附件五：**Decommissioning Plan for Hamaoka Nuclear Power Station Unit 1 and Unit 2**

Decommissioning Plan for Hamaoka Nuclear Power Station Unit 1 and Unit 2

1

浜岡原子力発電所1，2号機運転終了に伴う廃止措置計画について

Overview of facilities at Hamaoka NPS

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Reactor type	BWR-4		BWR-5		ABWR
Thermal power (MWt)	1,593	2,436	3,293	3,293	3,926
Type of Primary Containment Vessel	Mark-1		Mark-1 modified		RCCV
Generating output (MWe)	(540)	(840)	1,100	1,137	1,380
Total power output (MWe)			3,617		
Construction commencement	March 1971	March 1974	November 1987	February 1989	March 1999
Operation commencement	March 1976	November 1978	August 1987	September 1993	January 2005
Current status	Decommissioning (Operation terminated on January 30, 2009		In outage (since November 29, 2010)	In outage* (since January 25, 2012	In outage* (since March 22, 2012)
			Safety improvement measures being implemented		

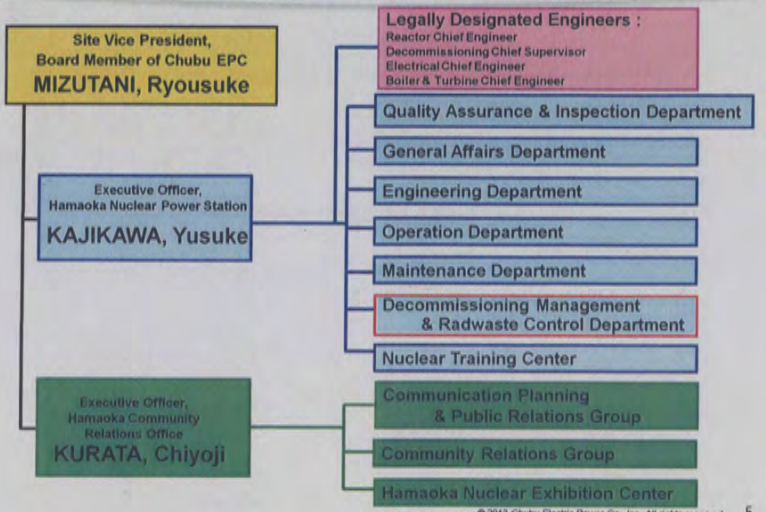
*At the request of the Japanese government, all Units at the Hamaoka NPS halted operation as of May 2011. (Unit-4: May 13, 2011 Unit-5: May 14, 2011)

浜岡原子力発電所 設備概要

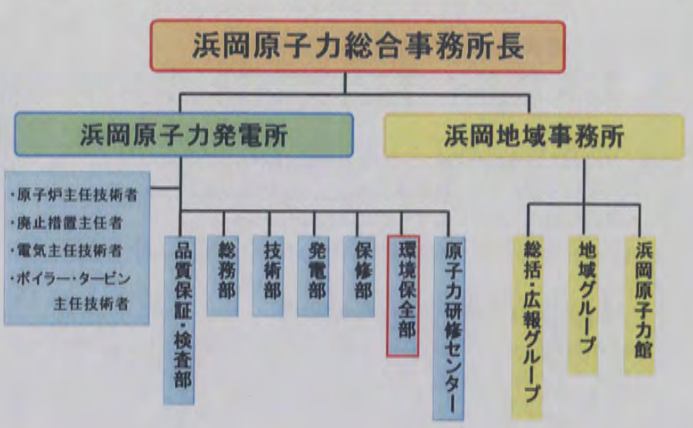
	1号機	2号機	3号機	4号機	5号機
原子炉型式	BWR-4		BWR-5		ABWR
熱出力 (MWt)	1593	2436	3293	3293	3926
格納容器	Mark-1		Mark-1 改良型		RCCV
電気出力 (MWe)	(540)	(840)	1100	1137	1380
総電気出力 (MWe)			3617		
着　工	昭和４６年（１９７１）３月	昭和４９年（１９７４）３月	昭和５７年（１９８２）１１月	平成元年（１９８９）２月	平成１１年（１９９９）３月
運転開始	昭和５１年（１９７６）３月	昭和５３年（１９７８）１１月	昭和６２年（１９８７）８月	平成５年（１９９３）９月	平成１７年（２００５）１月
現在の状況	廃止措置中（H21.1.30運転終了）		定期検査中（H22.11.29～）	定期検査中※（H24.1.25～）	定期検査中※（H24.3.22～）
			＜安　全　向　上　対　策　実　施　中＞		

※内閣総理大臣要請を受けて停止（4号機：H23．5．13　5号機：H23．5．14）

Organization Chart of Hamaoka



浜岡原子力発電所　組織図



Basic decommissioning policy (safety assurance)

1. Maintaining and managing facilities required for safety assurance

Facilities required to ensure safety during the decommissioning period are periodically inspected to maintain their functionality and performance, and also ensure their seismic safety.

2. Preventing the leakage and spread of radioactive substances

Measures are taken to prevent the leakage and spread of radioactive substances to eliminate the effect of radiation on the surrounding environment during and after the decommissioning period.

3. Protecting dismantling workers from radiation

Measures are introduced to remove and decay radioactive substances for radiation reduction. Dismantling will be carried out in the methods and procedures in line with the basics of radiation protection (time, distance, shielding).

廃止措置の基本方針（安全確保対策）

1. 安全確保に必要な施設の維持管理

廃止措置期間中の安全確保に必要な施設は点検や検査を行い、機能・性能を維持します。耐震安全性も確保します。

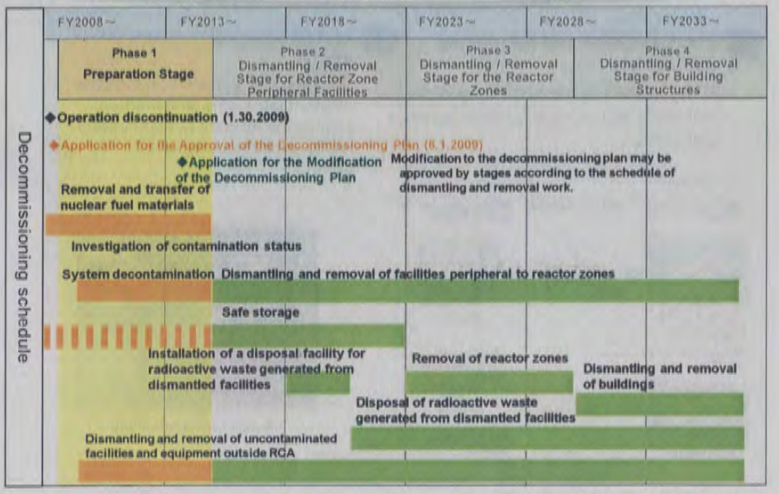
2. 放射性物質の漏えいおよび拡散防止対策

廃止措置期間中は、周辺環境への放射性物質の漏えいや拡散を防止し、周辺環境に影響を及ぼすことがないようにします。
廃止措置終了時も、周辺環境に影響を及ぼすことがないようにします。

3. 解体作業従事者の放射線防護

放射性物質の除去や減衰により放射能の低減を図るとともに、放射線防護の基本（時間・距離・遮へい）に沿った工法、手順などに基づいて作業を進めます。

Basic decommissioning policy (overall plan)



汚染廃棄 → 保管専用

1，2号機 廃止措置の全体スケジュール

多份报 need have 事前也是多 place

平成21～26年度	平成27～34年度	平成35～41年度	平成42～48年度
第1段階 解体工事準備期間	第2段階 原子炉領域周辺設備 解体撤去期間	第3段階 原子炉領域 解体撤去期間	第4段階 建屋等解体撤去期間
◆運転終了(2009．1．30) ◆廃止措置計画認可申請(2009．6．1) ◆廃止措置計画認可申請の一部補正(2009．9．15) ◆廃止措置計画認可(2009．11．18) ◆廃止措置計画変更認可申請(2010．12．27) ◆廃止措置計画変更認可申請の一部補正(2011．1．31) ◆廃止措置計画変更認可(2011．2．16) ◆廃止措置計画の変更届(2012．8．24) ◇廃止措置計画変更認可申請			
燃料搬出			
汚染状況の調査・検討			
系統除染	原子炉領域周辺設備解体撤去		
安全貯蔵		原子炉領域解体撤去	建屋等解体撤去
放射性廃棄物の処理処分（運転中廃棄物または解体廃棄物）			
放射線管理区域外の設備・機器の解体撤去			

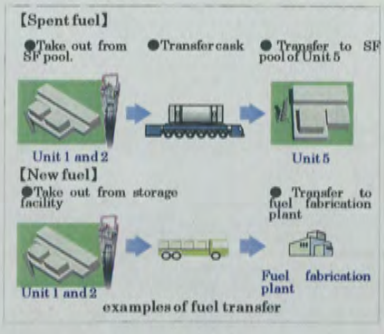
廃止措置の第2段階以降については、第1段階期間中に実施する施設の汚染状況の調査結果等を踏まえ、解体撤去の工法・手順、放射性廃棄物の処理・管理等について検討し、原子炉領域周辺設備の解体撤去に着手するまでに実施事項を定め、廃止措置計画の変更認可を受けます。（注）維持管理中に発生する放射性廃棄物の処理処分は、解体工事準備期間中から実施しています。

Dismantling procedure (preparation stage)(1/2)

中部電力

Transportation and transfer of nuclear fuel

All fuel materials are carried out of the fuel pools and storage facilities at Unit 1 and Unit 2.



examples of fuel transfer

Investigation of contamination status

The results are used to decide the dismantling timing and method, assess the amount of dismantling waste, and evaluate the safe-storage period.


example of investigation

第1段階 解体工事準備期間(1／2)

中部電力

燃料の搬出・譲渡し

1，2号機の燃料プールおよび新燃料貯蔵庫から、すべての燃料を搬出します。

燃料搬出の流れの例

汚染状況の調査・検討

施設の汚染状況の調査を行い、その結果に基づき、解体時期の決定、解体方法の策定、解体廃棄物の量の評価、安全貯蔵期間の評価を行います。


汚染状況の調査の例

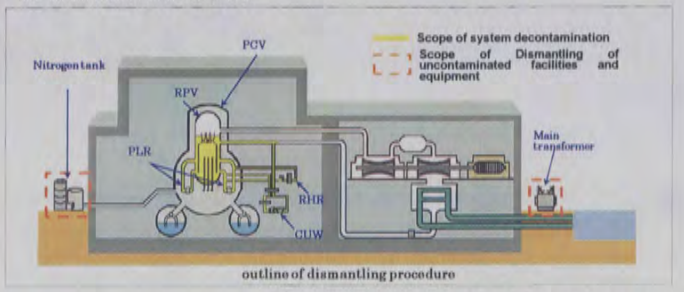
Dismantling procedure (preparation stage)(2/2)

System decontamination

Chemicals are used to remove radioactive substances affixed to the interior walls of piping and containers. System decontamination is performed on the Recirculation System, Reactor Water Clean-Up System, Residual Heat Removal System and reactor pressure vessels.

Dismantling of uncontaminated facilities and equipment outside RCA

Facilities and equipment that have gone out of service (e.g. a transformer) are dismantled and removed.



outline of dismantling procedure

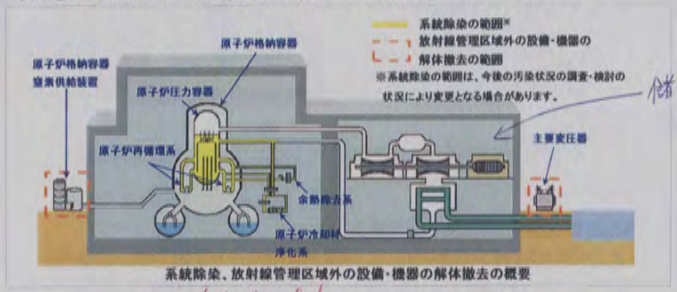
第1段階 解体工事準備期間(2／2)

系統除染

配管や容器の内面に付着した放射性物質を、薬品を使って除去します。系統除染の対象は、再循環系、原子炉冷却材浄化系、余熱除去系および原子炉圧力容器としています。

管理区域外の汚染のない設備・機器の解体撤去

供用を終了した設備・機器(変圧器など)について順次、解体撤去を行います。



系統除染、放射線管理区域外の設備・機器の解体撤去の概要

Dismantling procedure

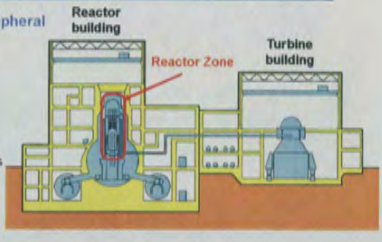
Dismantling / Removal stage for Peripheral facilities

Phase 2: Dismantling / Removal Stage for Reactor Zone Peripheral Facilities

Dismantling and removing Reactor Zone Peripheral Facilities*

Facilities peripheral to reactor zones with a low level of radiation are dismantled and removed

※ Reactor Zone Peripheral Facilities signify facilities other than those in reactor zones, and include facilities inside a turbine building as well as reactor cooling facilities in a reactor building. The Reactor Zone contains a reactor vessel and radiation shields surrounding the vessel.



Safe storage

Facilities are kept for a set period of time, according to the results of evaluation performed on Reactor Zone facilities in the Preparation Stage.

Installation of a disposal facility for radioactive waste from facility dismantling

A disposal facility where waste is cut into sections and stored in cylinders is installed to prepare radioactive waste, generated from dismantling the facilities, for underground disposal.

Turbine etc.
関知 from low dose to high
exclude core! → phase II

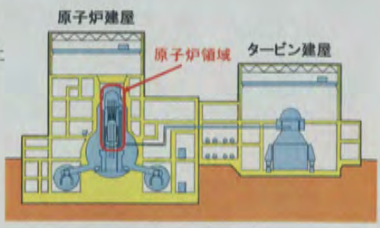
廃止措置の計画

第2段階 原子炉領域周辺設備解体撤去期間

原子炉領域周辺設備※の解体撤去

放射能レベルの低い原子炉領域周辺設備について順次、解体撤去を行います。

※ 原子炉領域以外の設備をいい、タービン建屋内の設備、原子炉建屋内の原子炉冷却系統施設などのこと。
原子炉領域とは、原子炉容器および原子炉容器を取り囲む放射線遮へい体を含む領域のこと。



安全貯蔵

原子炉領域設備に対する解体工事準備期間での評価結果を踏まえ、期間を定めて貯蔵します。

解体放射性廃棄物処理設備の設置

解体放射性廃棄物を埋設処分できるよう、廃棄物を切断したり容器へ収納する設備を設置します。

Dismantling procedure

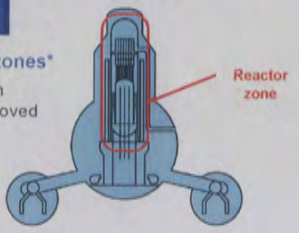
Dismantling / Removal stage for reactor and building

Phase 3: Dismantling / Removal Stage for the Reactor Zones

Dismantling and removal of reactor zones*

Reactor zones, which has a relatively high level of radiation, are dismantled and removed after the end of the safe-storage period.

* The section consisting of the reactor vessel and radiation shields surrounding the vessel



Phase 4: Dismantling / Removal Stage for Building Structures

Removal of radioactive substances in buildings structures

Radioactive substances remaining on building walls, etc. are removed through "chipping" and other means.

Dismantling and removal of building structures

Once the removal of all radioactive substances is confirmed, the buildings will be dismantled and removed.

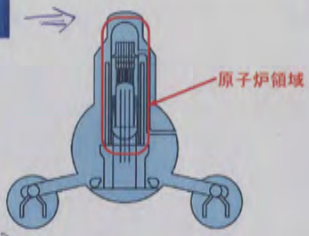
廃止措置の計画

第3段階　原子炉領域解体撤去期間

原子炉領域※などの解体撤去

放射能レベルの比較的高い原子炉領域の解体撤去は、安全貯蔵の終了後に着手します。

※ 原子炉容器および原子炉容器を取り囲む放射線遮へい体を含む領域のこと。



第4段階　建屋等解体撤去期間

建屋内の放射性物質の除去

建屋内の壁面などに残っている放射性物質を"削り取る"等の方法で除去します。

建屋の解体撤去

建屋内の放射性物質が除去されたことを確認した後、建屋を解体撤去します。

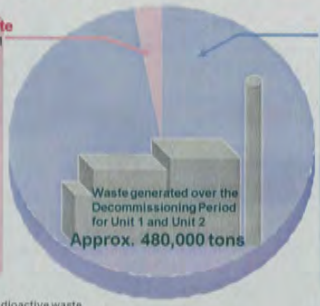
Disposal of items contaminated by nuclear fuel materials (1)

CHUBU Electric Power

Waste generated in the Decommissioning Period is sorted rationally and processed appropriately.

Low-level radioactive waste
Approx. 17,000 tons (3%)*1

Low-level radioactive waste is sorted based on legal classifications according to the type of radioactive substances contained and the level of radiation. The waste is buried at different depths or disposed of in other appropriate manners according to the classifications.



Non-radioactive waste or waste that does not need to be treated as radioactive waste *2
Approx. 467,000 tons (97%)

Non-radioactive waste (442,000 tons) and waste that does not need to be treated as radioactive waste (25,000 tons) are recycled or disposed of as industrial waste.

*1 This does not include low-level radioactive waste, generated while the plants were operational (e.g. waste timber from inspections and spent filters).

*2 This does not include underground structures such as building foundations.

*The amounts of waste cited are estimation only, and subject to change depending on the outcome of the investigation into the status of contamination.

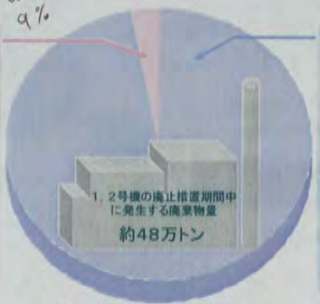
放射性物質によって汚染された物の廃棄（1）

中部電力

廃止措置期間中に発生する廃棄物は、合理的に区分し、適切に処分します。

低レベル放射性廃棄物
約1．7万トン（約3%）※1

法令に基づき、含まれる放射性物質の種類や放射能レベルなどによって区分し、区分に応じ埋設する深さを変えるなど、適切に処分します。



放射性廃棄物でない廃棄物および放射性廃棄物として扱う必要のない廃棄物 ※2
約46．7万トン（約97%）

放射性廃棄物でない廃棄物（約44．2万トン）、放射性廃棄物として扱う必要のない廃棄物（約2．5万トン）は、資源として再利用するか、産業廃棄物として処分します。

※1 約1．7万トンには、運転中などに発生した低レベル放射性廃棄物（点検作業で発生した廃材、使用済フィルタなど）は含まれていません。

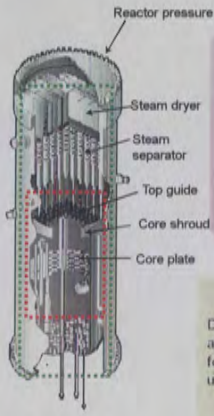
＊発生量は、現在の推定値であり、汚染状況の調査結果により変わります。

※2 約46．7万トンには、建屋基礎などの地下構造物は含まれていません。

Disposal of items contaminated by nuclear fuel materials (2)

CHUBU Electric Power

Low-level radioactive waste **Approx. 17,000 tons**



Waste with a relatively high level of radiation (L1)	Waste with a relatively low level of radiation (L2)	Waste with an extremely low level of radiation (L3)
Approx. 200 tons	**Approx. 2,200 tons**	**Approx. 14,000 tons**
・In-core structures Top guide Core shroud Core plate etc.	・In-core structures Steam dryer Steam separator ・Recirculation pump parts ・Reactor clean-up water pump parts etc.	・Main steam pipes ・Feedwater pipes ・Turbine parts ・Other metal and concrete items etc.
Disposal at a depth that allows sufficient margin for general underground use	Near-surface disposal in a concrete pit	Near-surface disposal without a man-made structure

0m
25m
50m
100m

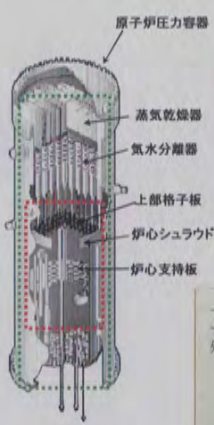
Specific disposal methods are defined before the dismantling and removal of reactor zone peripheral facilities.

* The above figures do not include low-level radioactive waste, generated while the plants were operational (e.g. waste timber from inspections and spent filters).

放射性物質によって汚染された物の廃棄(2)

中部電力

低レベル放射性廃棄物　**約1．7万トン**



放射能レベルの比較的高いもの(L1)	放射能レベルの比較的低いもの(L2)	放射能レベルの極めて低いもの(L3)
約200トン	**約2，200トン**	**約1．4万トン**
・上部格子板 ・炉心シュラウド ・炉心支持板 など	・原子炉圧力容器 ・気水分離器 など	・再循環系や非常用炉心冷却系のポンプ、配管 ・主蒸気配管 ・給水配管 ・その他金属およびコンクリート　など
一般的な地下利用に対して十分余裕をもった深度への処分	コンクリートピットを設けた浅地中埋設処分	人工構造物を設けない浅地中埋設処分

0m
25m
50m
100m

具体的な処分方法は、原子炉領域周辺設備解体撤去工事の着手までに定めます。

＊上記の廃棄物量には、運転中に発生した低レベル放射性廃棄物(点検作業で発生した廃材、使用済フィルタなど)は含まれていません。

附件六：**Tokai 2 Nuclear Power Station**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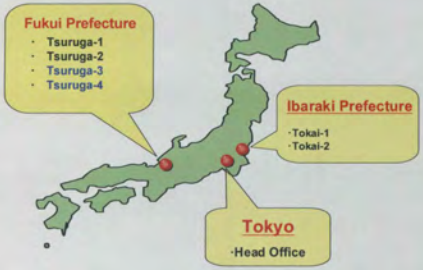
Profile of Tokai Village



Profile of Tokai Village

Our town Tokai Village was born on March 31, 1955. The villages of Muramatsu and Ishigami merged under the Town and Village Merger Promotion Act to create Tokai Village.

Tokai Village faces the wide expanse of the Pacific Ocean, and is located about 15 kilometres northeast of Mito, the capital of Ibaraki Prefecture. The city of Hitachi is located to the north of Tokai Village across the Kuji River. Naka City is located to the west, and Hitachi-Naka City is located to the south.

There are farms and forests on the heights located in the west of Tokai Village, and in the lowlands on the south side of the Kuji River and in Masaki-ura and Hoso-ura, which are rich in water resources, there are rice paddies that produce an abundant harvest. The land gradually inclines to the east until it reaches the dunes that overlook the Pacific Ocean. The Japan Atomic Energy Agency and The Japan Atomic Power Co. are located in these dunes, that have developed as the birthplace of the peaceful use of nuclear power in Japan. The riches created by the land and sun, and advanced technology ... Tokai Village is a very comfortable place to live - a place that combines nature, culture and technology.

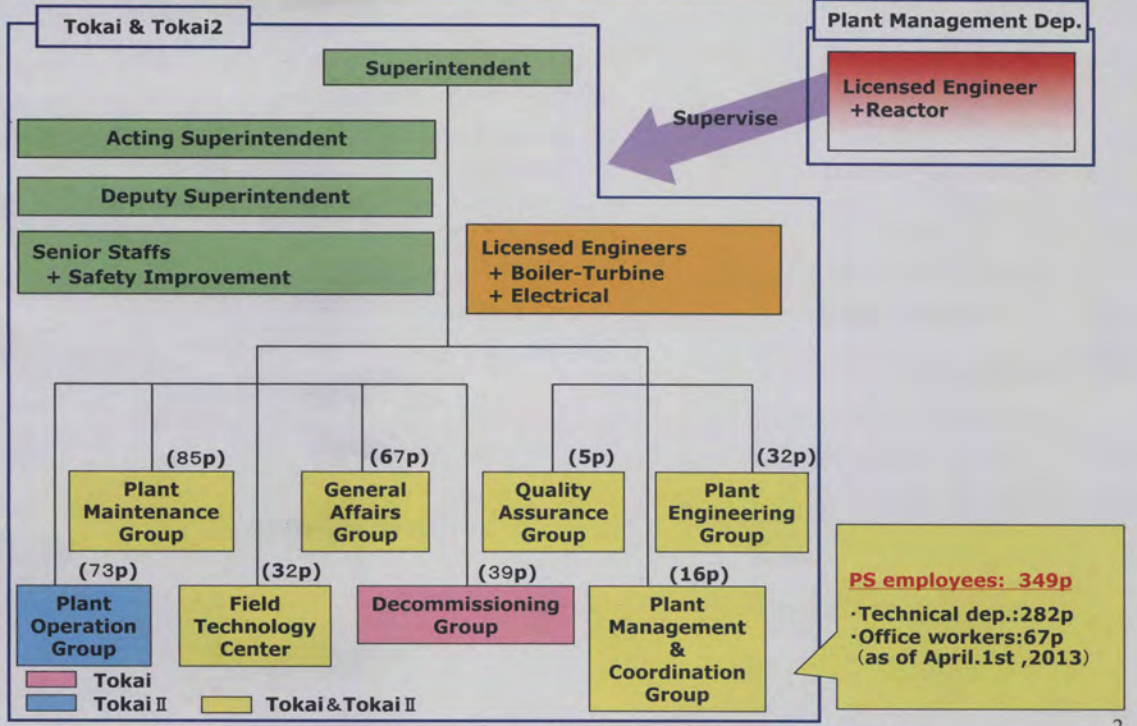
<Nuclear Facilities in Tokai Village>

<Area and Population (As of 1 April 2013)>

The Area 37. 48km²

The Population 37,789

Organization chart



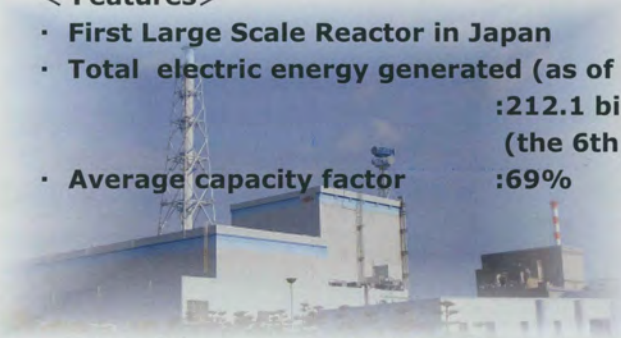
Outline of Tokai-2

<Specifications>

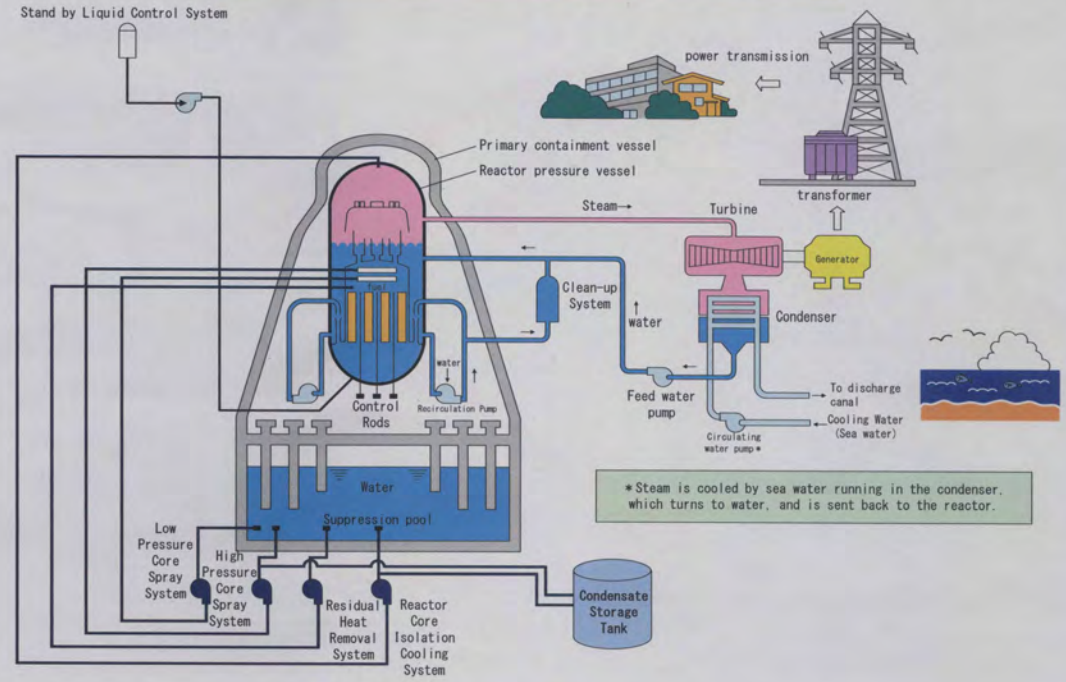
- Reactor type :Boiling Water Reactor (General Electric)
- Electrical output :1,100MWe, 50Hz Frequency
- Fuel :Low Enriched 3.7% Uranium Dioxide (approx.132tons/core)
- Start of commercial operation:28 November 1978
- Power supplied to :Tokyo Electric Power Co.Inc Tohoku Electric Power Co.Inc

< Features>

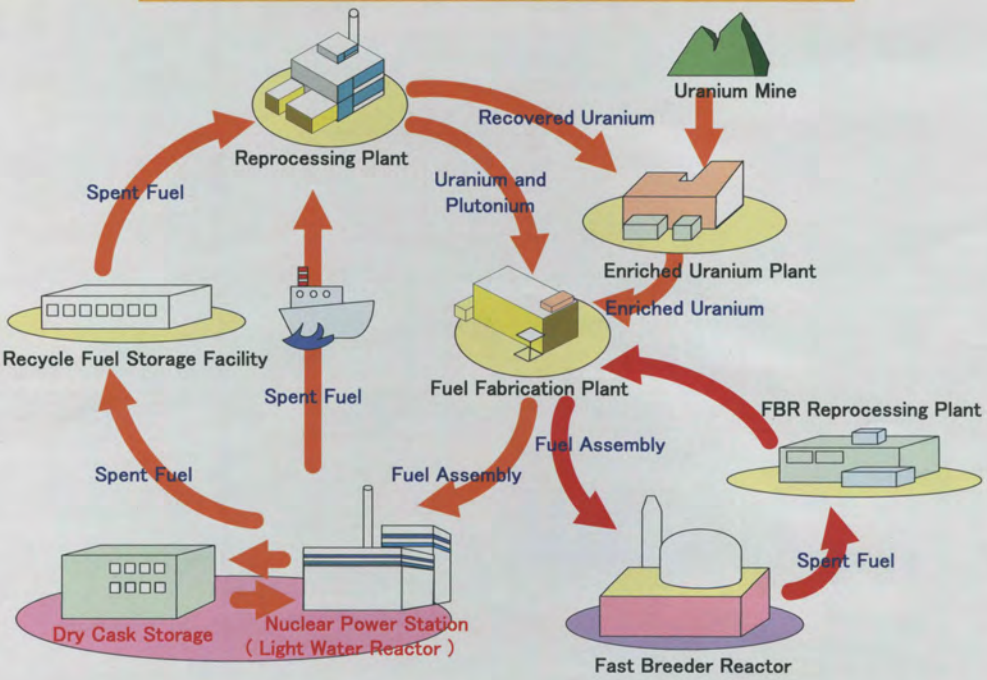
- First Large Scale Reactor in Japan
- Total electric energy generated (as of March 2008) :212.1 billion kWh (the 6th of the world BWR)
- Average capacity factor :69%



Outline of Tokai-2

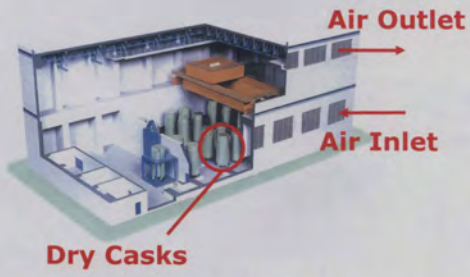


Nuclear Fuel Cycle



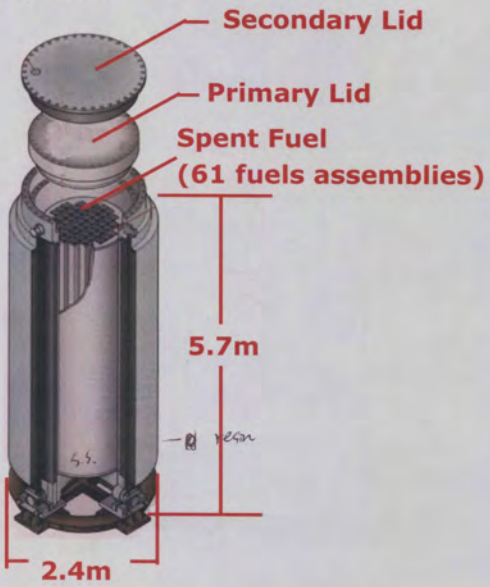
Outline of Dry Cask Storage of Spent Fuel

Dry Cask Storage Facility



Capacity : 24 Dry Casks
U-weight : 250t
Reinforced Concrete Structure
Natural Circulation Cooling

Dry Cask

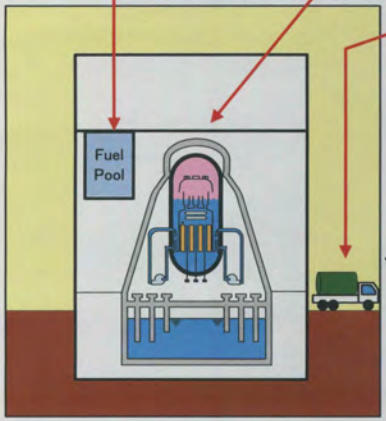


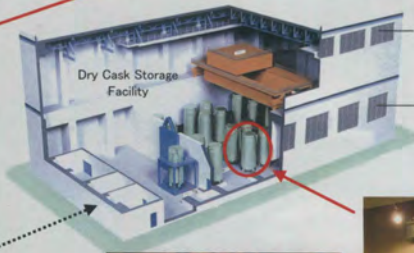
Outline of Dry Cask Storage of Spent Fuel

Fuel Loading in Fuel Pool

Leak Tightness Inspection

Transportation to Dry cask Storage Facility





Installation of Dry Cask

Decommissioning Plan & Preparation for Licensing in Nuclear Power Plant

The Japan Atomic Power Company

Nov.2013

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Profile of the Japan Atomic Power Co.

Established : November 1,1957

Business Objective:

We conduct the following operations to develop civilian nuclear power generation business.
We may contract to conduct surveys, designing, construction supervision, construction operation and other relevant engineering assistance relating to nuclear power plants.

Capital : ¥120,000 million

Number of employees : about 1,400

Owned Plant :

- Tokai - Ⅱ (Electric Power: 1,100MW、Commercial Operation Start :Nov.1978)
- Tsuruga unit 1 (Electric Power: 357MW、Commercial Operation Start :Mar.1970)
- Tsuruga Unit 2 (Electric Power: 1,160MW、Commercial Operation Start :Feb.1987)
- Tsuruga Unit3&4 (Electric Power: 1,538MW × 2unit、Under Constraction Preparation)

Under Decommissioning Tokai- Ⅰ

Tsuruga Unit1

Tokai-Ⅱ

Tsuruga Unit2

Decommissioning System in Japan

Decommissioning of NPP

< What is Decommissioning? >

The nuclear power plant under operation must end operation someday. The nuclear power plant which ended operation is dismantled ,removed, processing disposal of waste and the work for former site effective us.

These activities are called "Decommissioning" .

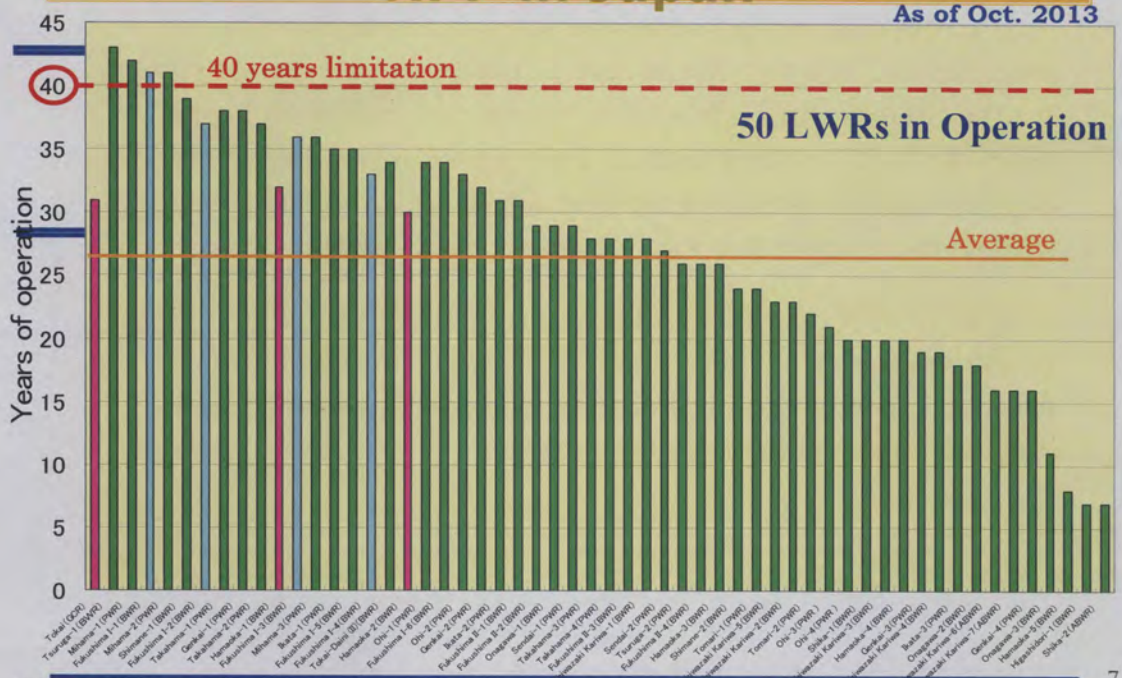
< The end conditions of decommissioning >

- **Transfer of Nuclear fuel material is completed.**
- **Decontamination of soil and institution in site is completed.**
- **Disposal of Nuclear fuel material and Radioactive waste is completed.**

The reason for Judgment for Decommissioning

- **Objective Achievement:**
  Research Reactor、*Demonstration Reactor*
- **Economical reason:**
  The 1960s previous small-scale plant etc
- **Safety or Technical reason:**
  In case of no economical solution profitable
- **Accident:**
  TMI-2、Chernobyl、Fukushima-Daiichi
- **Political reason:**
  Italy、German、Sweden etc

Operational years of commercial NPP in Japan



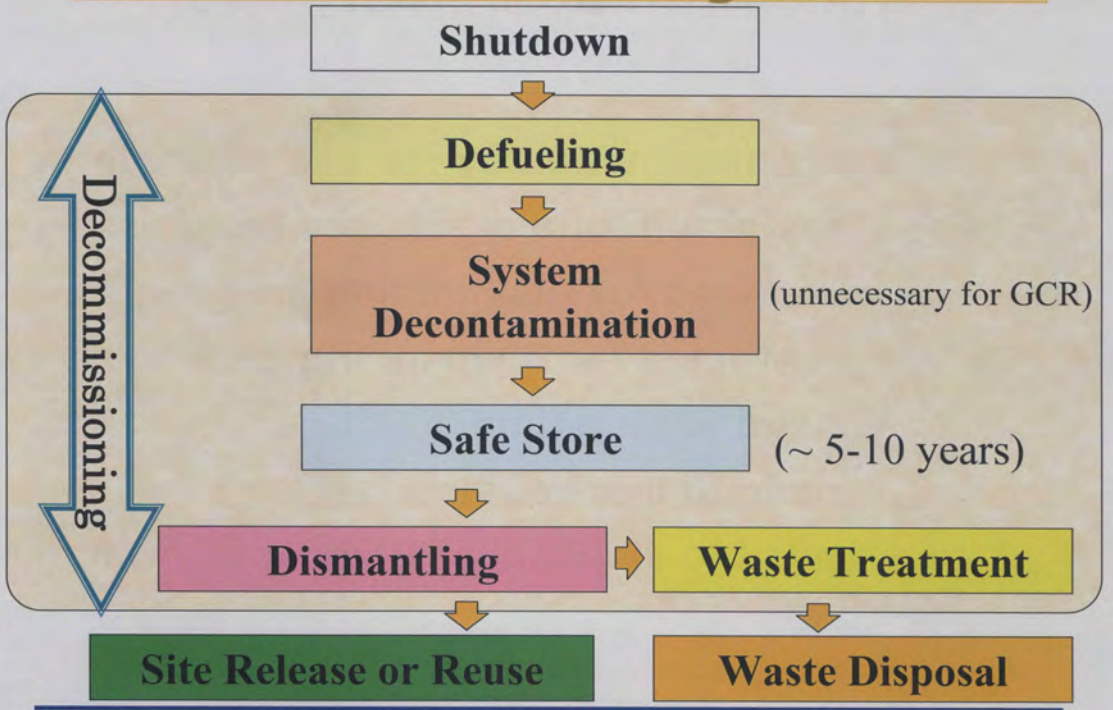
Japanese Stance for Decommissioning

◇**It is important to undertake the decommissioning of nuclear facilities on the major premise of safety assurance, under the responsibility of the installer, based on amended Nuclear Reactor Regulation Law and Under the safety regulations of the Government, while gaining the understanding and cooperation of the local community.**

◇**Reuse of material from decommissioned nuclear facilities, which is not required to be treated as radioactive material, is reasonable because it is consistent with the concept of a sound recycle policy.**

Framework for Nuclear Energy Policy
(Japan Atomic Energy Commission October 11, 2005)

Japanese Standard Scenario for Decommissioning of NPPs



The feature of Decommissioning of NPPs

There are contamination by radioactive material.

⇒ restricted form regulatory body.

required for Dismantling procedure.

restricted for Dismantling method.

need to long time.

need to large cost

need to disposal of Radioactive waste

The expense allowance of Decommissioning in Japan

Decommissioning allowance system

① **deposit from operation start to end**

② **deposit depend on electric output**

③ **deposit in 40 years**

④ **rational estimate**

1000MWe LWR ～ ¥60,000 million

➡ Changed the system on 2013

① **deposit to reactor dismantling start**

② **deposit every year**

③ **deposit in MAX 50years**

The comparison of safety measurement with operating plant and decommissioning plant

Safety measurement in operating

prevention of public & worker dose

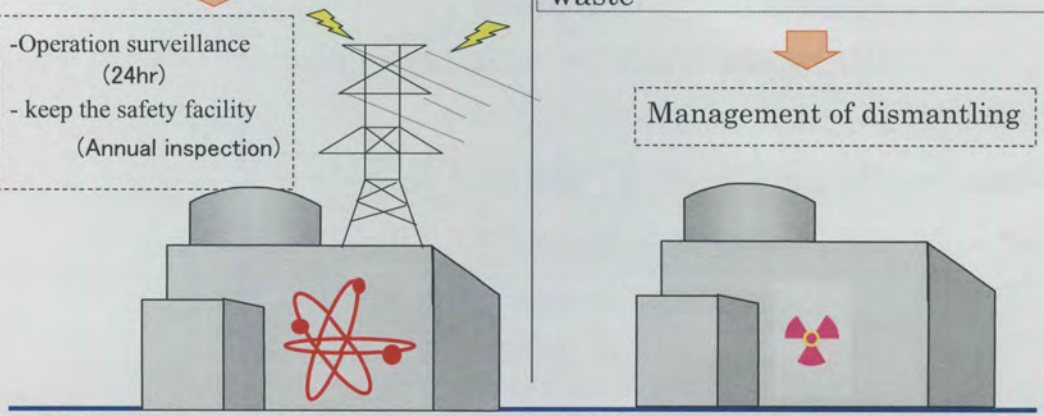
Safety measurement in decommissioning

【Point on operating】
- Safety operation of reactor
- keep safety function
  (stop、cool、confine)
- Safegards

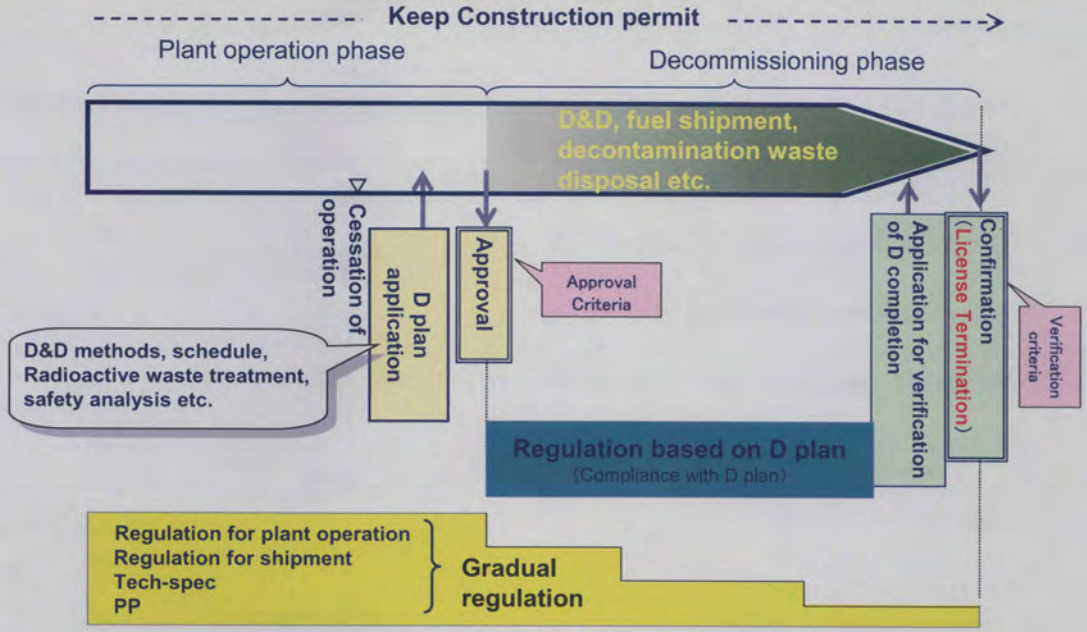
【Point on decommissioning】
- radiation & waste management
- keep confinement function
- confirm final condition of site & waste

-Operation surveillance
(24hr)
- keep the safety facility
(Annual inspection)

Management of dismantling



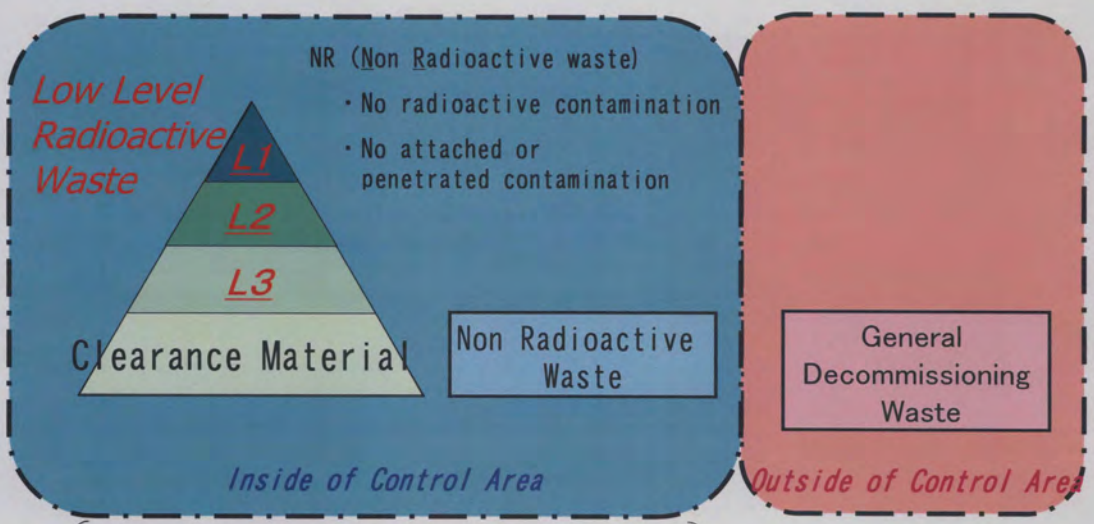
Safety regulation on decommissioning in Japan



Contents of Decommissioning Plan application

- **Decommissioning Facility & Radiological Characterization**
- **Fuel Management & Shipment plan**
- **Decontamination Method**
- **Dismantling Method**
- **Waste Management & Disposal Method**
- **Project Schedule**
- **Safety Analysis**
- **Estimated Cost**

Waste arose from decommissioning



L1: Relatively high radioactive waste
L2: Relatively low radioactive waste
L3: Very low level waste
Clearance material: No necessity to be dealt as radioactive

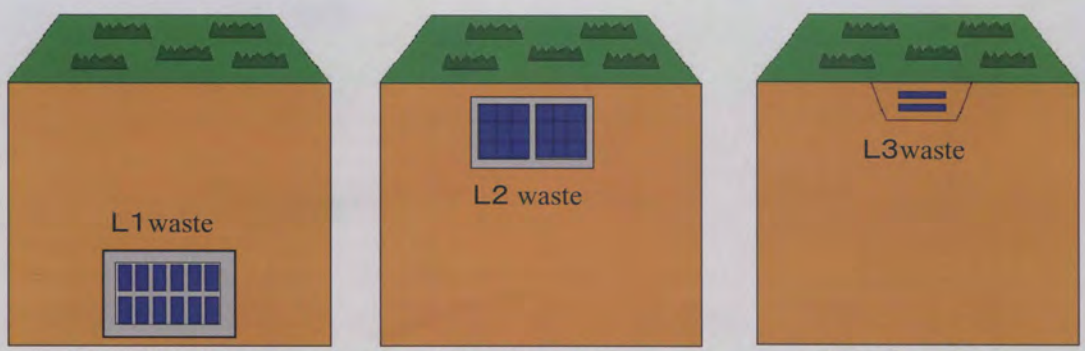
Amount of each level waste on Tokai-1

	Weight [ton] (Removed Material)	
Relatively High Radioactive Waste (L1 Waste)		1, 530
	Graphite (Graphite Block)	: 1, 520
	Metal (Control Rods)	: 20
Relatively Low radioactive Waste (L2Waste)		8, 870
	Metal (Reactor Vessel) etc	: 2, 980
	Concrete (Inner Shielding Wall)	: 5, 890
Very Low Level Radioactive Waste (L3 Waste)		13, 100
	Metal (SRU)	: 2, 300
	Concrete (Outer Shielding Wall)	: 10, 800
Clearence Material		40, 200
	Metal	: 4, 900
	Concrete	: 35, 400
Non Radioactive Waste (include General removed Material)		128, 000
	In Radiation control Area	: 71, 000
	Out of Radiation Control Area	: 57, 000

総量：19.2万ton

Disposal method of LLW in Japan

Relatively high radioactive level	Relatively low radioactive level	Very low radioactive level
(Intermediate depth disposal)	(Near surface pit disposal)	(Near surface trench disposal)



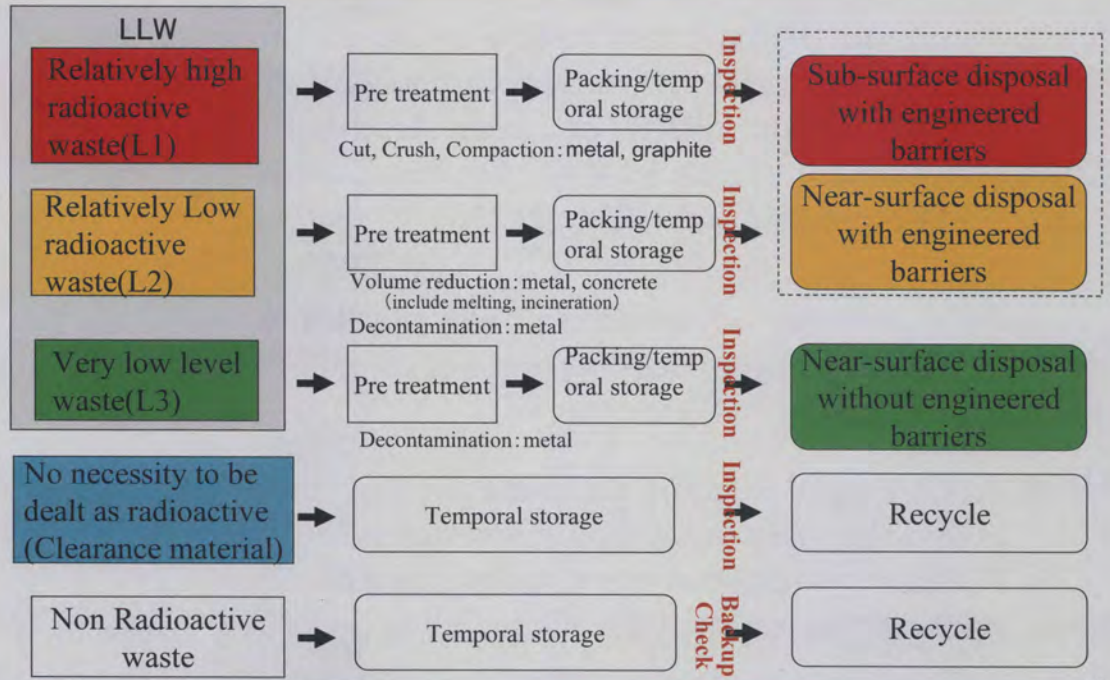
Monitoring 300～400years	Monitoring 300～400years	Monitoring 50years

Classification Criteria for LLW Disposal Concept

Bq/kg

Nuclide	Limit Concentration for Intermediate Disposal	Limit Concentration for Near Surface Pit Disposal	Limit Concentration for Near Surface Trench Disposal	Clearance Concentration
H-3	—	—	—	1E+05
C-14	1E+13	1E+08	—	1E+03
Cl-36	1E+10	—	—	1E+03
Mn-54	—	—	—	1E+02
Co-60	—	1E+12	1E+07	1E+02
Ni-63	—	1E+10	—	1E+05
Sr-90	—	1E+10	1E+04	1E+03
Tc-99	1E+11	1E+06	—	1E+03
I-129	1E+09	—	—	1E+01
Cs-134	—	—	—	1E+02
Cs-137	—	1E+11	1E+05	1E+02
Eu-152	—	—	—	1E+02
Eu-154	—	—	—	1E+02
α核種	1E+08	1E+07	—	—

Waste treatment & disposal flow



The Decommissioning status in Japan

- From the 1970s, examination of development of the technology relevant to decommissioning is repeated. Dismantling of JPDR) of Japan Atomic Energy Research Institute (Japan Atomic Energy Agency) will be completed in Mar,1996.

- As a commercial nuclear power plant, the JAPC starts Tokai Decommissioning project for the first time on Dec, 2001.

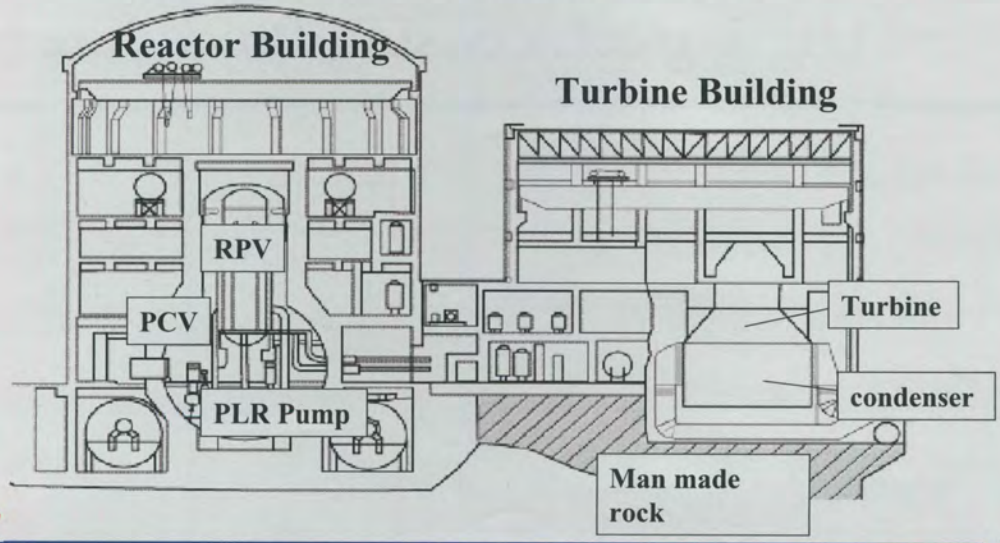
- JAEA Fugen and the Chubu Electric Power Co Hamaoka 1/2 are started decommissioning. Fukushima-Daiichi are special case of decommissioning.

Preparation for Decommissioning
~Planning &Licensing Procedure~

Profile of Tsuruga-1

First LWR Plant in Japan (BWR2 Mark- Ⅰ)

Will be ceased operation in 2016



Outline of Tsuruga-1

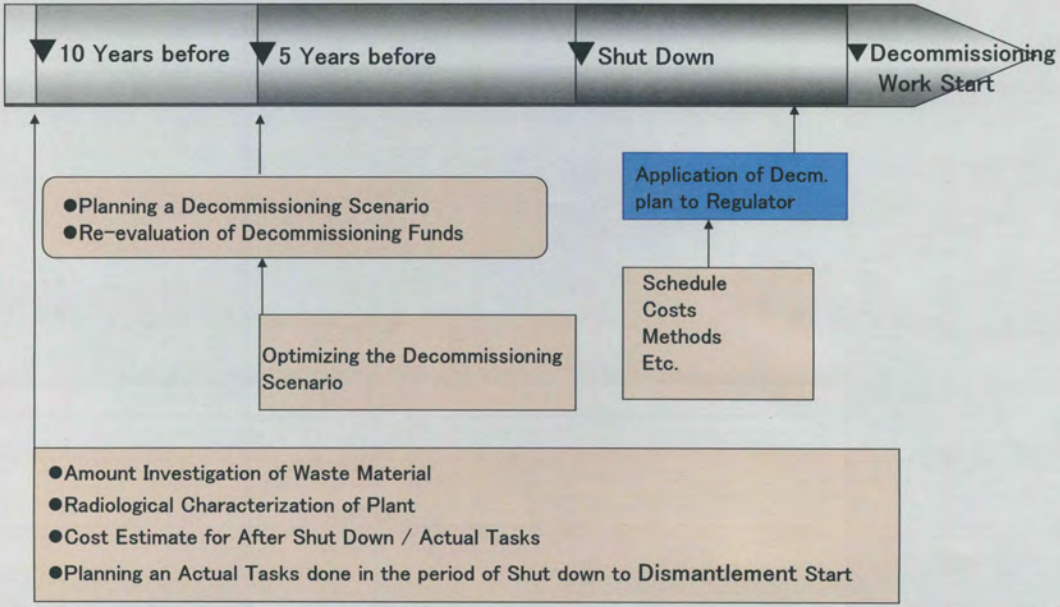
Table-1 Major Specifications of Tsuruga Power Plant Unit 1

Type of Reactor	BWR (BoilingWaterReactor)
Thermal Power	1070MWt
Electric Output	357Mwe
Core Assembly	
Core Equivalent Radius	151cm
Core Height	366cm
Numbers of Fuel Assembly	308

Reactor Pressure Vessel (RPV)	
Inner Radius	2.35m
Height	10.5m
Thickness	14cm
Primarily Containment Vessel (PCV) & Biological Shielding Wall (BSW)	
BSW Thickness	2~4m
PCV Inner Radius (Upper Part)	2.5m
PCV Inner Radius (Lower Part)	8.5m

Schedule of Preparation work for Decommissioning

(Example for reference NPP)



Decommissioning method of reactor facility

Method of dismantling are as follows mainly

- Immediate dismantling method

Dismantling the reactor facility actively in the state that made the adequate exposure measures

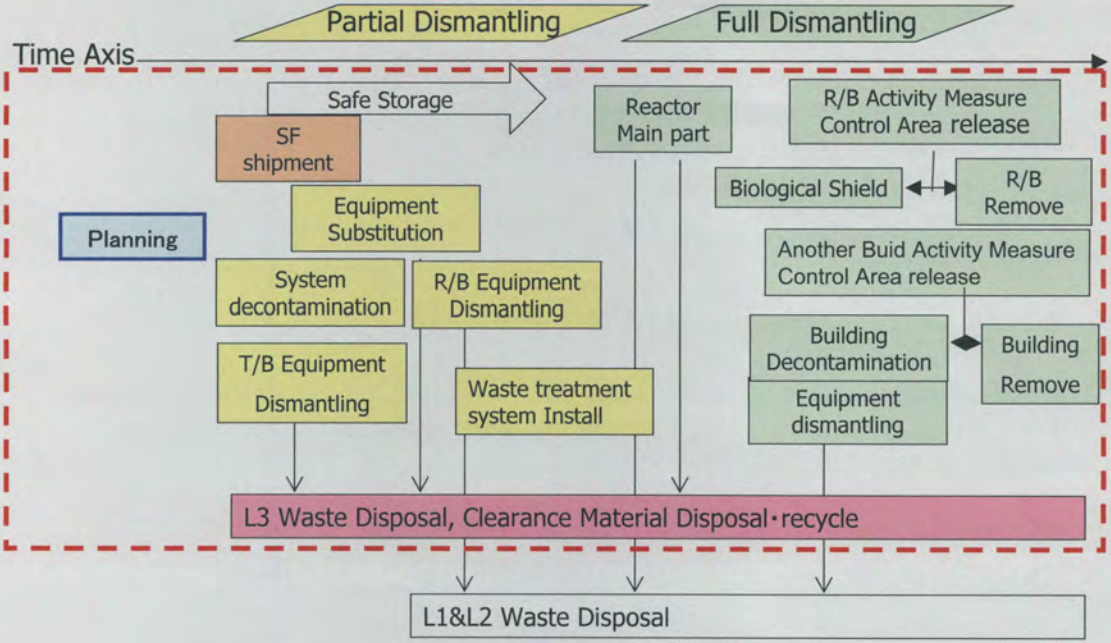
- Safe storage ⇒ dismantling method

Safe storage period is set by taking into account that the annual exposure dose of radiation workers of dismantling work period is the same or less than the annual exposure dose during operation

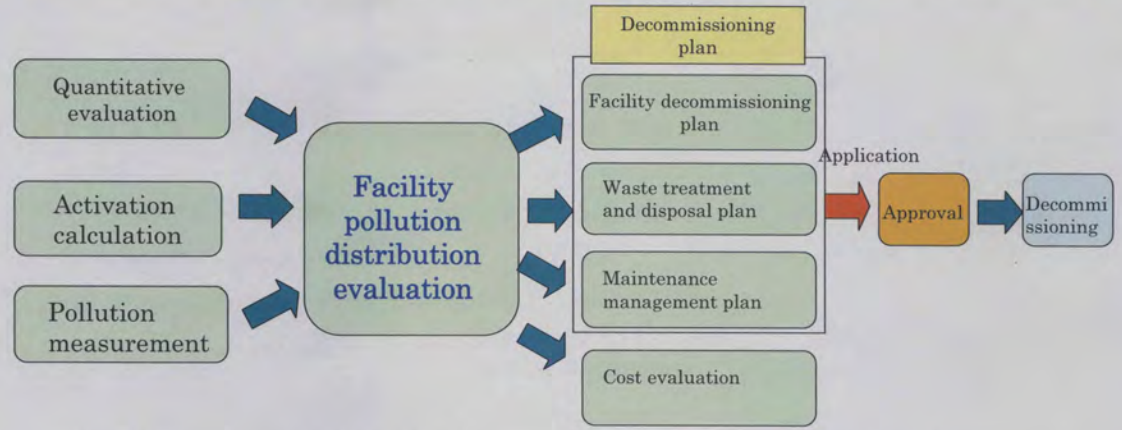
- Shielding isolated ⇒ dismantling method

Dismantling after a long period of time at isolated shielding to reduce the radioactive waste and to reduce exposure

Decommissioning Work Flow for LWR

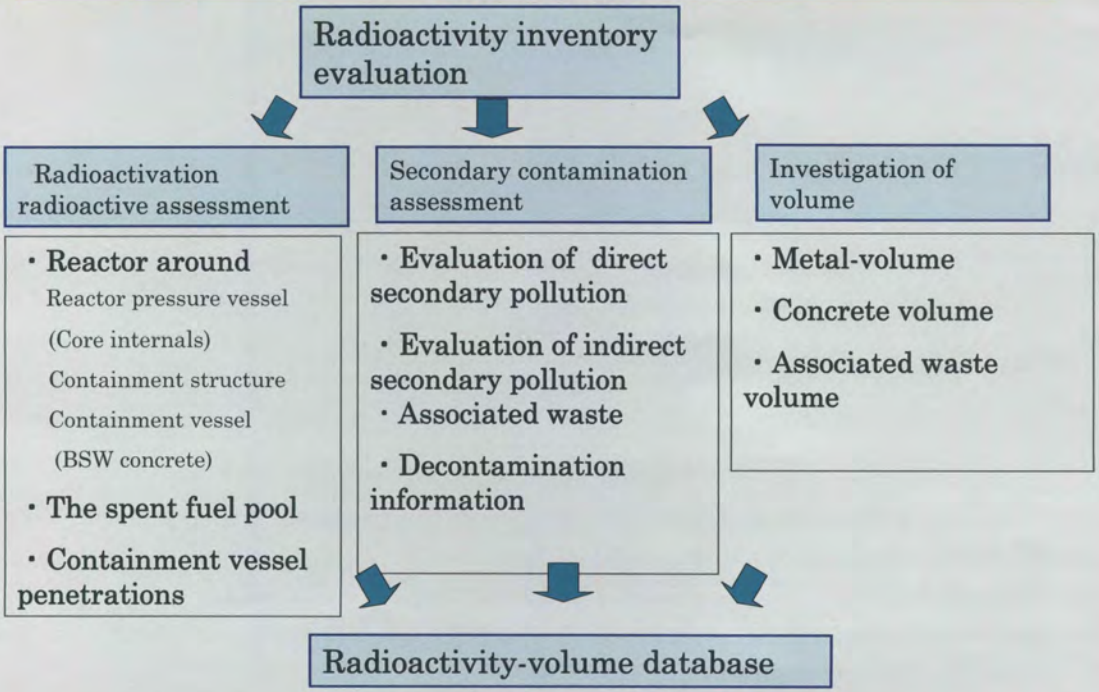


Flow of planning of decommissioning

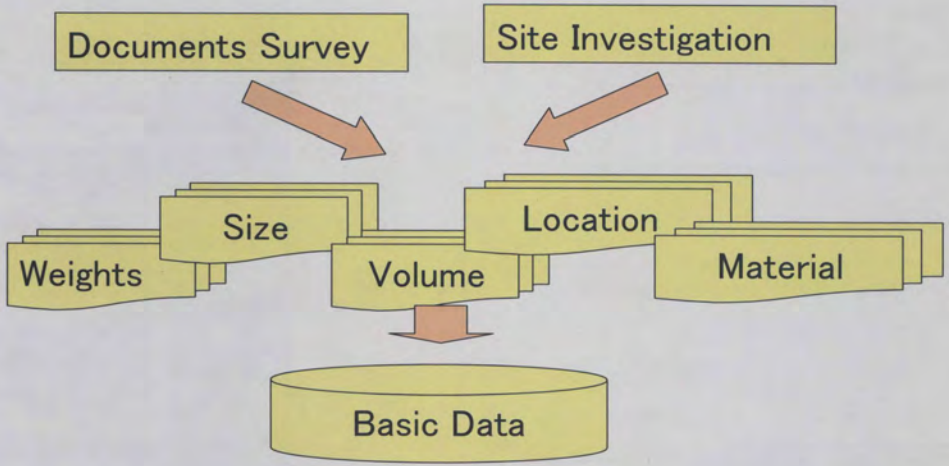


- Facility pollution distribution evaluation is necessary for the planning of the decommissioning plan.
- Quantitative evaluation and Radio-activation calculation and Pollution measurement are necessary for facility pollution distribution evaluation.

Configuration of radioactivity inventory evaluation



Amount Investigation of Waste Material



Investigation of volume & Result of evaluation

Investigation of metal volume

-Core internals

Calculation of the amount by drawing

-Piping, Equipment, Structures, etc.

Calculation of the amount by drawing

Field investigation

estimation from the 3D information

・Concrete (Building etc)

Calculation of the amount by drawing

・Associated waste

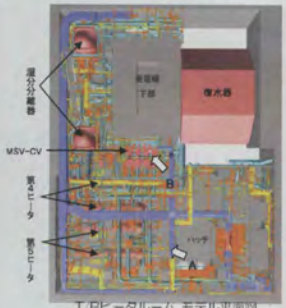
The amount of associated waste estimate from the Tokai power plant decommissioning and outage experience

・The equipment contraction by volume table

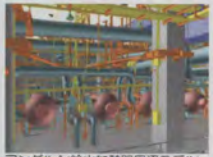
（運転停止６年後）

廃棄物分類	機 器 名 称	材 質	重 量 (kg)	放射能濃度 (Bq/t)	放射能レベル	処理区分	費用区分
RPVプラント廃（下部）	プラケット類（RPV12）	CS	273	3.19E+09	C3	L2	02
	CRD用ラノズル（B-9）（RPV10）	CS	130	6.19E+08	C2	L2	02
	CRノズルスタブ（RPV1）	CS	1,330	2.46E+08	E	L3	02
	炉心スプレイノズル（B-5）（RPV10）	CS	280	6.16E+08	C2	L2	02
	給圧計ノズル（B-11）（RPV1）	CS	25	3.41E+07	B	L2	02
	給水ノズル（B-4）（RPV10）	CS	1,490	3.57E+08	C2	L2	02
	ECノズル（B-5）（RPV12）	CS	670	1.63E+08	E	L3	02
	計装ノズル（B-11）（RPV9）	CS	170	8.19E+08	C2	L2	02
	計装ノズル（B-14）（RPV12）	CS	170	1.57E+08	E	L2	02
	計装サポートブラケット（RPV13）	CS	195	1.90E+07	B	L2	02
	計装サポートブラケット（RPV4）	CS	270	9.55E+09	C1	L2	02
	再循環入口ノズル（B-2）（RPV1）	CS	1,050	3.41E+07	B	L2	02
	再循環出口ノズル（B-1）（RPV2）	CS	9,680	6.64E+08	C2	L2	02
	シールスカート（RPV13）	CS	2,180	1.81E+08	E	L2	02
	支持スカート（RPV11）（保温材の外側）	CS	7,090	2.09E+07	B	L2	02
	（保温材の内側）			9.36E+08	B	L3	02
	スタビライザブラケット（RPV12）	CS	1,870	4.73E+07	C1	L3	01
	スタッドボルト（RPV13）	CS	1,130	5.95E+05	E	CL	02
	差圧出口ノズル（B-3）（RPV12）	CS	3,210	1.29E+08	E	L2	02
	RPV上蓋ベントノズル（B-6）（RPV13）	CS	90	2.90E+05	F	CL	02
	RPV上蓋ドライヤホールドダウンブラケット（RPV13）	CS	42	2.01E+04	F	CL	02
	RPV上蓋吊具（RPV13）	CS	160	6.66E+05	E	CL	02
	上蓋計装ノズル（B-7, B-10）（RPV13）	CS	420	1.28E+05	E	CL	02
	RPV上蓋ナット&ワッシャ（RPV13）	CS	1,220	7.90E+05	E	CL	02
	小 計		31,150				

Volume table



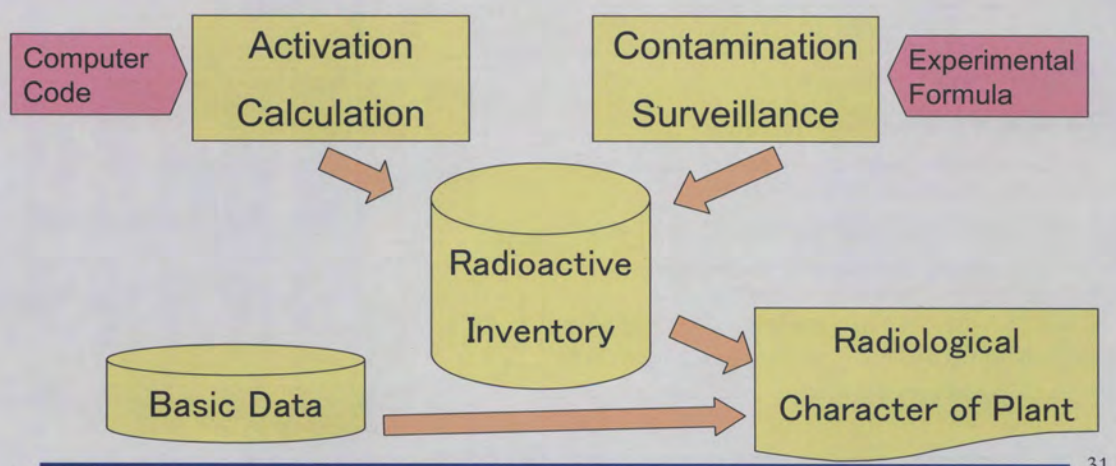
T.Bヒータルーム モデル平面図



アングルA(給水加熱器周辺モデル)

Estimation from the 3D information

Radiological Characterization of Plant



The results of radioactivation radioactive assessment

Valuation by actual measurement

- Neutron measurement by metal foil

  (Reactor around , Containment vessel penetration)

- Sample collection and measurement

  (Concrete core Bowling, Metal sampling)

- Building dose measurement, measurement of radioactivity density

Measurement of the neutron flux by the metal foil

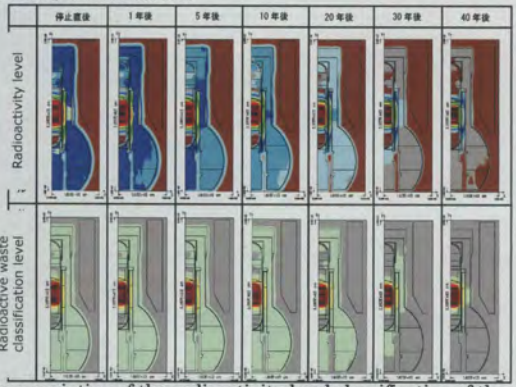
Concrete core Bowling of biological shield wall

Valuation by analysis

- Neutron flux distribution
- Radioactivity, radioactivity density distribution and classification level distribution

(two-dimensional, three-dimensional calculation)

- Radioactivity distribution, Radioactivity level classification distribution evaluation, Radioactivity concentration distribution evaluation
- Radioactivity density distribution of each structure and equipment

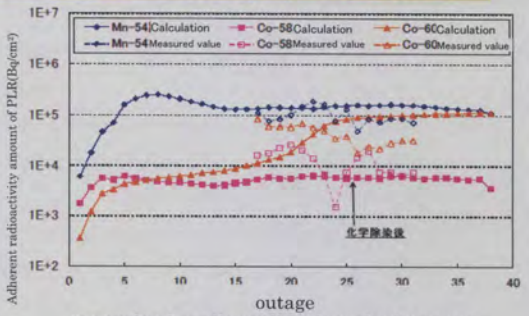


Time variation of the radioactivity level classification of the reactor around

The Results of evaluation of secondary pollution

Evaluation of direct secondary pollution

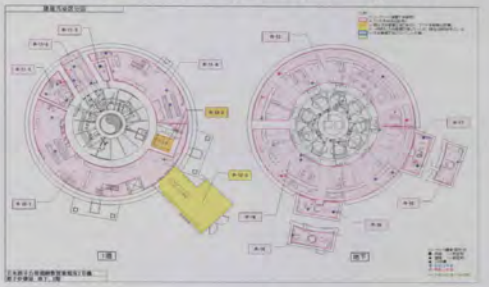
- Target : primary cooling water sys, main steam sys, feed water sys, cleanup sys, off-gas sys and RW sys
- The calculation by adhesion-desorption model of ions, clad and tritium and clad
- Evaluation of radioactivity concentration of reactor water, off-gas emissions evaluation and investigation of pipe radionuclide deposition amount



example of radionuclide deposited amount evaluation results of primary cooling water

Evaluation of indirect secondary pollution

- Investigation of surface contamination of building, equipment, piping and structure
- Drawing up the pollution map of the building
- Associate waste estimation
- Decontamination information



Example of contamination map

Radioactivity-volume database

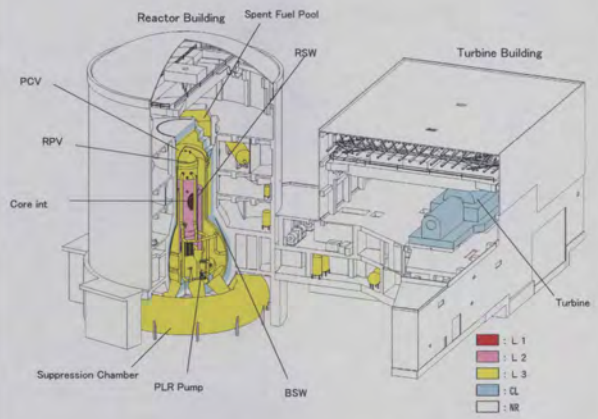
Main function

- ID management of equipment and structures
  (All decommissioning facilities subject)
- Details of the ID registration
  Radioactivity level ,Waste classification level ,Total radioactivity concentration
  Radioactivity concentration of each nuclide (Mean, median, minimum and maximum value)
- Registration item
  Equipment, location of structures, structural materials, dimensions, weight, Evidence of the calculation etc
- Search function of registration for each item, editing function
- The registration data of time-dependent concentration of radioactivity and radioactivity level classification (Immediately after the stop, one year for each of the 1-40 year ,50,100 years, 1000, 10,000 years, 100,000 years,one million years)
- Secondary pollution evaluation results and activation radioactivity evaluation resultscan be uptake into Excel file

The positioning of radioactivity inventory evaluation

Radioactivity inventory evaluation is an evaluation of the top of the decommissioning preparation work. It is utilized in various studies of decommissioning.

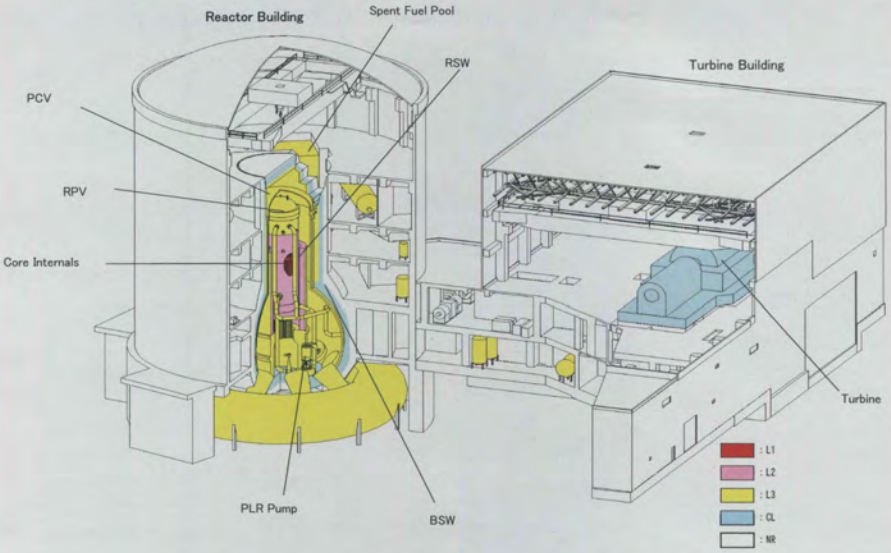
Radioactivity · volume evaluation



Classification of Radio-activity Level(Tsuruga1)

- Plan of dismantling method
- Waste treatment and disposal plan
- Clearance plan
- Safety assessment
- Decommissioning cost
- Legal procedures paperwork

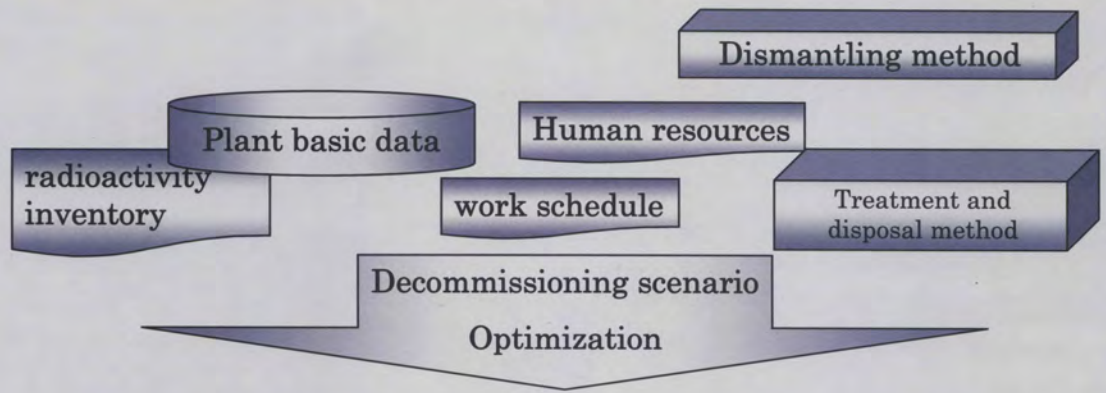
Radiological Characterization of Tsuruga-1



Classification of Radio-activity Level

May contain JAPC's proprietary information. Subject to JAPC's prior written consent before using for other purposes than originally intended or disclosing to any third party.

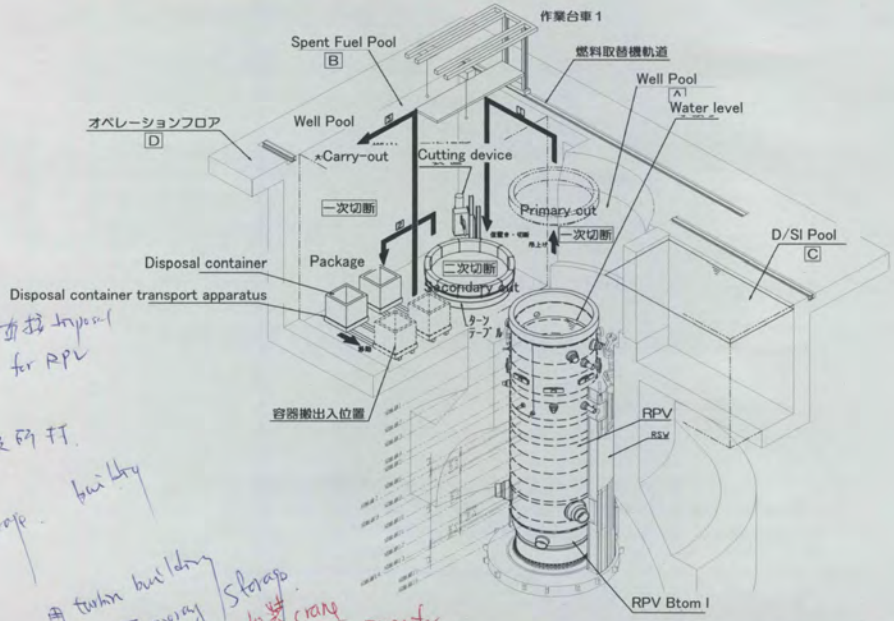
Study of decommissioning scenario



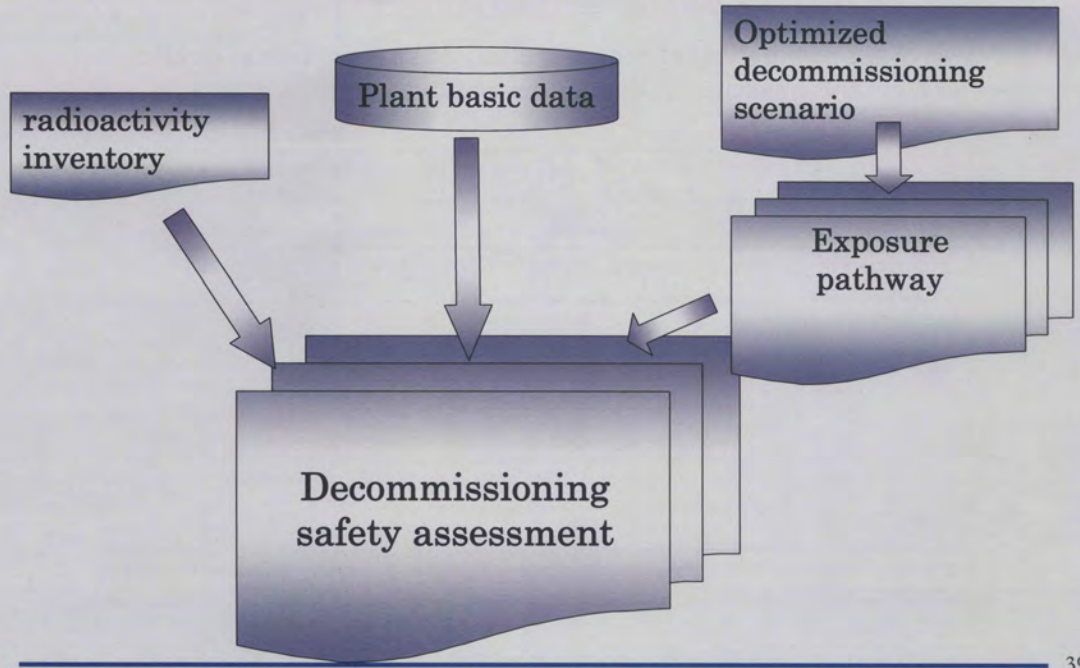
Optimized decommissioning scenario

Optimization of decommissioning costs

Example of dismantling method (reactor area dismantling Review)



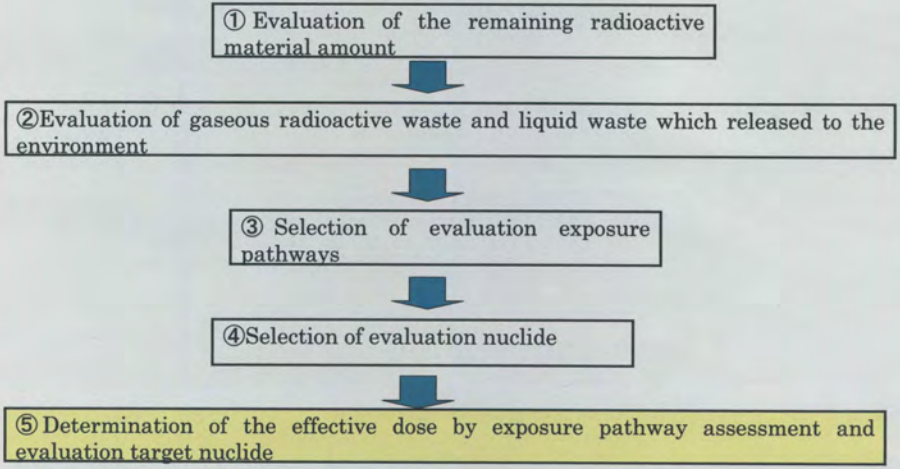
Decommissioning safety assessment



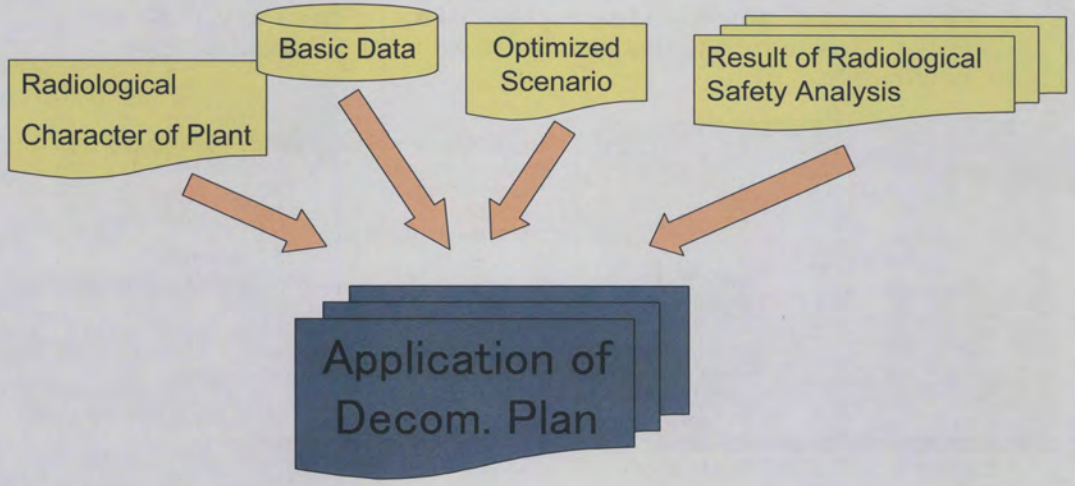
Decommissioning safety assessment flow

＜Tokai-1：Example of Safety assessment ＞

The flow of the evaluation of the execution dose the general public receives from the gaseous radioactive waste and liquid waste



Application of Decommissioning Plan



Education & Training

Education and training for technicians involved in the decommissioning

- Decommissioning Education Seminar
- Course attendance record

Technician of power company,JAPC&Family company,JAEA etc
Future, Nuclear industry company, General Contractors can participate

Lecture at Tokai Training Center

Course attendance record(2011 year-end)

- Nuclear reactor facility decommissioning course
  - Power company 30
  - JAEA etc 64
  - JAPC & Family company 73
  - total 167 peoples
- Clearance measurement judgment training course
  - Power company 22
  - JAEA etc 31
  - JAPC & Family company 96
  - total 149 peoples

Use of Information Technology in decommissioning

We have developed a variety of systems for the purpose of efficient decommissioning preparation work

"Decommissioning support system "

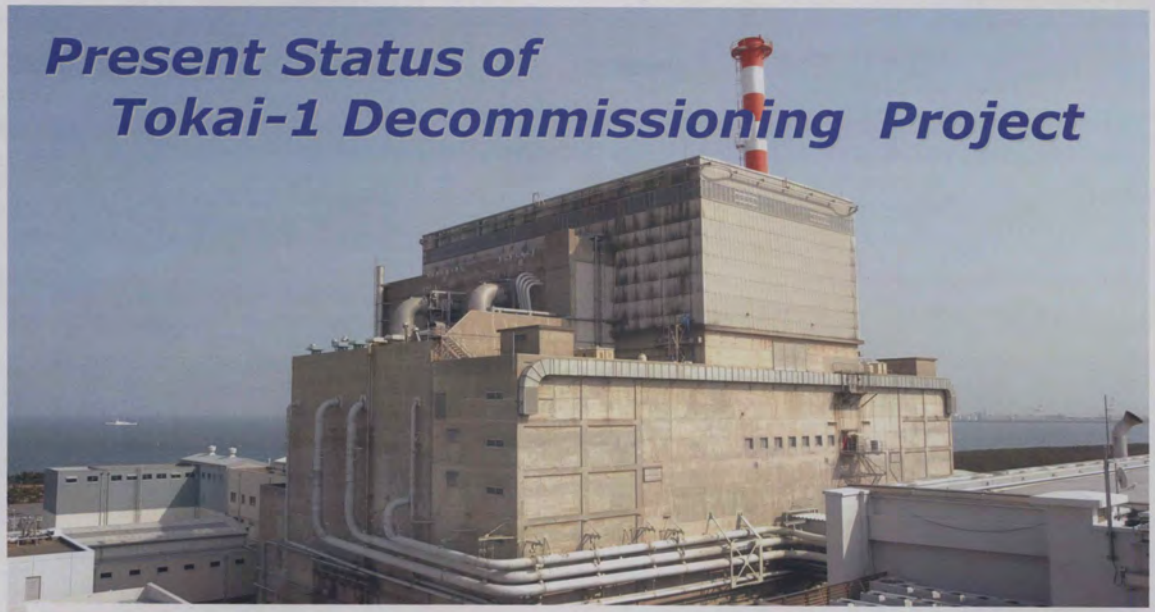
- ✓ **Decommissioning database**
- ✓ **Radioactivity inventory computing system**
- ✓ **Multi-function 3D CAD**
- ✓ **Cost optimization Consideration evaluation system**
- ✓ **Scenario optimization support system**
- ✓ **Safety evaluation system**
- ✓ **Waste management system**
- ✓ **Process control system**

END

Thank you for your attention

附件七：**Present Status of Tokai-1 Decommissioning Project**

Present Status of Tokai-1 Decommissioning Project



Shooting date: Dec. 2001(before removal of outdoor piping)

at Tokai Japan
14 Nov. 2013

The Japan Atomic Power Company

Tokai-1 Power station profile

Capacity: 166 MWe

Reactor Type: Gas Cooled Reactor

Fuel: Metal Natural Uranium with Magnox Cladding

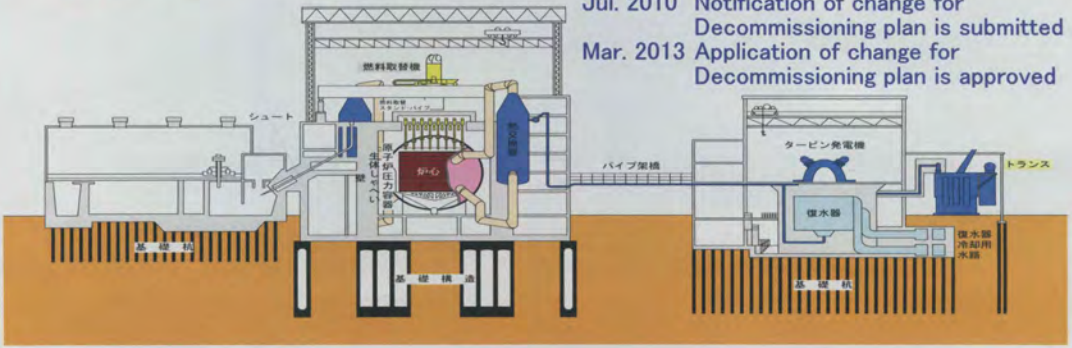
Moderator : Graphite

Coolant : Carbon dioxide Gas

《Actual result》

Cumulative outputs:	29 tera-Wh
Average availability factor:	77.5%
Average capacity factor:	62.9%

Jul.1966	Commercial operation starts
Mar.1998	Permanent Shutdown(32 years operation)
May 1998–Mar.2001	Defueling
Jun..2001	The last shipment of Spent Fuel
Oct. 2001	Submitted the notification of decommissioning plan
Dec..2001	Started Decommissioning work
Mar. 2006	Preparatory work completed
Jun. 2006	Decommissioning plan approved
Sep. 2006	Clearance (CL) measuring and judgment method approved
Jun. 2007	CL material first shipment
Sep. 2008	Non Radioactive material first shipment
Jul. 2010	Notification of change for Decommissioning plan is submitted
Mar. 2013	Application of change for Decommissioning plan is approved

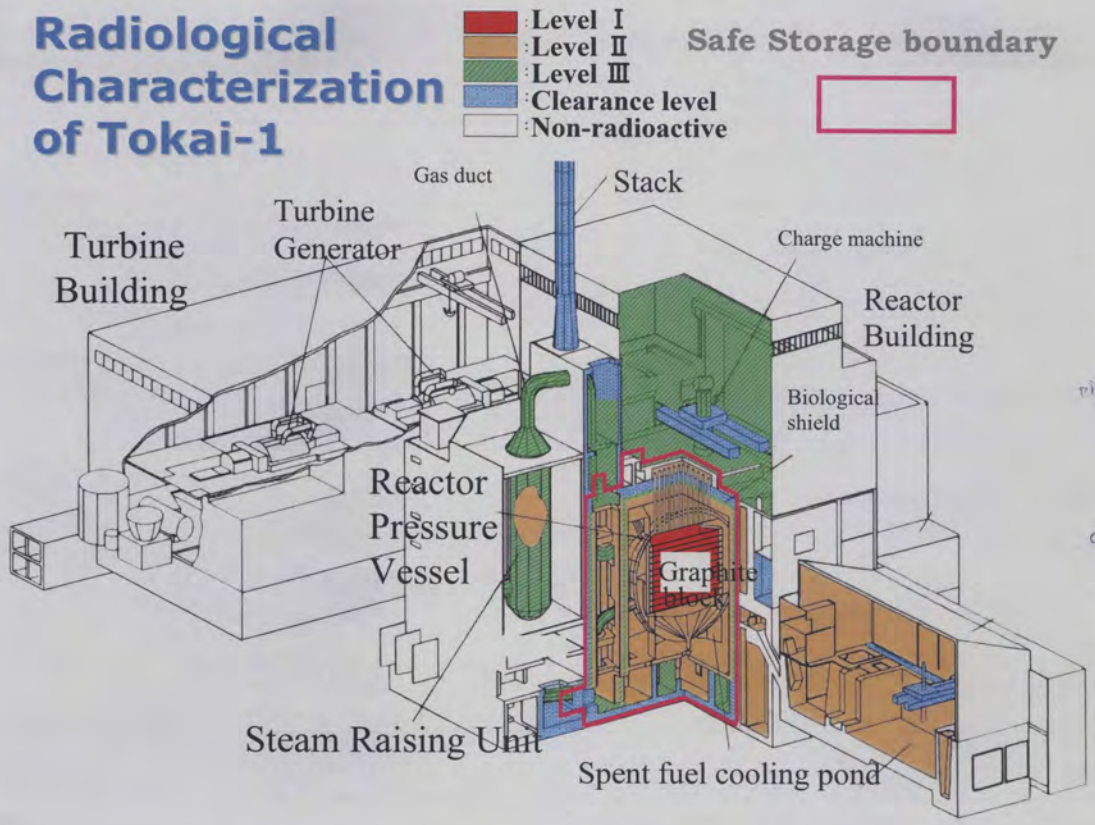


1. Tokai-1 decommissioning project

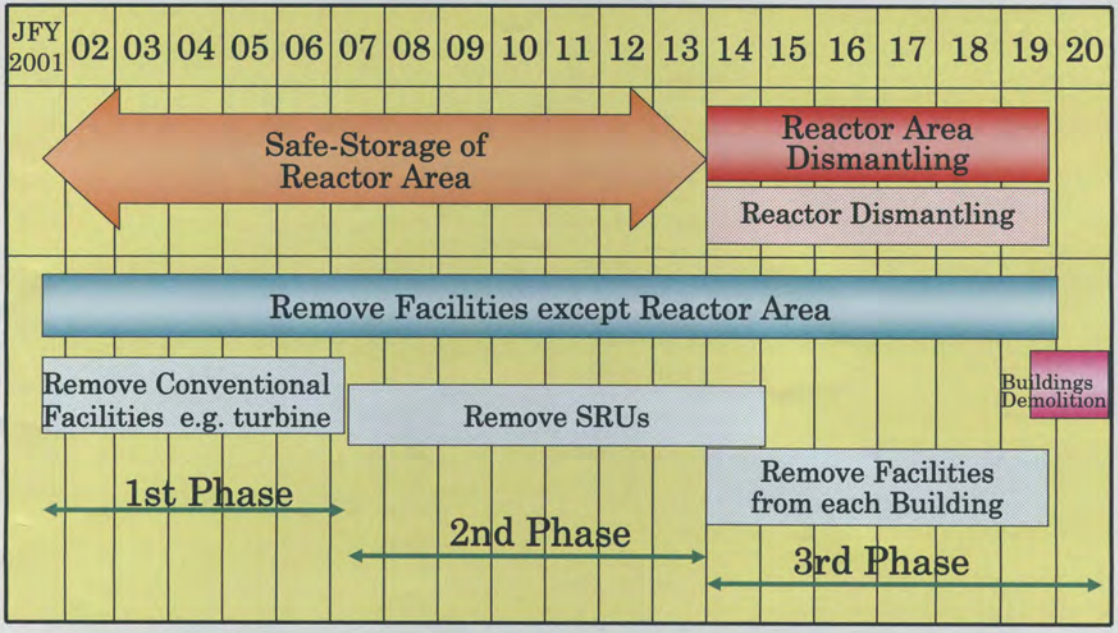
Decommissioning Strategy for Tokai-1

- **Reactor structure will be dismantled after safe-store**
- **Conventional components will be removed during reactor safe-store**
- **After decontamination, facilities will be released from control area and removed.**
- **The land is to be reused for future nuclear power operation**

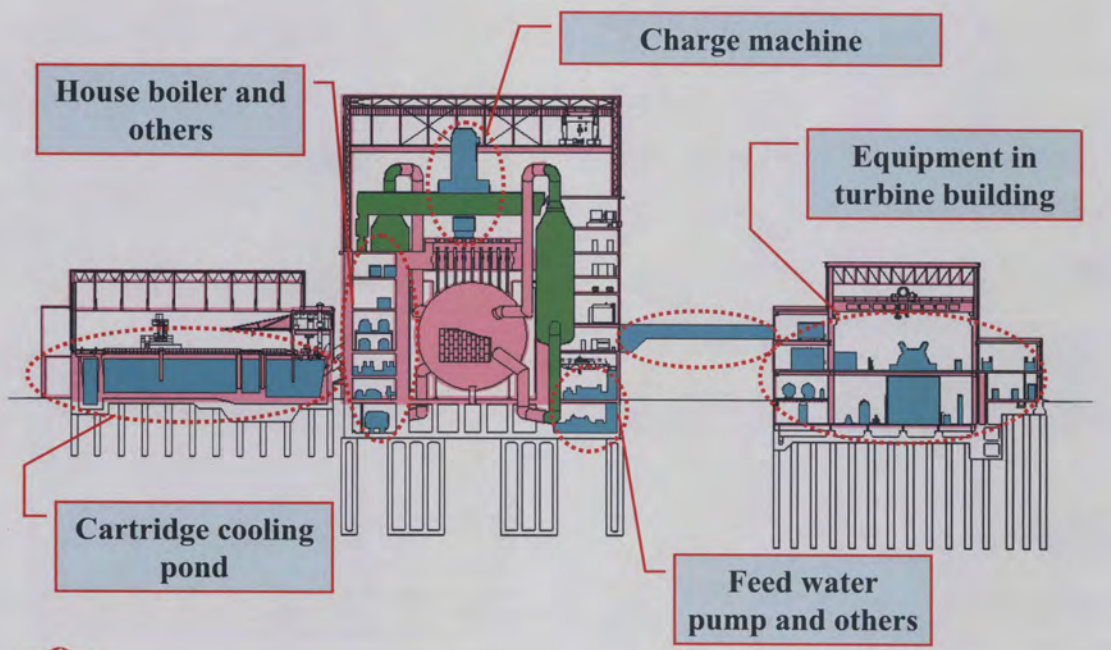
Radiological Characterization of Tokai-1



Tokai-1 Project Schedule

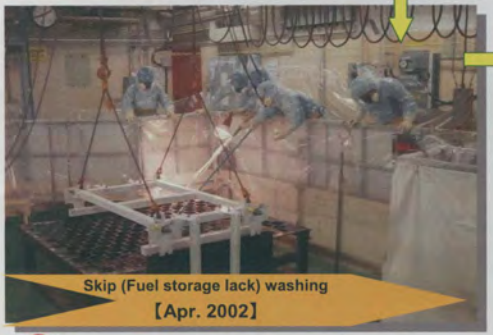


First Phase (2001-2005)



Preparatory work & peripheral equipment removal

CCP Cartridge cooling Pond Draining & Cleaning



Preparatory work & peripheral equipment removal

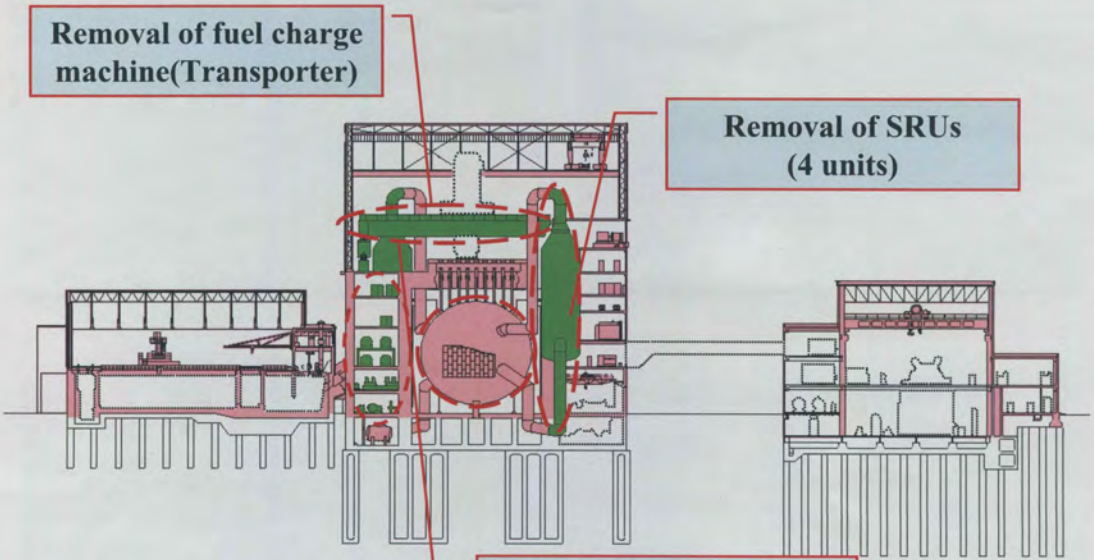
Removal of turbine Building Equipment

Removal of turbine generator【May 2003】

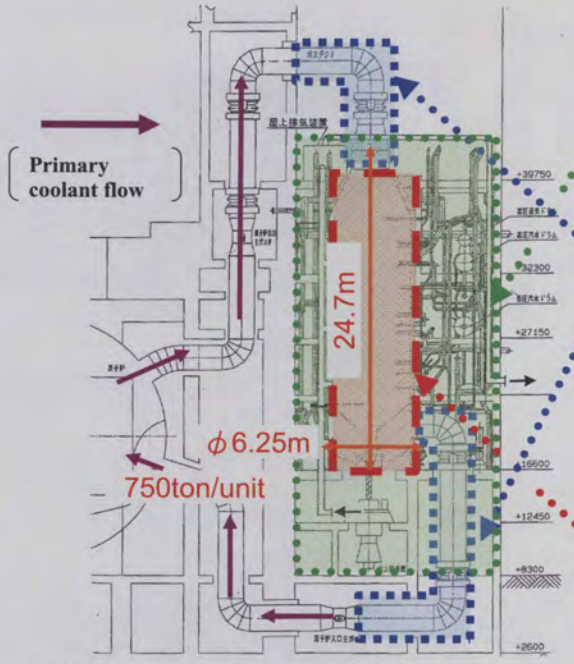
Removal of turbine【Jun. 2003】

Removal of concrete pedestal【Jan. 2004】

Second Phase (2006-)



SRU Dismantling Concept(No.1, 2)



Sequence

Remove peripheral equipment

(2006～2008)

Remove gas duct

(2007～2008)

Preparatory work
(Jack system & Remote dismantling system installation)

(2009)

Remove SRU

(2010～)

SRU peripheral equipment removal

No.1,2 Hot gas duct removal

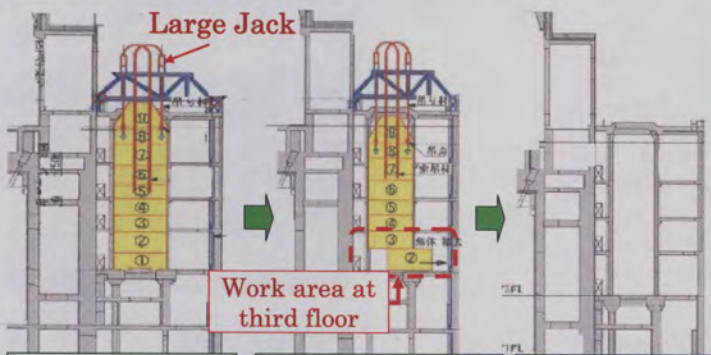
【Before removal】

【After removal】
Oct.2008

【Temporary building installation】
May 2008

【Gas duct removal】
May 2008

SRU Dismantling Method

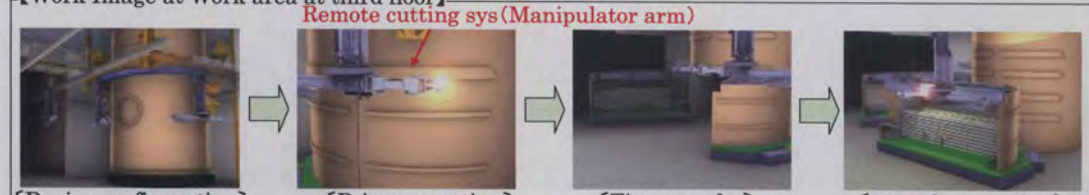


Preparation
- Large jack installation
- Remote cutting sys installation

Cutting & removal
- Primary cutting (Divide tiers)
- Secondary cutting (Cutting into pieces)

Storage

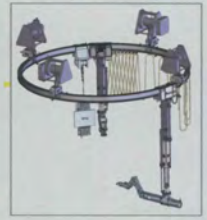
【Work Image at Work area at third floor】



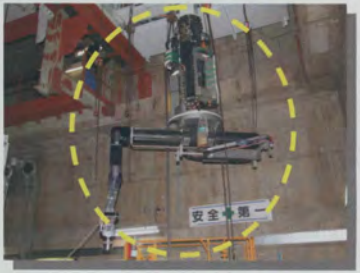
Remote Cutting System

Primary Cutting Device

Manipulator arm



Secondary Cutting Device



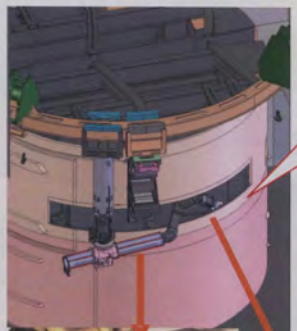
Extractor

Gripper

Air Caster

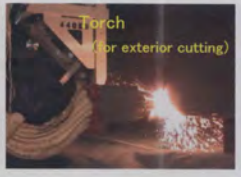
No.2 SRU removal

【SRU body segmentation with remote dismantling system】

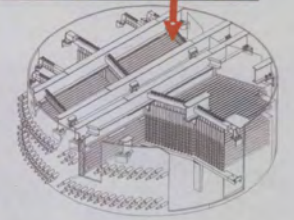


Open 12 windows on SUR body.
Insert arm of remote dismantling machine and cut internal structure (joint part)

Remote control room



Arm and fore end of remote dismantling device



Complicated internal structure
(Hear exchanger tube, Baffle plate, Beam)

Result of Internal removal
(Baffle plate at the center of SRU)

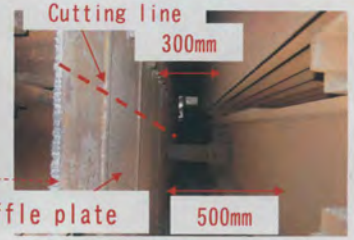
Internal structure: Separate baffle plate by electrical disk cutting

〔Restriction〕

・Narrow insertion pathway (300mm) for cutting arm (arm width 250mm)

Opening at SRU body①

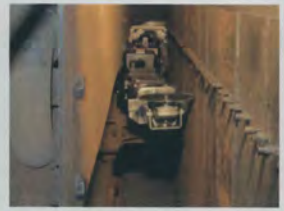
Opening at SRU body②



Cutting line inside the opening

Cutting arm Insertion ①

Cutting arm insertion②



Cutting arm insertion③

Cut baffle plate

Separation of Tier-7 and Top Head

Cutting line

Tier-7 before 2nd cutting

Top head

No.2 SRU removal was complicated on Aug.2013

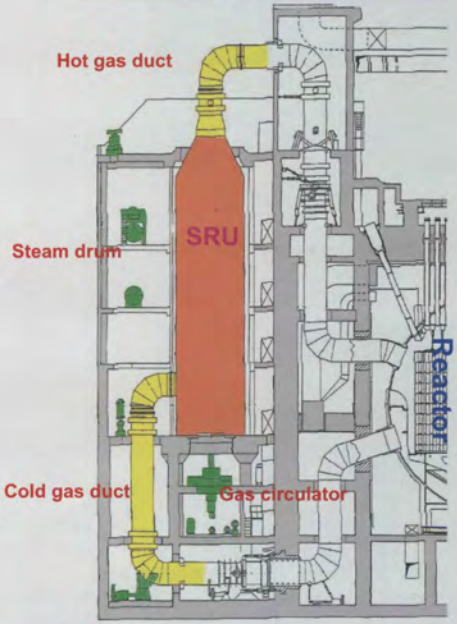
No.2 SRU removal is completed

Whole No.2 SRU is removed

Remained remote cutting device

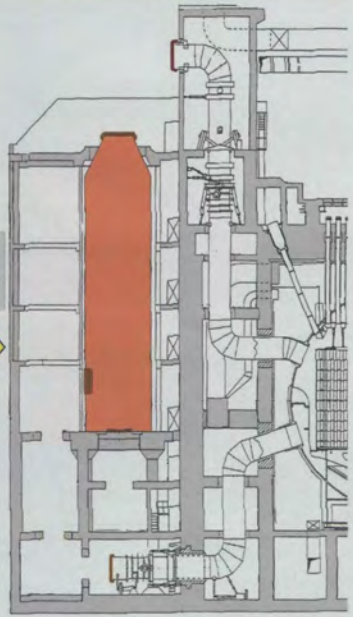
No.3,4 SRU peripheral equipment removal

Before removal（Started Jan. 2013）



Insulation and it's cover are removed now

After removal

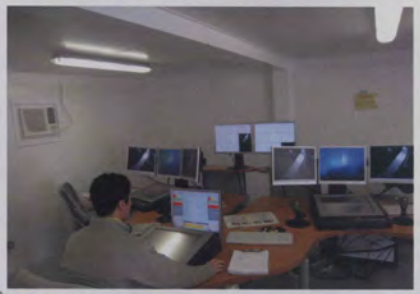


2.Outline of

Tokai-1 Site tour

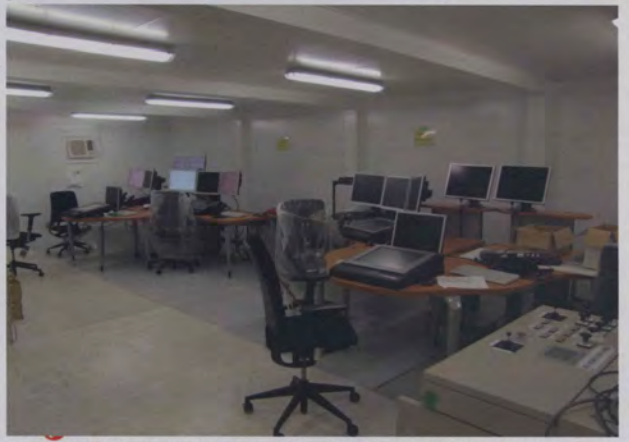
Main Control room

Control Room of Remote Dismantling System



Temporary house

Outside of SRU build



(1)For operator
- Control board (remote cutting sys monitor, position data monitor)
- Video monitor: 2
- 3D monitor: 1
- Joystick: 3
- Emergency stop button: 1

(2)For supervisor
- Control board (position data monitor)

Flow for clearance

M&J method Approval by NSR

↓

Object selection

↓

Sorting, segregation

↓

M&J below clearance

↓

Measurement by clearance measurement equipment

↓

Storage at storage area(Ⅰ)

↓

Inspection of M&J result of NSR

↓

Storage at storage area (Ⅱ)

↓

Gate monitor／release(recycle)

Clearance measurement equipment

Specification

measurement	Measure 6 sides of steel box
container size maximum volume maximum weight	1350W × 1350L × 1065H 1.5m^3 1.5ton
measurement time	12min/box (Net measurement time: 240sec)

《 Storage area(Ⅰ)》
Storage until inspection by NSR

《Storage area(Ⅱ)》
Storage until release to manufacture

Clearance Material Recycle

Biological shielding iron block
(for J-PARC)

100×50×20cm
700kg

Benches

40~50kg

Foundation for pipes

Interlocking paver blocks

weight: 10kg/1 block

Defense block for PP

weight: 1. 6ton

weight: 200Kg