CASE STUDIES ON "PROJECT AND LOGISTICS MANAGEMENT IN NUCLEAR NEW BUILT"

The ABWR Project at Shimane-3, Japan

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Shimane Nuclear Power Plants (I)

- In Japan, before the Fukushima accident, nuclear energy accounted for almost 30 % of the total electricity from 47.5 GWe of capacity (30 BWRs and 24 PWRs).
- The Shimane nuclear power station is located in Kashima-chou, Shimane Prefecture, and owned by the Chugoku Electric Power Company (The Chugoku EPCO)
- The Chugoku EPCO has two Boiling Water Reactors. The ratio of nuclear power generation capacity is less than 10 %.
  - Unit No. 1 of Shimane (460 MW): Operation in 1974
  - Unit No. 2 of Shimane (820 MW): Operation in 1989

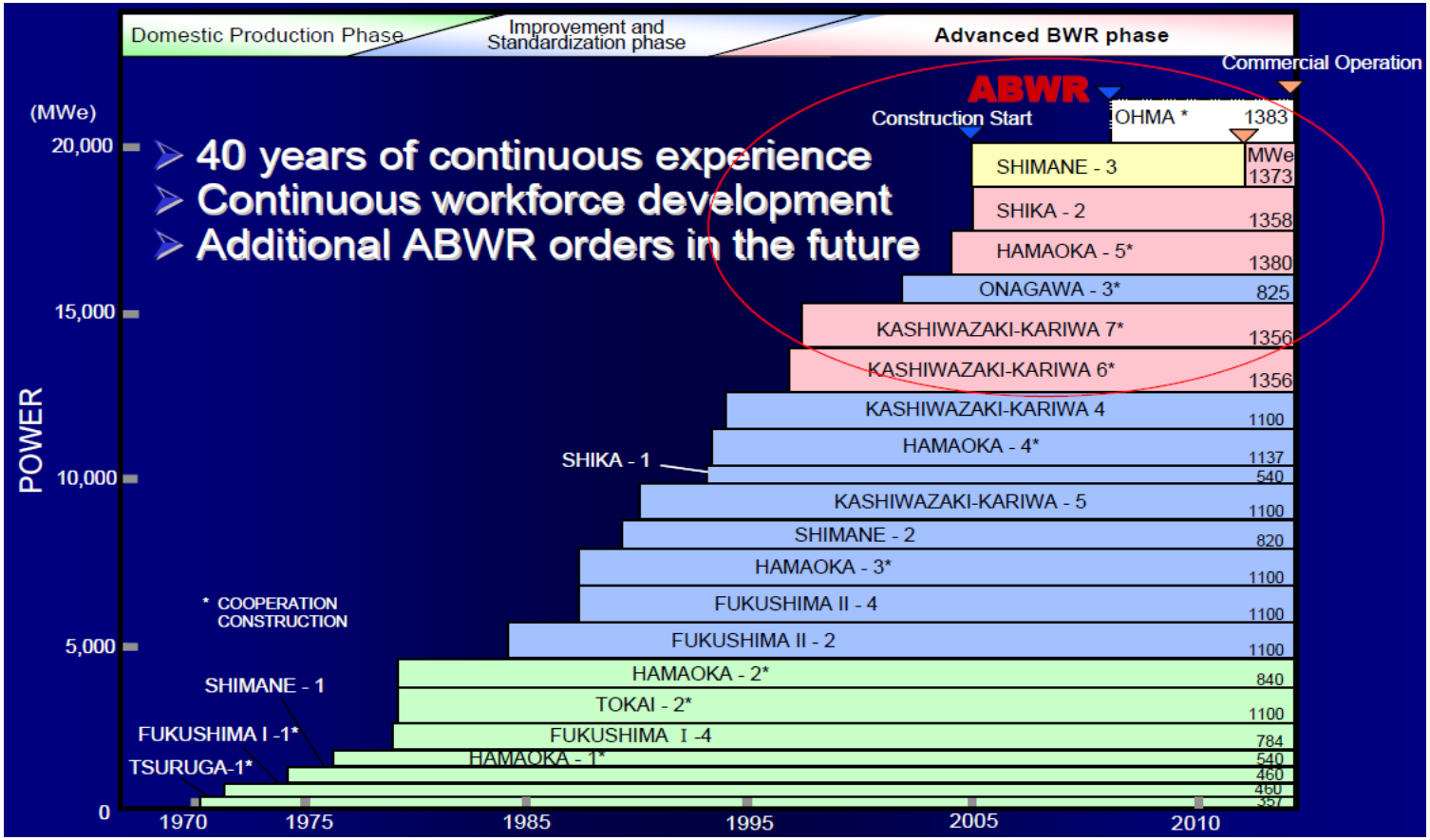
  This unit No. 1 is the first “all-Japanese plant”, whose design, manufacture and construction were conducted by The Chugoku EPCO and Hitachi LTD.

Shimane Nuclear Power Plants (II)

- Unit No. 3 of Shimane (Shimane-3) is under construction.
  - One of the largest and the 5th ABWR (1373 MWe) in Japan
  - After issuance of construction license, the excavation of main building started in Oct. 2006.
  - Originally planned to enter commercial operation in Dec. 2011
  - After the Fukushima accident, the construction was suspended (construction progress 94 %)
  - In Sep. 2012, METI approved the restart of construction in Shimane-3 and Ohma-1 plants. The final schedule is not known.
- The Chugoku EPCO planned to build two Kaminoseki ABWR nuclear Power units on Nasgashima Island and confirmed its intention to proceed in 2012.

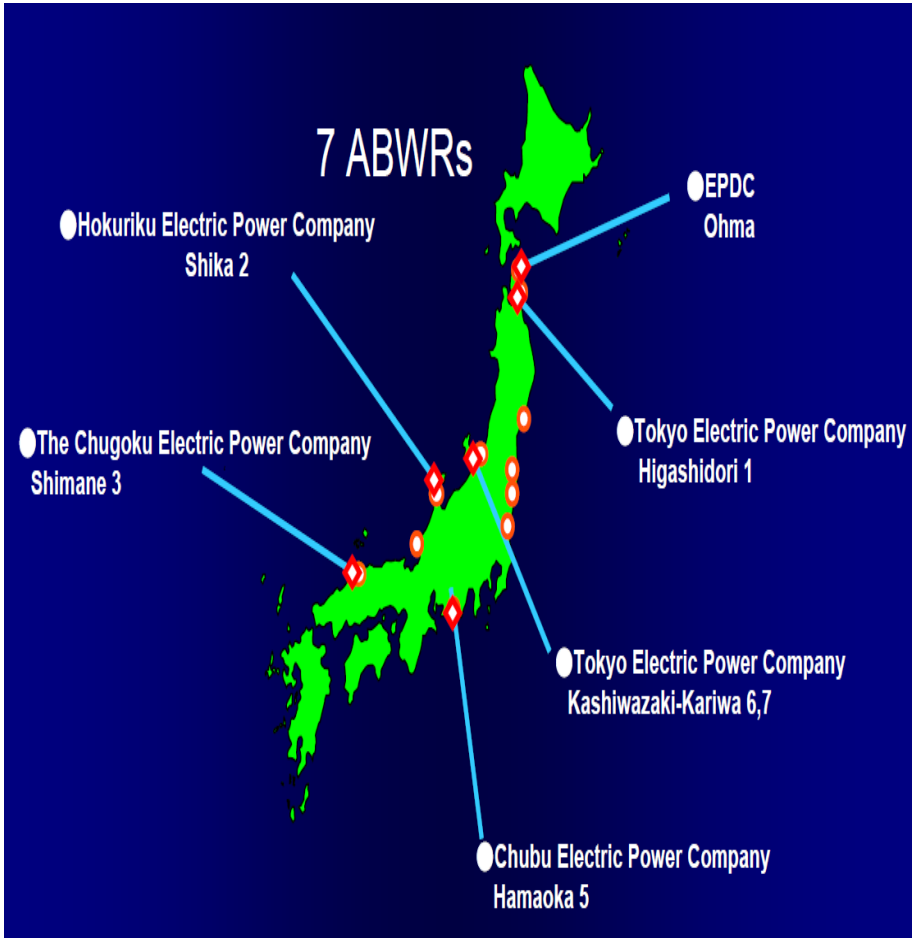
ABWR NPPs in Japan

- Since 1970, 32 BWRs (including 4 ABWRs) have been brought into operation. The first ABWRs were TEPCO's Kashiwazaki-Kariwa 6&7, build by a consortium of General Electric (USA), Toshiba and Hitachi.



(Source : Hitachi-GE Nuclear Energy, Ltd.)

All ABWR NPPs in Japan



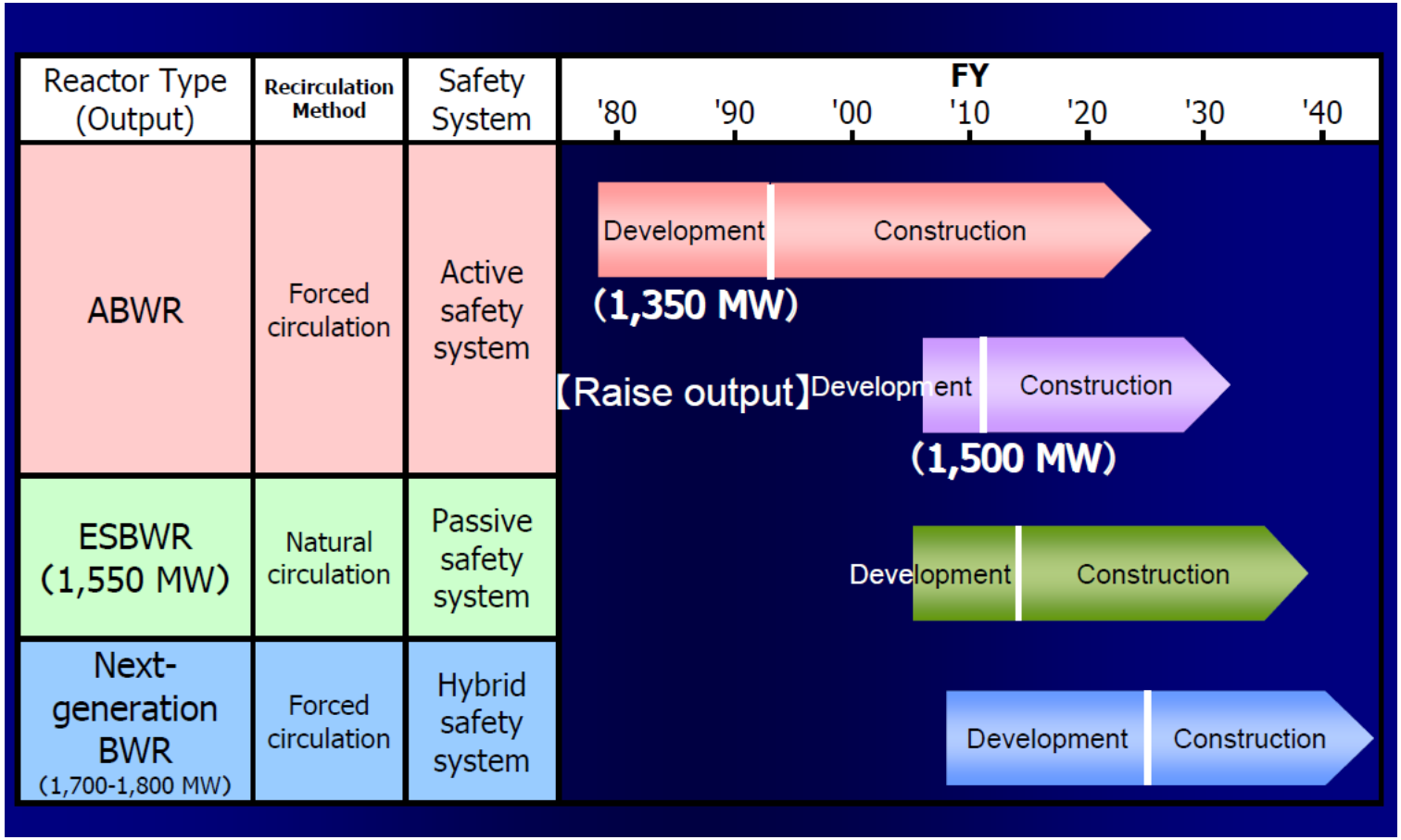
Plant	Construction Start*	Commercial Operation
Kashiwazaki-Kariwa 6	Nov. 1992	Nov. 1996
Kashiwazaki-Kariwa 7	July 1993	July 1997
Hamaoka 5	July 2000	Jan. 2005
Shika 2	Aug. 2001	Mar. 2006
Shimane 3	Sep. 2007	defered, TBD
Ohma 1	May 2010	TBD
Hagashidori	defered	-

(* : Construction Start is based on the first concrete of the reactor building base mat)

ABWR Development and Licensing

- The development of the ABWR started in 1978 as an international-cooperation between five BWR vendors.
  - The ABWR was included in the third standardization programme of Japan from 1981, carried out by Toshiba, Hitachi and GE with six Japanese utility and Japanese government.
  - From 1987 GE, Hitachi and Toshiba started project engineering and preparation of licensing for Kashiwazaki-Kariwa 6&7.
  - In Sep. 1987, GE applied for certification of the US ABWR standard design. USNRC adopted as final design certification rule for the US ABWR design in May 1997.
- Both Toshiba and GE-Hitachi have applied separately to NRC for design certification renewal. In 2011, the NRC certified for GE-Hitachi an evolved version. Hitachi was also developing 600, 900 and 1700 MWe versions of the ABWR.

ABWR Development and Licensing



(Source : Hitachi-GE Nuclear Energy, Ltd.)

- GE Hitachi's ESBWR is in advanced stages of licensing review with the US NRC. Japan launched the Next- Generation LWR development program in 2008, for one PWR & one BWR design.

Japanese Practice in Construction of NPPs

(Source : IAEA N. E. series No. NP-T-2.7).)

- Japanese legislation define that the sole licensee must be the electric power company, which is responsible for the safety of the plant and must submit for the approval of the safety analysis report and the construction permit.
- All Japanese electric companies are large and have the tradition to do the engineering of their power plant themselves. The owner/utilities in Japan carry the burden of major portions of the engineering, procurement and construction (EPC) of their NPPs.
- Consequently, the Japanese electric companies have built NPPs by awarding split-package contracts (the so-called island approach) as well as smaller component contracts.
- Given the large number of utilities in Japan, each company built relatively few NPPs and this has made it difficult to maintain a highly qualified workforce. All utilities in Japan have developed and maintained good relationship with each other and willingly share their human resources. Salaries and expenditures continued to be paid by the original employers.

Project Management of Shimane-3 (I)

- For Shimane-3, the Chugoku EPCO coordinates all contractors in civil, building and mechanical fields, and control work progress among each contractor.
  - Civil work (land forming, intake and discharge structure): Civil Joint Venture
  - Building work (main building): Building Joint Venture
  - Mechanical work (piping/equipment/commissioning): Hitachi-GE

- The project management is responsible for the cost, schedule and technical performance of the project and is in control of design, engineering, procurement, manufacture, construction and commissioning.

- There are many activities in project management, for project planning and scheduling, design schedule, construction schedule, control of project progress, management of information and method to subcontract materials and construction works.

- The quality assurance (QA) programme is an interdisciplinary management tool that provide a mean that all work is adequately planned, correctly performed and assessed.

Project Management of Shimane-3 (II)

- The most significant point in ABWR is standardization, which consists of design standardization, document standardization and quality management standardization.

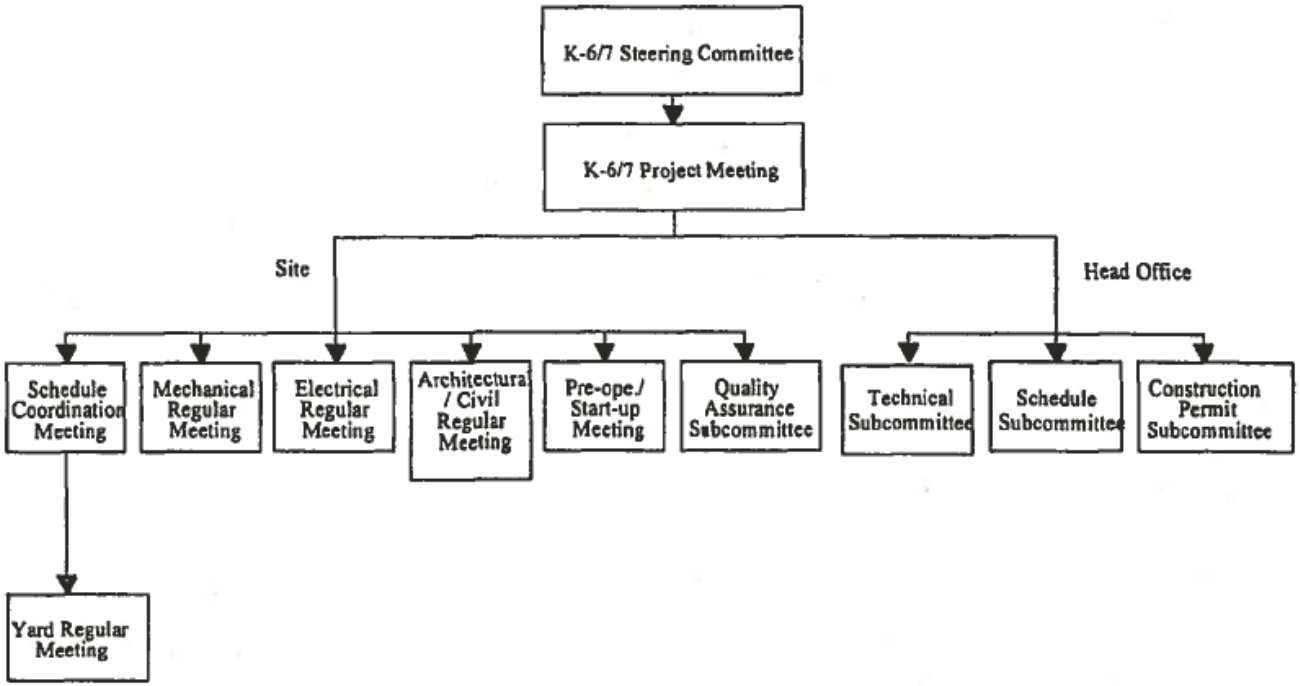
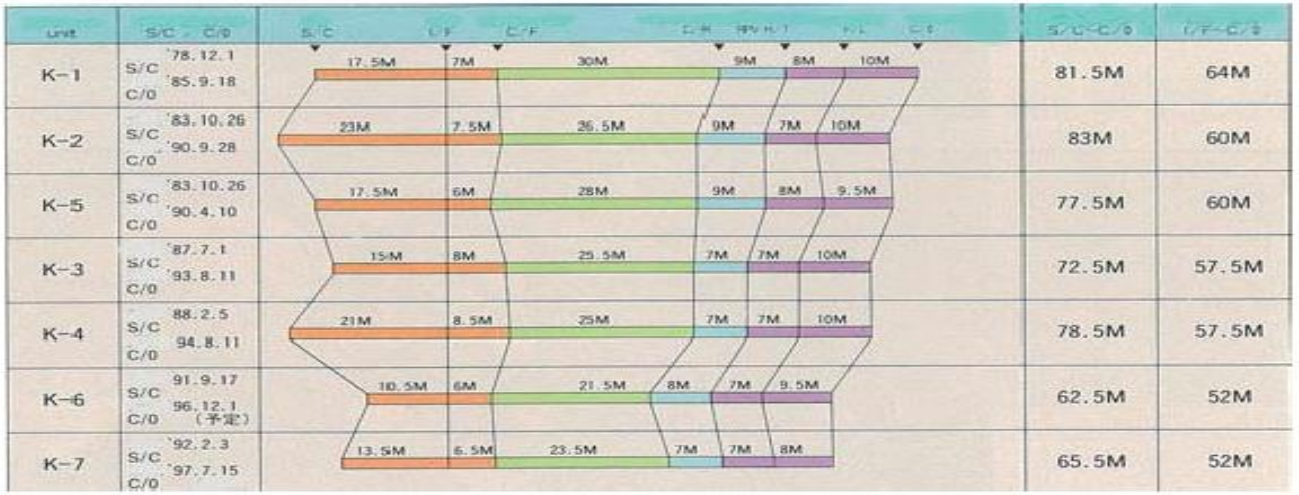


Fig. Project Organization for TEPCO's Kashiwazaki-Kariwa 6&7 Project

Advanced Tech. in ABWR Construction(I)

- Comparison of construction periods of Kashiwazaki-Kariwa Power Station



Legend:
S/C- Start of construction
I/F – Inspection of foundation
C/F- Completion of foundation mat
C/R- Completion of refuelling floor
RPV H/T- RPV First hydrostatic test
F/L- Fuel loading
C/O- Start of commercial operation

(Source : IAEA-SM-353/36)

- The normal definition of the construction period refers to “from pouring of first structural concrete to start commercial operation”. In case of K-6, the time from I/F (July 1992) to C/O was 51.5 months. From the first concrete (Nov. 1992) to the first criticality (Dec. 1995), it took 37 months. The 40-month schedule is a aggressive target in comparison with the past U.S. construction experience(Before the TMI it was 60-70 months; after that, extended significantly)

Advanced Tech. in ABWR Construction(II)

- Advantages of ABWR in construction of Kashiwazaki-Kariwa 6&7 as FOAK (first of a kind Engineering)
  - Design features of ABWR for better plat constructability
  - Prudent design change control with a principle of “test before use”
  - Advanced construction technology
  - Detailed engineering at early stage of the project
  - Good construction management

- Main features in reduction of construction time in Kashiwazaki-Kariwa 6&7
  - Increased composite modularization
  - Increased pre-fabrication
  - Application of steel-concrete structure
  - Inspections rationalization
  - Better communication through IT

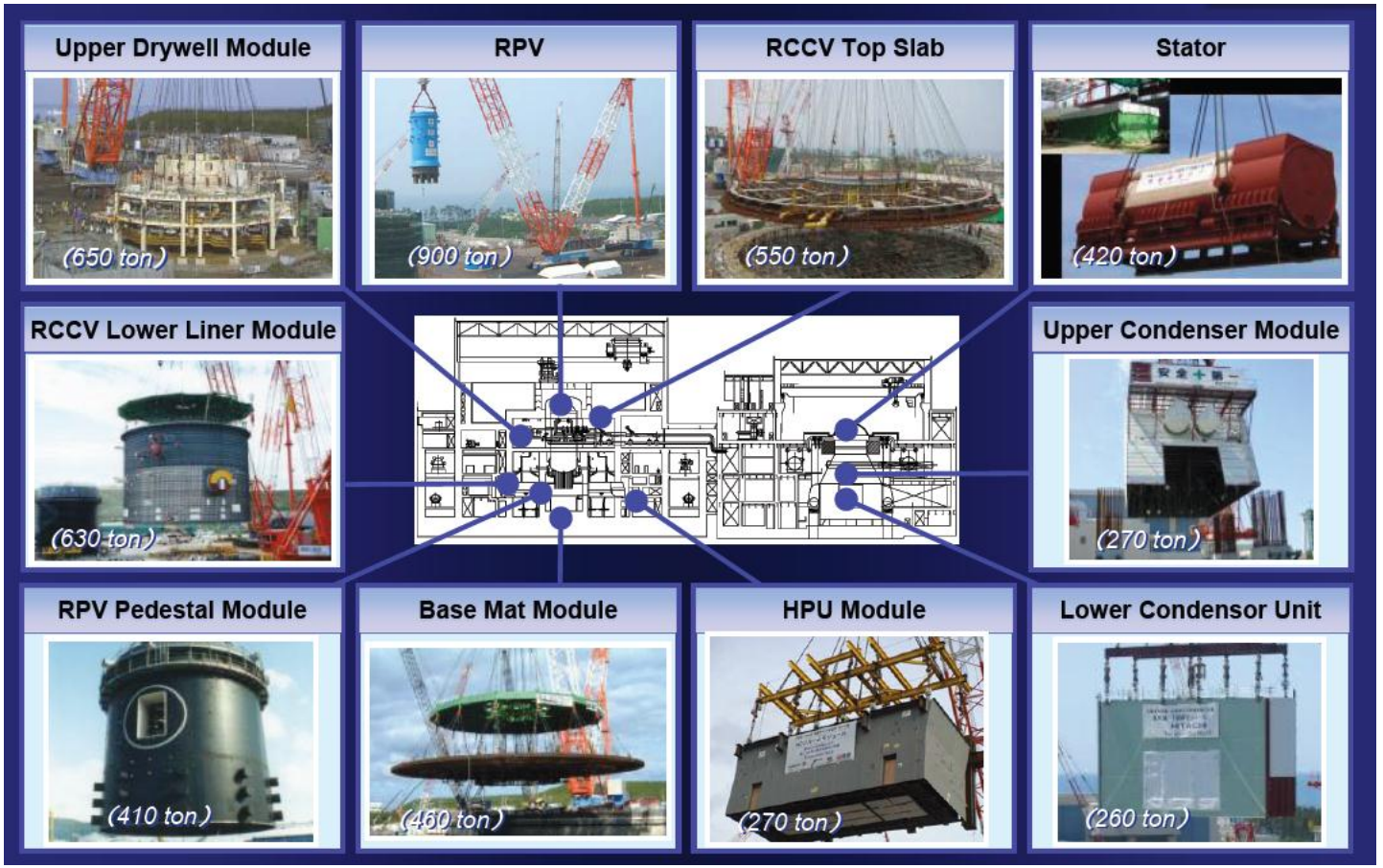
Advanced Tech. in ABWR Construction(III)

- Applied Construction Technologies in Shika-2
  - Broader application of large module/block construction methods
  - Open-top and parallel construction method
  - Application of floor packing construction methods
  - Full application of information technology to qualify plant engineering and construction achievements.

- Further Improvement of Construction Technology in Shimane-3
  - Parallel construction
  - Floor packaging construction
  - Modularization : about 190 modules including the HCU (hydraulic control unit) room module
  - Development of integrated on-site construction system
  - Advanced construction management using RFID (radio-frequency identification)

Advanced Tech. in ABWR Construction(IV)

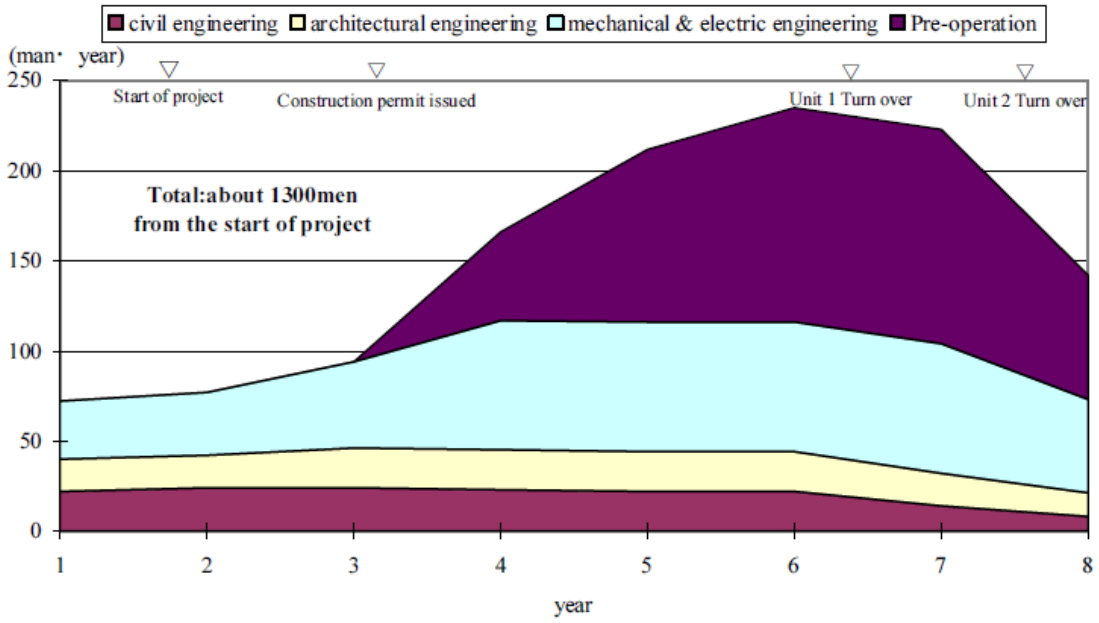
- Modularization Method



(Source : Hitachi-GE Nuclear Energy, Ltd.)

Workforce in ABWR Construction

- Owner's Project Management Team in case of Kashiwazaki-Kariwa 6&7



Note: For twin ABWR plant: about 1,300 men-year, out of which: mechanical & electrical (average57, max 72); architect (19, 22); civil (20, 24); administration (61, 82)

(Source IAEA-TECDOC-1390.)

- Other resources utilized in Kashiwazaki-Kariwa 6&7
  - Manpower- construction [man-hours] : U6 14,400,000; U7: 10,800,000
  - Materials : Piping [tons]: U6: 11,000.; U7 : 6,000.
    Concrete [m3]: U6: 200,000. ; U7: 167,000.

Summary

- The ABWR is the evolutionary design of the conventional BWR and the first design, among Generation III LWR designs, with construction and operating experiences.
- The first ABWR, Kashiwazaki-Kariwa 6, was constructed on a 37 months schedule from the first reactor building structure concrete pour to fuel load. The advanced management and construction technologies have been developed and demonstrated through continuous experiences of ABWR construction in Japan.
- The Shimane-3 was constructed for "On-budget and On-schedule" with application of more advanced design and construction methodology, just before the Fukushima accident. It was 94 % complete and construction was suspended in March 2011.