

Efforts toward Safe, Steady and Efficient D&D

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Key words; D&D, Tsuruga-1

Abstract

Before Fukushima Daiichi accident, only four nuclear power plants (NPPs) were under decommissioning in Japan. But other eleven NPPs were decided to terminate operation after Fukushima Daiichi accident, and some of those NPPs started decommissioning work recently. It is supposed that the number of NPPs in decommissioning phase will continue to increase in the future.

In order to advance decommissioning, there are four principal conditions which have to be established. In order to responsibly finish all the activities of the closed NPPs, it is necessary for all the stakeholders involved in nuclear power generation to play their roles respectively to establish the conditions above.

Because it is also important for Japanese utilities to learn decommissioning experience of other countries, The Japan Atomic Power Company (JAPC) signed an agreement with EnergySolutions on strategic cooperation for Japanese decommissioning projects for the introduction of successful international experiences in April 2016.

1. Current situation on D&D of nuclear power plants in Japan

Before Fukushima Daiichi accident in March 11, 2011, only four NPPs, Tokai-1 (GCR), Fugen (ATR) and Hamaoka-1/2 (BWR), were under decommissioning in Japan.

But after Fukushima Daiichi accident, other NPPs, Mihama-1&2 (PWR), Tsuruga-1 (BWR), Genkai-1 (PWR), Shimane-1 (BWR), Ikata-1 (PWR) and Monju (FBR), were decided to terminate operation, and most of those NPPs started D&D work recently (See Table-1 and Table-2.). It is supposed that the number of NPPs in decommissioning phase will continue to increase in the future.

Table-1 Current Status of NPPs in Japan

Status as of October 31, 2017	Number	NPPs
Commercial operation	5	Sendai-1&2, Ikata-3, Takahama-3&4
Preparation for restart (Reactor establishment license amendment was approved.)	7	Takahama-1&2, Mihama-3, Ohi-3&4, Genkai-3&4
Under NRA Review (Application for the reactor establishment license amendment was submitted.)	14	Tomari-1,2&3, Higashi-dori-1, Onagawa-2, Kariwazaki-6&7, Tokai-2, Hamaoka-3&4, Shika-2, Shimane-2, Tsuruga-2, Ohma
Under consideration	19	Kashiwazaki-1,2,3,4&5, Ohi-1&2, etc.
Preparation for Decommissioning (Permanent Shutdown)	1	Monju
Decommissioning	10	Tokai-1, Hamaoka-1&2, Fugen, Mihama-1&2, Genkai-1, Shimane-1, Tsuruga-1, Ikata-1
Dealing with the accident for Decommissioning	6	Fukushima Daiichi-1,2,3,4,5&6

Table-2 NPPs under decommissioning & preparation for decommissioning in Japan

Plant	Operator	Type	Electric Capacity	Commercial Operation	Permanent Shutdown
Tokai-1	JAPC	GCR	166MW	Jul.25. 1966	Mar.31. 1998
Fugen	JAEA	ATR	165MW	Mar.20. 1979	Mar.29. 2003
Hamaoka-1	CHUBU	BWR	540MW	Mar.17. 1976	Jan.30. 2009
Hamaoka-2	CHUBU	BWR	840MW	Nov.29. 1978	Jan.30. 2009
Tsuruga-1	JAPC	BWR	357MW	Mar.14. 1970	Apr.27. 2015
Mihama-1	KANSAI	PWR	340MW	Nov.28. 1970	Apr.27. 2015
Mihama-2	KANSAI	PWR	500MW	Jul.25.1972	Apr.27. 2015
Genkai-1	KYUSHU	PWR	559MW	Oct.15. 1975	Apr.27. 2015
Shimane-1	CHUGOKU	BWR	460MW	Mar.29. 1974	Apr.30. 2015
Ikata-1	SHIKOKU	PWR	566MW	Sep.30. 1977	May 10. 2016
Monju	JAEA	FBR	280MW	Sep.18. 1991 (start of test operation)	Dec 21. 2016 (decision of shutdown)

2. Issues and efforts for safe, steady and efficient D&D in Japan

It is necessary for not only electric utilities but also all the Japanese people and local citizens to perform the decontamination and decommissioning (D&D) of NPPs safely, steadily and efficiently because the increase of the cost necessary for performing D&D activities may lead to the increase of the liability of Japanese people.

In order to perform D&D activities efficiently, there are four principal conditions which have to be established, such as:

- 1) Organization and staff with culture and mindset suitable for D&D project
- 2) Securing paths for spent fuel and low-level radioactive waste (LLW)
- 3) Funding and accounting system
- 4) Reasonable regulation and D&D operation

2.1 Culture, mindset and organization for D&D project

“D&D” is a quite different field from “Research and development (R&D)” and “Operation and Maintenance (O&M)” in nuclear industry as shown in Table-3. Culture & mindset are quite different among them. It is impossible for a person to switch his thinking way each time. D&D activities except for Fukushima Daiichi 1-4 can be implemented with existing (proven) technologies. R&D may increase D&D project risk (cost increase & schedule delay). Management is much more important than technologies. Especially, total program management including waste management is most important as a key part.

Japanese electric utilities have to change their mind to be suitable for safe, steady and efficient D&D. It is also expected that regulator and local stakeholders understand and recognize the difference between D&D activities and reactor operation. Japanese electric utilities should perform D&D safely, steadily and efficiently in cooperation with all stakeholders. It is also important to establish incentive-providing system to contractors and individuals. Human resource development to maintain know-how and experience is also important for long-term D&D project.

Table-3 Tree thinking ways in nuclear industry

Fields	Viewpoints and Concerns
R&D	<ul style="list-style-type: none"> · What kind of the R&D is necessary? · Are innovative technologies used? (dismantling, decontamination, waste treatment and disposal) · Does the R&D leads to future opportunities?
O&M	<ul style="list-style-type: none"> · How to operate D&D safely and steadily under strict quality assurance and safety system? · How to maintain the existing equipment and dismantling/treatment devices for My Own Plant?
D&D	<ul style="list-style-type: none"> · How to perform D&D with minimal cost and shortest schedule based on safety first? · How to optimize Project Cost and Project Risk? · Do not waste money, because it is only Waste!

2.2 Securing paths for spent fuel and LLW

Currently there is no disposal facility in Japan for LLW arisen from D&D activities. LLW can be classified into three categories such as L1 (relatively high level), L2 (relatively low level) and L3 (very low level). Current status on LLW disposal facility is as follows.

L1; Regulatory standard is being developed.

L2; Japan Nuclear Fuel Limited (JNFL) is currently operating L2 disposal facility only for operational waste.

L3; JAPC's Tokai L3 disposal facility is under licensing review. Each utility individually considers their own L3 disposal facility.

In addition to disposal facility for LLW, it is essential to secure spent fuel (SF) paths. Some utilities are currently constructing interim SF storage facility.

"Free release of clearance material" is also necessary for efficient D&D. It is desirable to expand the scope of the clearance material, to reduce excessive conservatism in regulator's verification and to simplify licensing procedures.

2.3 Funding and accounting system

In Japan, following funding and accounting system is currently established.

① Funding System

Utilities recognize D&D cost as an asset retirement obligation (ARO), and reserve a fund internally as an allowance for D&D activities.

② Accounting System

The remaining book value of NPP can be depreciated even after decommissioning period.

2.4 Reasonable regulation and D&D operation

Regulation suitable for decommissioning stage/LLW disposal is needed. Risk level of NPPs in decommissioning stage is greatly reduced from those in operating stage. Therefore, regulation corresponding to the risk level (graded approach) is expected. NPPs in decommissioning stage can be regarded as radiological facility rather than nuclear facility. Owners also need to manage D&D and LLW based on more reasonable mindset in the field of maintenance of existing SSCs, waste confirmation conservatism, etc.

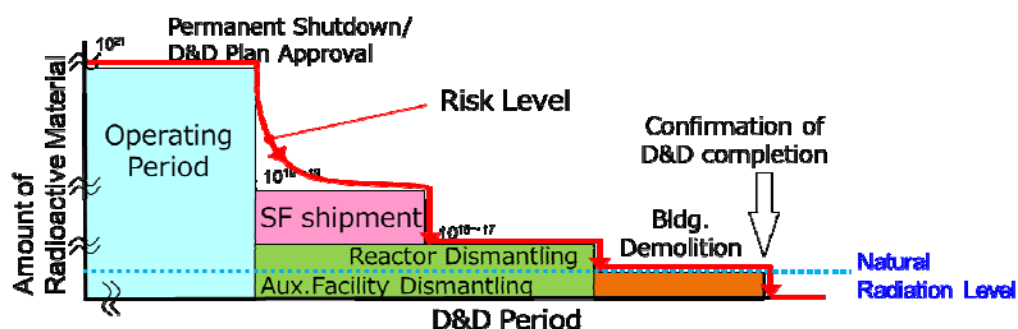


Figure-1 Change of risk level during decommissioning period (image)

3. D&D activities in JAPC

JAPC was established in 1957 as a wholesale electric power company solely engaged in nuclear energy in Japan. Since then, JAPC continues to play a leading role in the electric power industry as a pioneer in the field of nuclear power generation through various projects, including the construction of the first commercial NPP (Tokai-1) in Japan and other NPPs (Tsuruga-1&2, Tokai-2). JAPC also has a long history of D&D activities for NPPs. Table-4 shows key events with regard to D&D activities for NPPs owned by JAPC.

Because it is important for Japanese electric utilities to learn D&D experiences in other countries, JAPC has been cooperating with various overseas organizations related to decontamination, dismantling of systems, components and structures (SSCs) and demolition of buildings, radioactive waste processing and disposal. Table-5 shows the history of JAPC's cooperation with concerned organization abroad.

As part of the collaboration with international D&D companies, in April 2016, JAPC signed an agreement with EnergySolutions (ES), an American company dedicated to D&D business, on strategic cooperation for Japanese D&D projects for the purpose of the introduction of successful international experiences.

As a first step in this cooperation, D&D know-how accumulated inside ES through the US D&D projects is being applied to Tsuruga-1 D&D project with verifying its applicability to D&D projects in Japan.

Table-4 Key events in JAPC in D&D field

Date	Events
Dec., 2001	JAPC started Tokai D&D after submit of dismantling notification.
Jun., 2006	Tokai D&D Plan was approved in accordance with revised Reactor Regulation Law.
Sep., 2006	Clearance measurement method for Tokai was approved
Mar., 2015	JAPC decided a basic management plan that features Fukushima support, D&D business and overseas business.
Mar., 2015	JAPC signed a basic agreement with TEPCO regarding cooperation for 1F D&D business .
Jul., 2015	JAPC applied for Tokai L3 disposal project license .
May, 2017	JAPC started Tsuruga-1 D&D after approval of D&D plan.

Table-5 JAPC cooperation history with D&D organization abroad

Date	Topics
Jun., 2003	JAPC joined the Technical Advisory Group (TAG) of OECD / NEA D&D Program, and regularly participates in this meeting.
Sep., 2003	JAPC signed an information exchange agreement with the D&D division of EDF (DP2D), and is continuing information exchange regularly.
Apr., 2016	JAPC signed an agreement with EnergySolutions regarding collaboration for the LWR D&D in Japan, taking into consideration of future joint business.
Nov., 2016	JAPC signed an agreement with the UK NDA regarding information exchange (confidentiality obligation) of GCR D&D (Magnox & Tokai).

4. Conclusions

JAPC is making efforts to perform safe, steady and efficient D&D activities in Japan with learning the world-wide D&D experiences with aiming at contributing to nuclear industry in Japan.