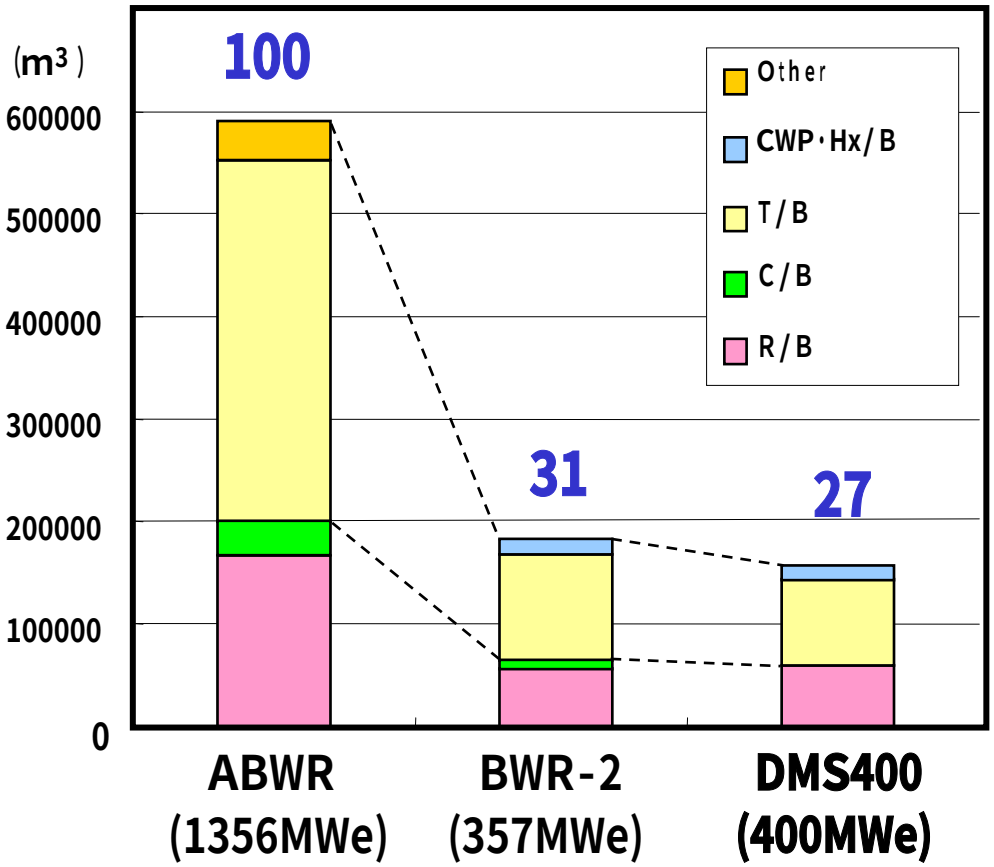
- **Standard Fixed Area**
  - Standard Design for PCV & Secondary Cont Area.
  - Reduction of Construct Cost.
- **Flexible Area**
  - Flexible Layout Design for MCR & Electrical Room.



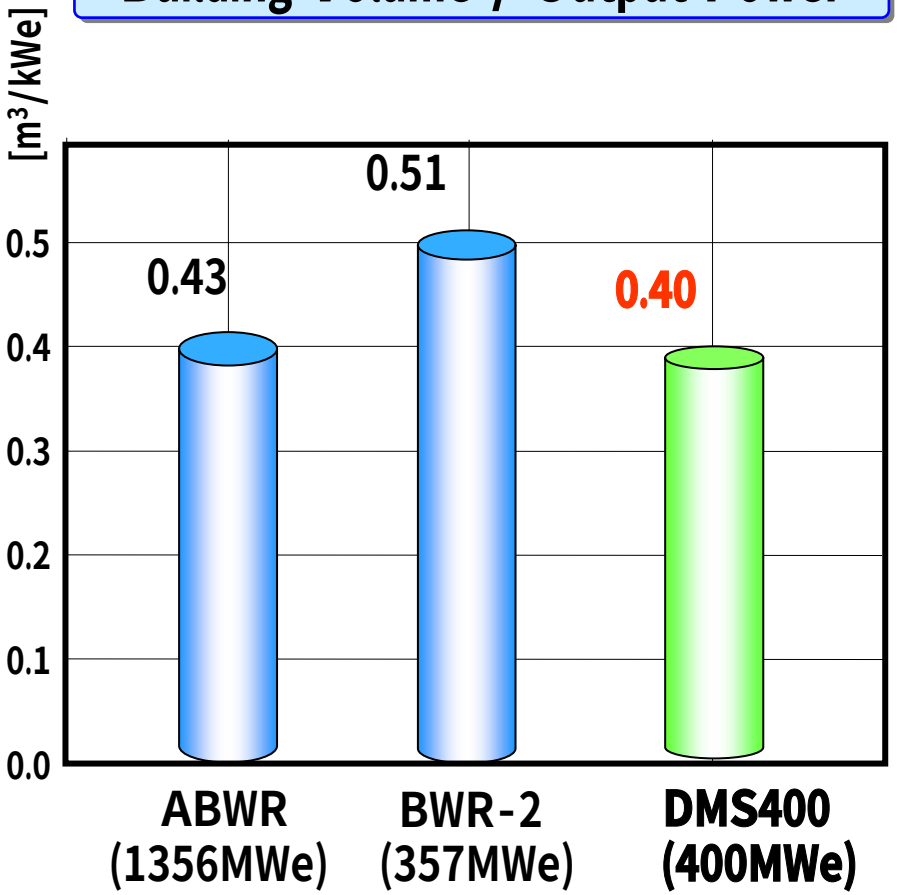
Cut View of Compact R/B

5. Plant Layout Design (3/3)

Building Volume



Building Volume / Output Power



Relative Building Volume of DMS-400 is equivalent to ABWR.

7. Conclusion

① DMS-400 has been developed as a 400MWe medium sized power plant.

② Compact RPV is achieved by adopting natural circulation, gravitational steam separation and short length fuel.

③ Simplified ECCS systems can be adopted with increased coolant inventory.

④ NSSS and BOP systems have been simplified by integrating of the systems with dual functions and etc.

⑤ PCV and building volume per unit output of DMS-400 become equivalent to a large-sized plant.

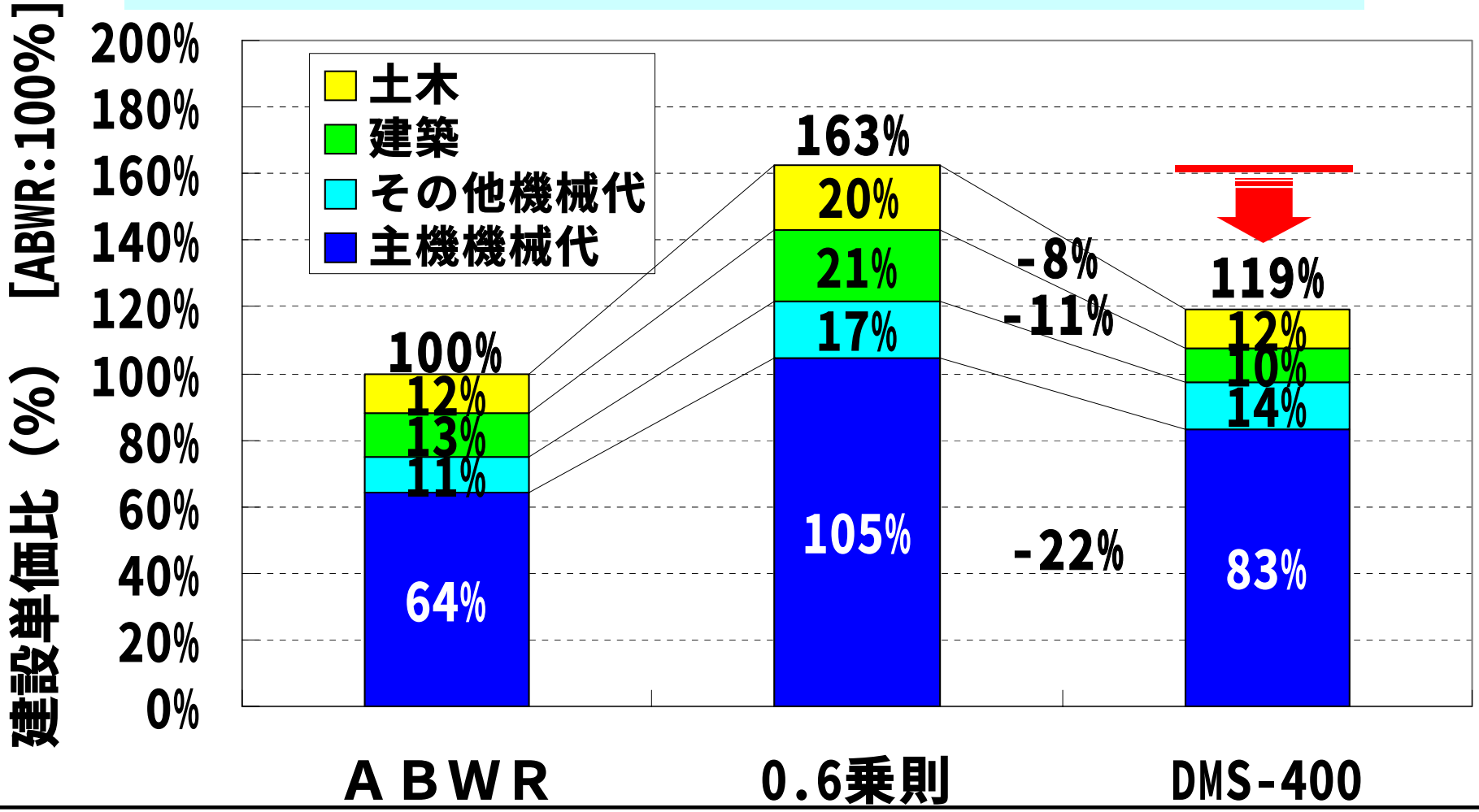
⑥ DMS-400 has attained the excellent economical competitiveness.

Further rationalization study is going on.

5. DMS－400の経済性評価

予備

プラント全体での経済性向上
建設単価比で約40％のスケールデメリットを解消



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