To Achieve Long-term Operation In TEPCO

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Tokyo Electric Power Company Holdings, Inc.
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About me Self introduction

＜Background＞

✓Joined TEPCO (Kashiwazaki Kariwa Construction Office)

✓Nuclear Asset Management Department within the head office.

- Managed the design for electrical equipment and I&C equipment, including aging management.

✓ Deputy Manager, Fukushima Daiichi NPS (1F NPS)

- Managed maintenance and replacement for I&C equipment in Unit 5/6.
- Worked on Fukushima Daiichi Nuclear Accident response following the Great East Japan Earthquake.

✓Current role (Head Office, Asset Engineering Group Manager)

- Managed the design for machine, electrical and I&C equipment in preparation for restart.

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On the shutdown periods of BWRs in Japan

- Since the Fukushima Daiichi Accident (2011) triggered by the Great East Japan Earthquake, the government has tightened regulations on NPPs. Plants can only be restarted once they have met new regulatory requirements (i.e., safety measures are added).
- Since 2011, Japanese BWR plants have been shut down for approximately 12 years. It is spreading.

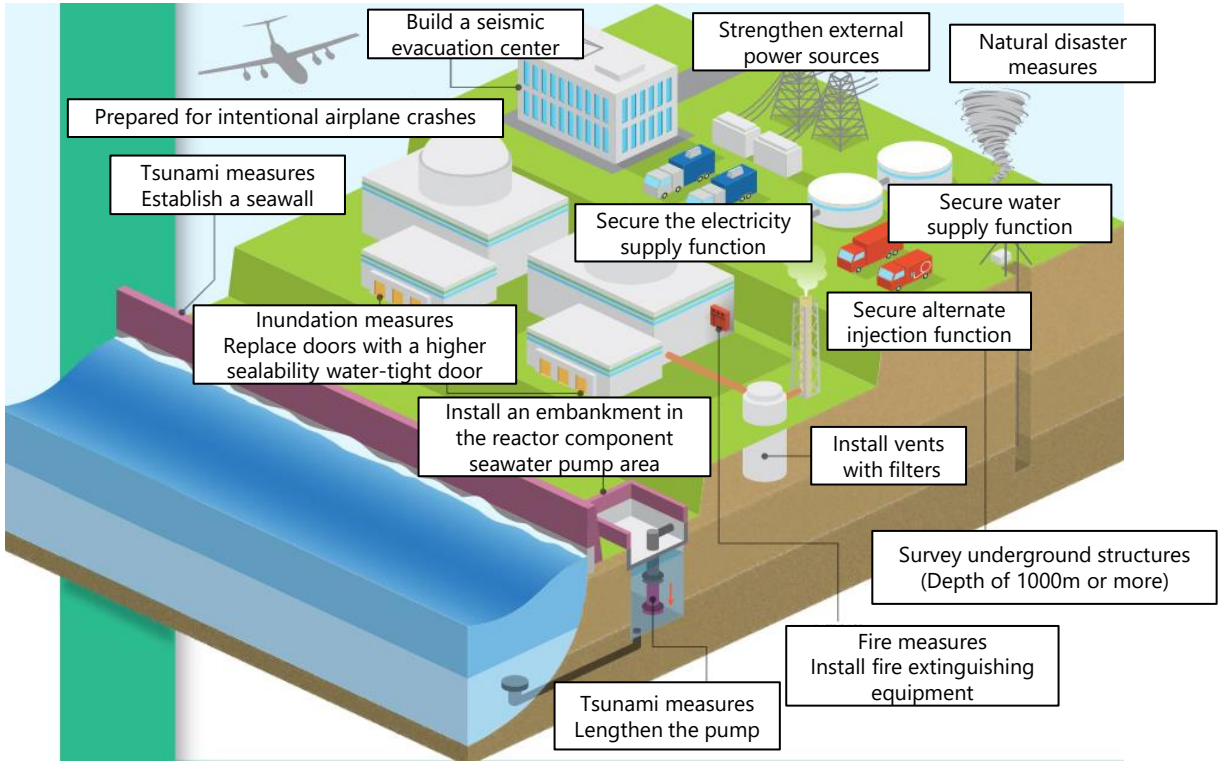

Fig.1 Example of additional safety measures in Japan※

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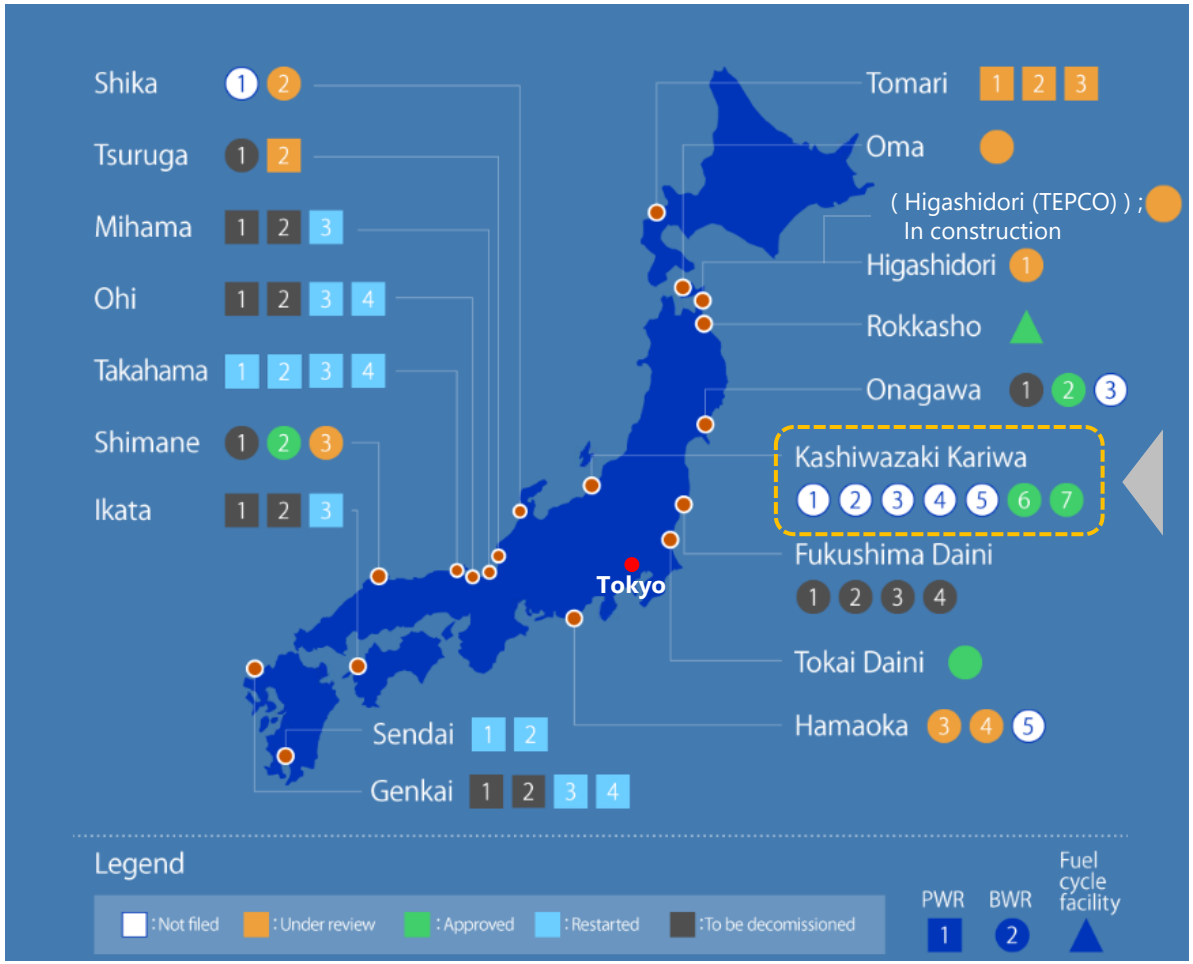
※ https://www.fepc.or.jp/enelog/archive/common/pdf/sp2015_vol4.pdf

Status of NPPs in Japan

- The number of NPPs in Japan has decreased from 54 units to 36 units. (16 PWRs, 20 BWRs)



TEPCO's plants that are being restarted

Fig.2 The state of NPPs in Japan※

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※ https://www.fepc.or.jp/english/nuclear/power_generation/plants/

Toward the stable supply of electricity

- Changes in the international situation, such as the coronavirus pandemic, conflicts over territory, etc., have pushed up the price of energy resources, and the importance of securing a stable supply of electricity is being felt more than ever.
- In addition, to achieve carbon neutrality in 2050, existing nuclear power plants must be maximally utilized.

- Discussions are being had on the operational period of NPPs.

<u>Operational period under the current system</u>

- 40 years in principle
- One time extension of up to 20 years is permitted

Fig.3 Toward achieving carbon neutrality by 2050※

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※ https://www.fepc.or.jp/sp/carbon-neutral/

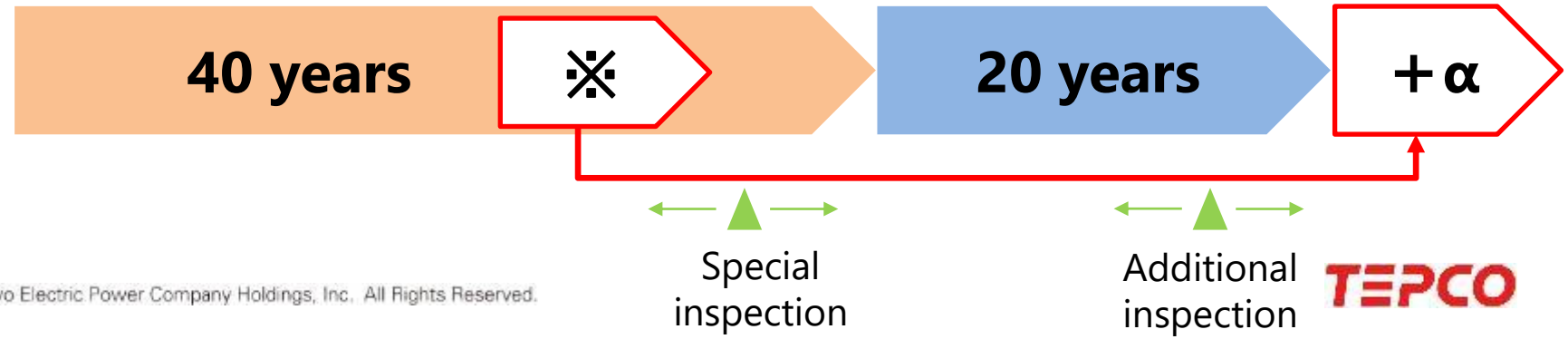
How will the operational period for NPPs in Japan change?

- The operational period is slated to change as follows.
  - ✓ The basic approach of 40 years + 20 years remains unchanged.
  - ✓ However, the operating period could be extended for the length of the time that the plant had to be shut down※ (+ α) to make changes for new regulations.

(Extension is conditional upon the plant receiving NRA approval based on the aging degradation assessment performed every 10 years after the first 30 years of operation.)

【Current system】 Maximum of 60 years

【After the revision of the law】Maximum of 60 years＋α



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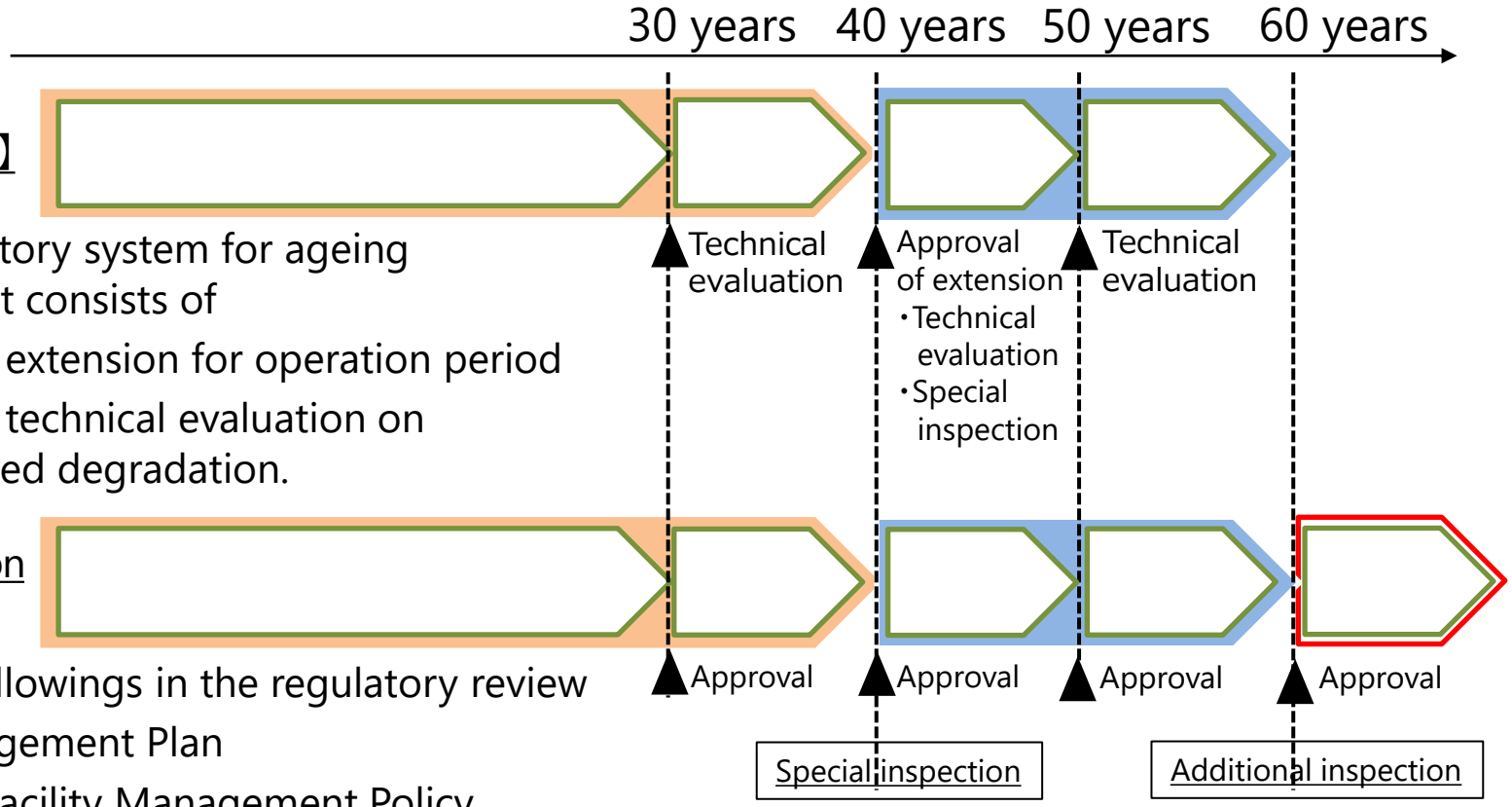
What is Japan's system for assessing aging degradation like?

・The assessment for aging degradation is going to be changed as follows.



Current regulatory system for ageing management consists of

1) Approval of extension for operation period
2) Approval of technical evaluation on ageing related degradation.

Confirm the followings in the regulatory review

・Ageing Management Plan

1) Long-term Facility Management Policy
2) Degradation Check Method and its Results
   (Special Inspection is carried out after 40 years of operation)
3) Technical Evaluation Method for Ageing related Degradation and the Conformity to the Technical Standards. etc…

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Ideal state

・To maintain a stable supply of electricity and achieve carbon neutrality, Japan will also need to restart its NPPs and operate them over the long term. With that in mind, going forward, we will aim to further extend the operational period.

＜Goals to achieve＞

✓ Long-term operation (80 years)

2022～	2023～	2024～	2030～	2035～
Exclude the long shut-down period from the operational period	To study international efforts for LTO	Restart KK7…	Extension of operating period	LTO (80 years) at KK7…

Goal !!

- **Stable supply**
- **Carbon neutrality**

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Towards achievement of long-term operation(LTO)…

<Japan's efforts to Ageing Management>

- Evaluate plants for ageing degradation by using the Code.
- Continuously feeding back the revisions of IGALL (AMR, AMP, TLAA of SRS82) to the Code for ageing management in Japan.
- Reflect International knowledge domestically and conduct necessary research and development as appropriate.
  - ✓ Based on IGALL (TLAA 122), thermal aging of martensitic stainless steels was added to the list of possible degradation phenomena, and related researches were carried out.

Code on Implementation and Review of Nuclear Power Plant Ageing Management Programmes 2021（AESJ-SC-P005E2021）

<Important perspective in Japan>

- To achieve long-term operation in Japan, we need to ensure accountability and foster the public's understanding of the safety of NPPs and aging degradation. (in particular, irradiation embrittlement)

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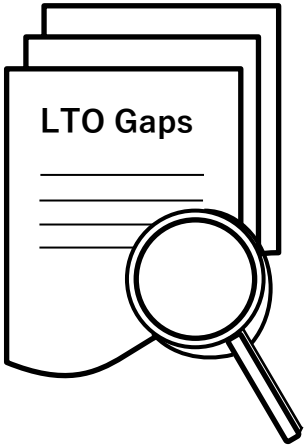
Actions underway to achieve LTO

(1) Participated in the OECD/NEA international project (SMILE Project) and collected knowledge on ageing degradation.
(SMILE ; Studsvik Material Integrity Life Extension)

(2) On benchmarking initiatives from the perspective of LTO (80 years)
It was started in FY2022, and gaps were extracted.

- Examples of Gaps on LTO ;
  - ✓ RPV embrittlement
  - ✓ Concrete
  - ✓ Cables
  - ✓ IASCC of reactor internals
  - ✓ SCC management of reactor internals, etc...



- Since FY2023, a project to conduct more detailed surveys and assessments has been planned.

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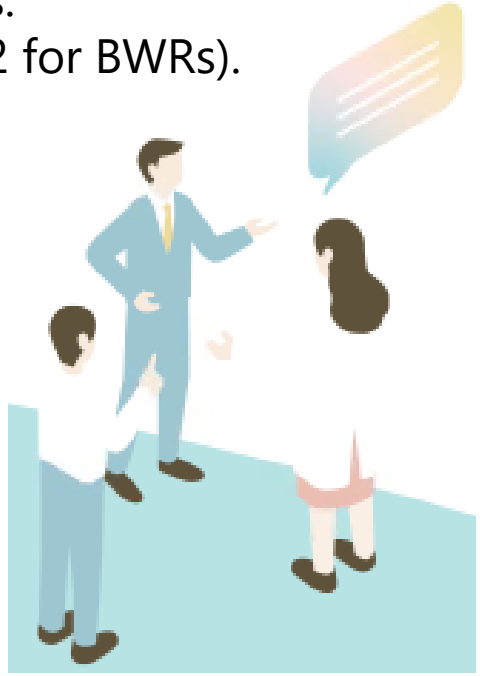
Lastly…

＜Going forward＞

- Due to the decrease in Japan's NPPs, data and knowledge obtained domestically are declining.
- We hope that we will be able to achieve long-term operation and increase the availability of NPPs by learning from leading operators in the world and widely deploying the learnings in Japan.
  - ✓ Knowledge about the aging degradation, operating experience, and inspection, evaluation and repair of reactor internals.
  - ✓ R&D regarding the application of new material (Alloy 52 for BWRs).

- We will share any insights gained from Japan's LTO initiatives or from R&Ds.
  - ✓ Assessment of the resistance of electrical instruments against severe accidents taking into account aging degradation.
  - ✓ Expansion of data on aging degradation of materials (e.g. SUS316L) using decommissioning plants in Japan, etc.



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Oze National Park（https://www.tepco.co.jp/toudenhou/hd/1468819_9039.html）

Backup slide

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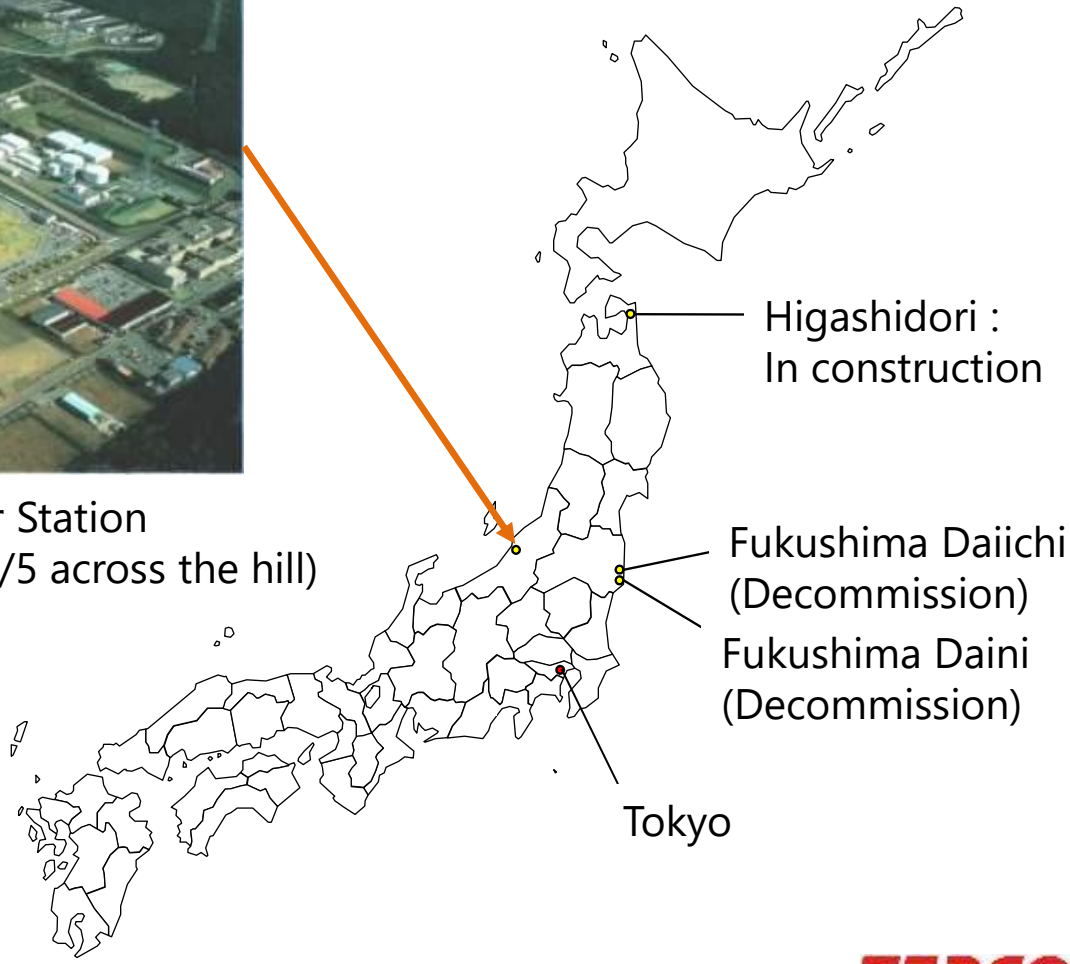
Overview of the Kashiwazaki Kariwa NPS

Kashiwazaki-Kariwa (KK) Nuclear Power Station
(Units 1/2/3/4 from the front, Units 7/6/5 across the hill)

- 7 units, 8,212 MWe
- Reactor type
  Units 1-5 : BWR5 (1,100MWe)
  Units 6,7 : ABWR (1,356MWe)



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What is the 40th-year special inspection?

<Special inspection※>

・A special inspection is an inspection performed at the 40th year of the plant operating, of all items not covered in normal maintenance. The plant is checked again for abnormalities now that a certain number of years has passed.

・It is performed 35 to 40 years from the start of operation. The table below is an overview of the special inspection items.

Table.1 Special inspection for BWR

Equipment	Part	Inspection method/inspection items
Reactor vessel	・Base material and welds (core area , all testable areas that can be reached)	・Check for defects using ultrasonic testing (UT)
	・Feedwater nozzle corner (part with the highest fatigue damage factor)	・Check for defects using surface testing or eddy current testing
	・Control rod driving mechanism (CRD) stub tube, in-core instruments (ICM) housing (all)	・Check for weld defects from the inside of the reactor using visual inspections (MVT-1) or for defects on the surface of the inner part of the housing using surface testing or eddy current testing
	・Foundation bolts (all)	・Check for defects inside of the bolt using ultrasonic testing (UT)
Reactor containment vessel	・Reactor containment vessel steel sheets (all testable areas that can be reached) ・Steel concrete reactor containment vessel	・Check the state of the coating in a visual inspection ・Check the strength, shielding capacity, neutron irradiation and alkali-aggregate reaction via core sampling
Concrete components	・Concrete components that perform a function in securing the safety of reactor facilities (reactor pressure vessel pedestal or similar parts)	・Check the strength, shielding capacity, neutron irradiation, chloride penetration, and alkali-aggregate reaction via core sampling

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※ https://www.nra.go.jp/data/000422893.pdf

What are the additional inspections required after 60 years?

＜Additional inspection※＞

- Every time the long-term facility management plan is put up for approval after the 60 year mark, an additional inspection is required.
- The first additional inspection is performed 55 to 60 years after the start of operation. Subsequent additional inspections are performed every 10 years afterward.
- The policy for performing additional inspections is as follows.

①The same items as in the special inspection are to be performed. However, the operator may employ different methods than that for the special inspection if they can provide the technical basis to show that they would be able to directly or indirectly produce results that would have the same level of reliability as that of the special inspection, based on the results of the special inspection.

②In addition to the above, the operator will be required to perform inspections deemed necessary according to the plant's characteristics based on its operating history and the latest findings from across the world.

Proactive action against NRA is needed!

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※ https://www.nra.go.jp/data/000428258.pdf

Special inspection ≒ Additional inspection ?

Special inspection	Item	Additional inspection
To confirm the scope not confirmed in normal maintenance	**Objective**	See left (Same as for the special inspection)
See Table.1	**Items**	See left (Same as for the special inspection)
Only once	**Frequency**	To be performed every 10 years after the first one
35 to 40 years after the start of operation	**Timing**	55 to 60 years after the start of operation
No	**Pre-inspection confirmation system**	Yes

The timing of the inspections and whether the operator can suggest the timing and methods used in the inspection (pre-inspection confirmation) differ.

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