

Safety Regulations for Aged Reactors

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Overview

- Background
- Physical ageing
- Obsolescence
- Conclusion

Background (1/2)



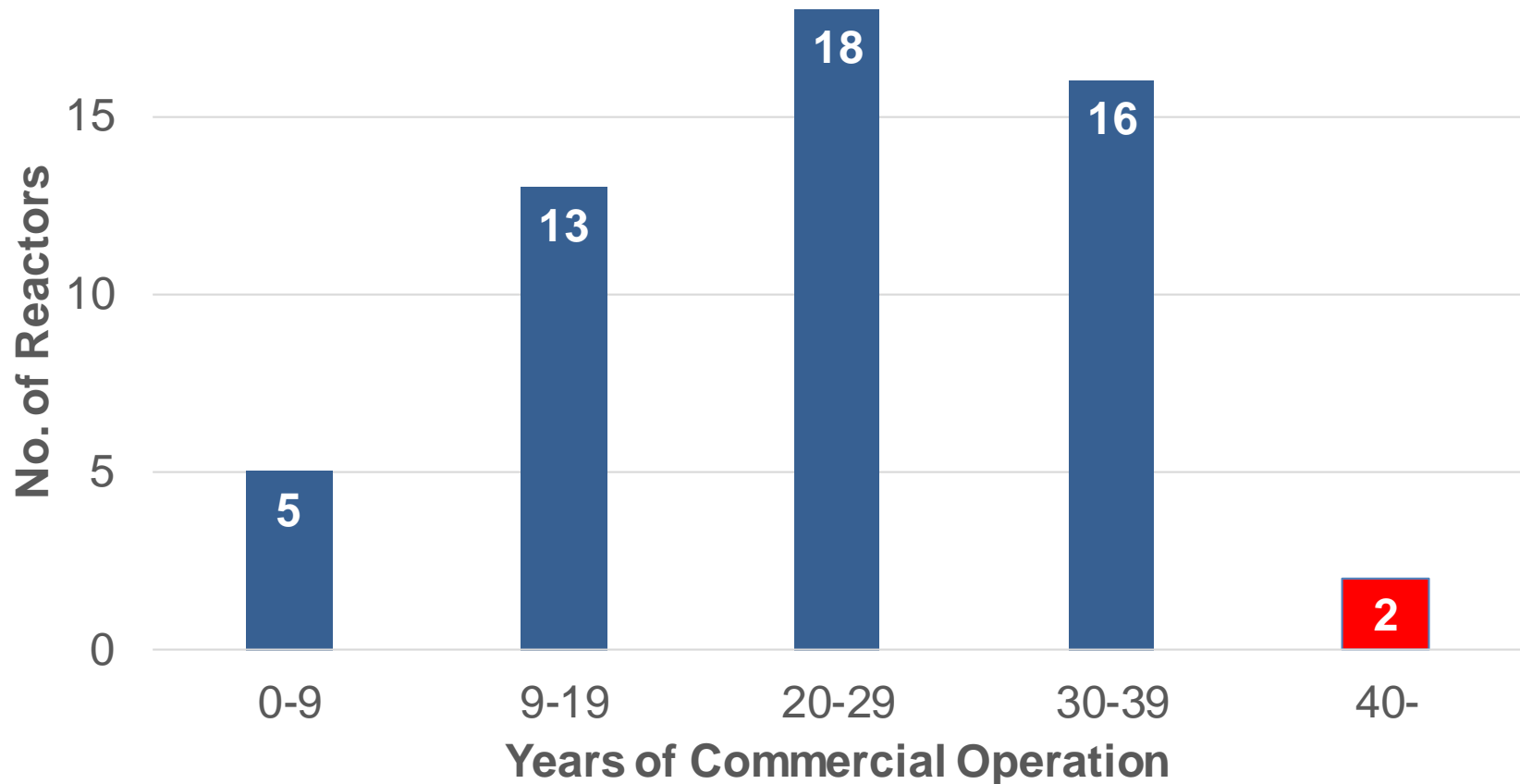
- ✓ The amended Reactor Regulation Act in 2012 limits NPPs' operational period to **40 years in principle** from the day of pre-service inspection after construction
- ✓ One-time extension **up to 20 years** is allowed upon the NRA's approval

“Extension of operational period”

Background (2/2)



Age of fleet in Japan as of March 2011 (Total: 54)

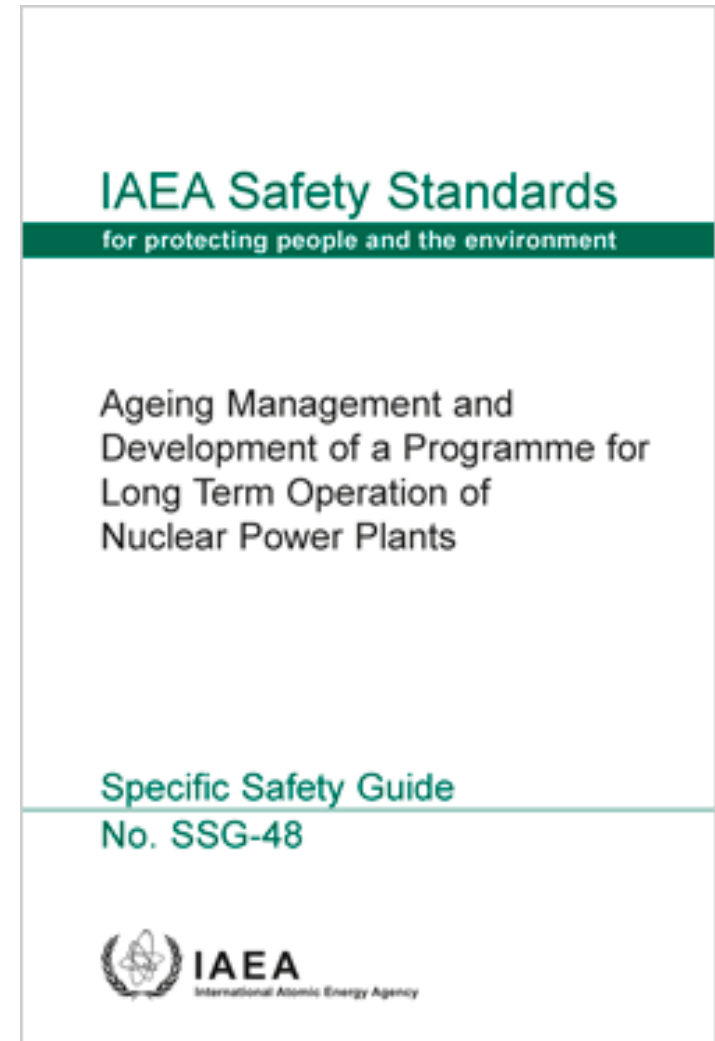


* Excluding reactors which are under decommissioning

Two aspects of “Ageing”

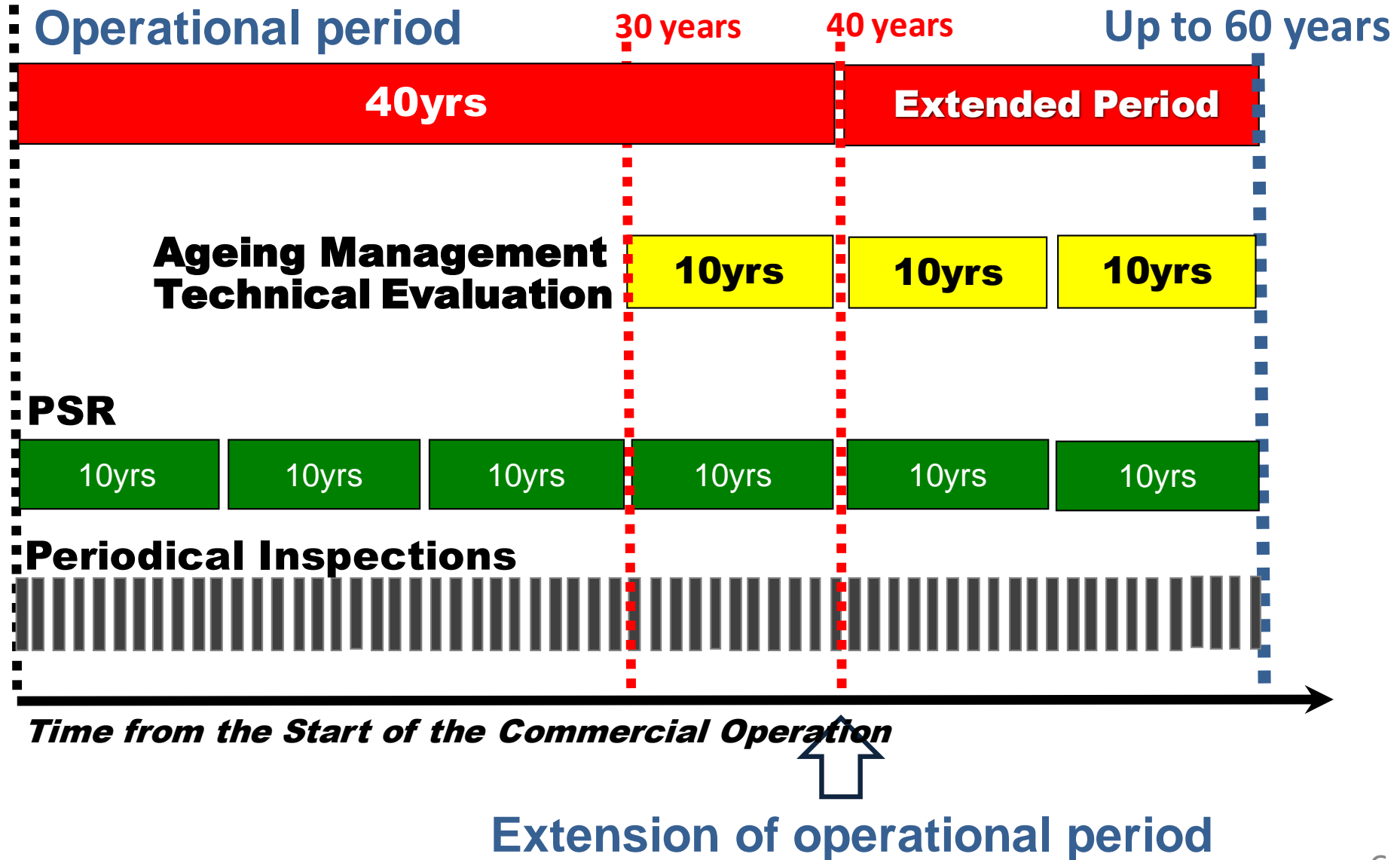


- **Physical ageing**
- **Obsolescence**
(Non-physical ageing)



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Regulations against physical ageing

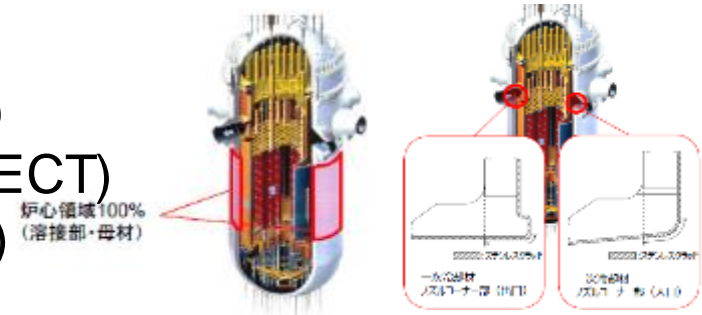


Special inspection for extension



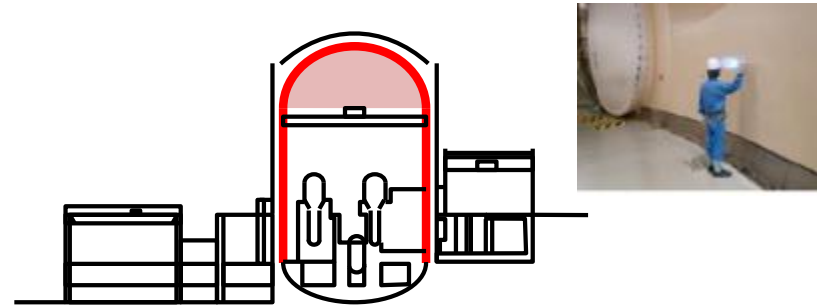
<Reactor Vessel>

Base material and weld (100% core zone) (UT)
Corner parts of primary coolant nozzle (PT or ECT)
Bottom Mounted Instrumentation (VT and ECT)



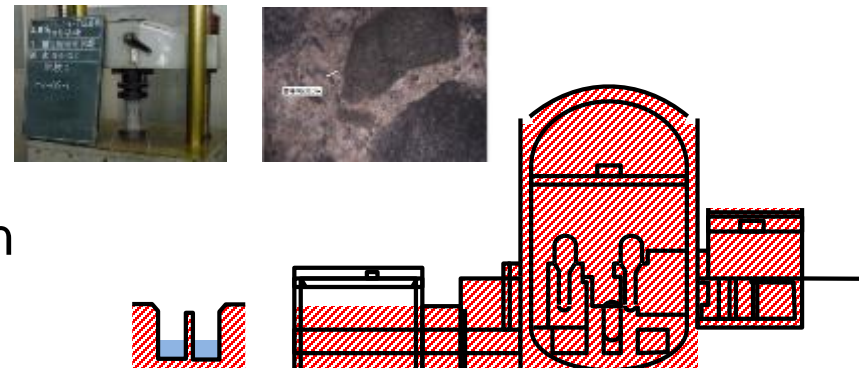
<Containment Vessel>

Steel plates of containment vessel (VT)



<Civil Structures(Concrete)>

Core samples
(strength / neutralization
salt permeation/alkali aggregate reaction
shielding capability)



Result of special inspection



Based on the review experience of **extension of operational period**, any safety concern was identified as results of special inspection

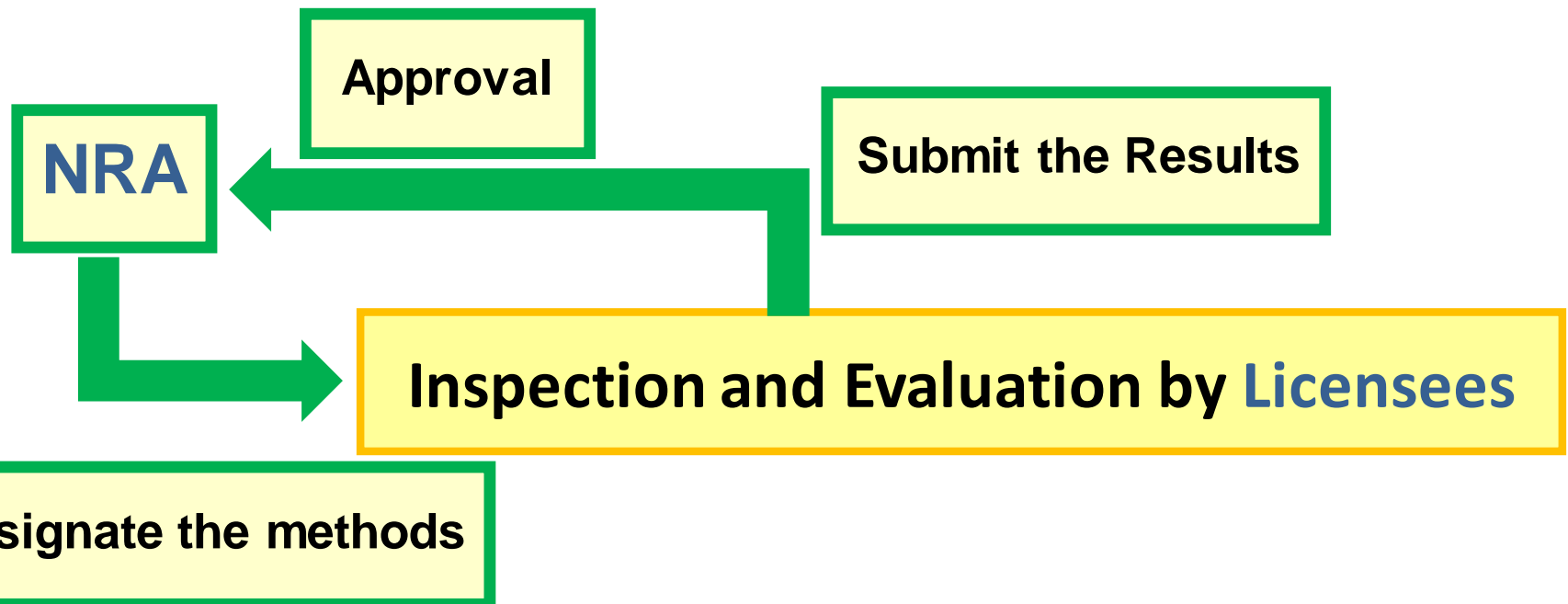
4 reactors have been approved for extended operation

- **Takahama-1** (PWR) 826 MWe
- **Takahama-2** (PWR) 826 MWe
- **Mihama-3** (PWR) 826 MWe
- **Tokai-2** (BWR) 1100 MWe

Updating example



The **methods** of inspection and evaluation, which conducted by licensees, **are designated** by the NRA, which are updated by taking into account **state-of-the-art knowledge**.



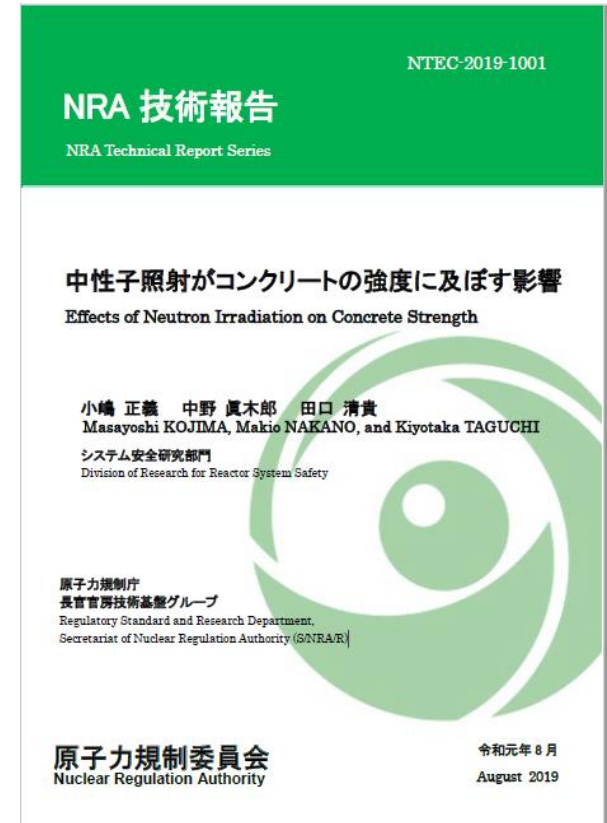
Updating example



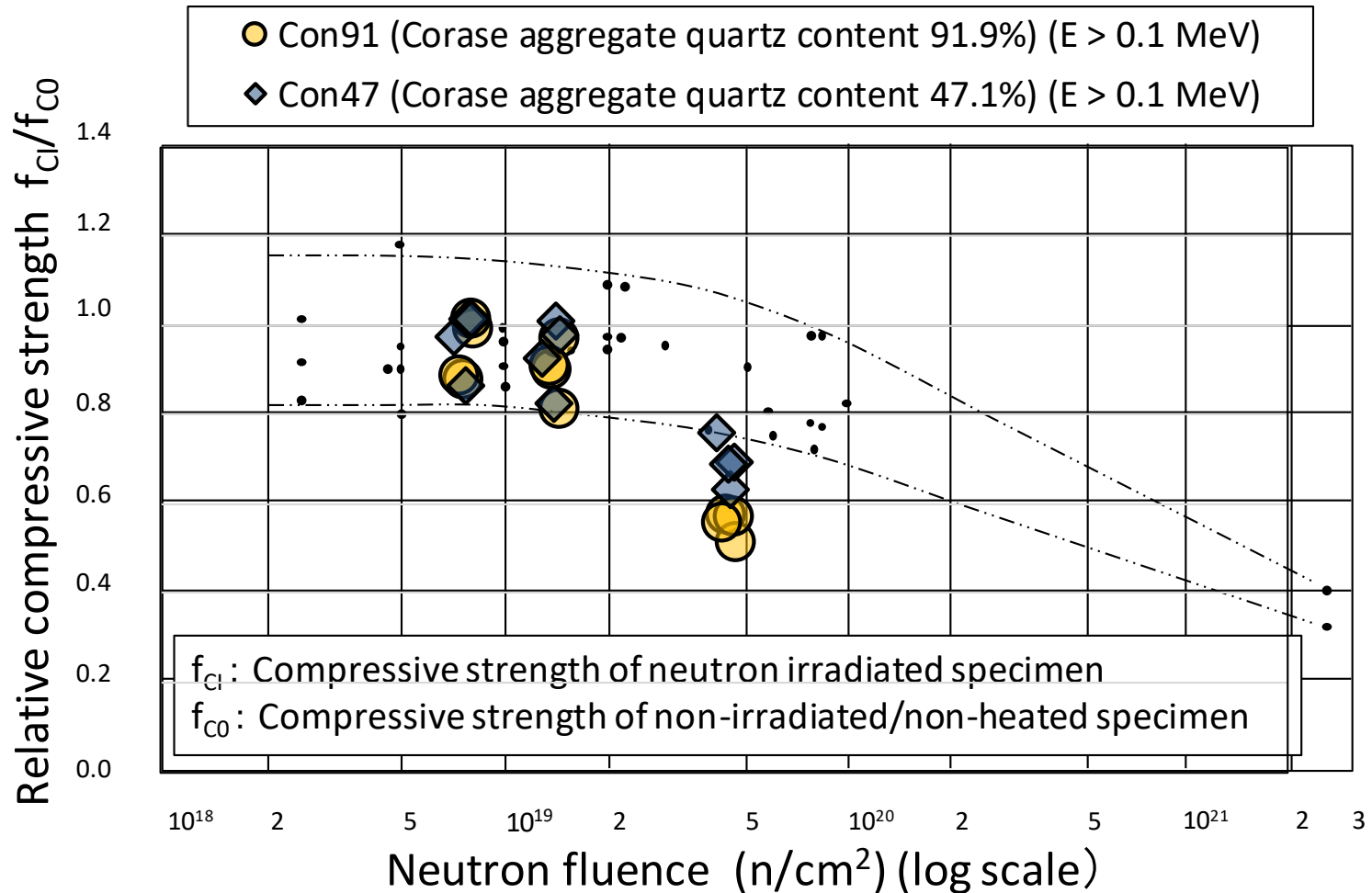
Recently, our research department published the **NRA Technical Report** which included new experimental data on ageing effect of neutron irradiations on concrete strength

NTEC-2019-1001

<https://www.nsr.go.jp/data/000281637.pdf>



NRA Technical Report



The report also shows volumetric swelling of the aggregate and concrete tends to be greater with the neutron fluence and quartz content.

Ref) Max. neutron fluence estimated at the age of 60 years of Takahama-2 is $4.49 \times 10^{19} n/cm^2$ ($E > 0.11$ MeV)

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“Obsolescence”



Types of obsolescence in SSG-48

- ✓ **Technology**
- ✓ **Regulations, codes and standards**
- ✓ **Knowledge**

Conformity for extension



Among the elements of obsolescence,
Design weakness is the most serious concern



For approval of extension of operational period,
plants are required to **conform with** the latest
regulatory requirements

Introduced measures



In the amended regulations after 2012,

Not only direct reflection of TEPCO Fukushima Daiichi NPS accident

- ✓ Measures against **tsunami, SBO, sever accidents, etc.**

But also

- ✓ Measures against **fire resistance, tornado, internal flooding, etc.**

was introduced



In order to identify **weak points** of the plant, as part of “Periodic Safety Assessment of Continuous Improvement” which refers SSG-25,

PSR (Periodic Safety Review) is required **every 10 years**

Decommissioning plants



After the establishment of the NRA, **11 reactors** have decided to be **decommissioned** without extension of operational period.

Reactor	Type	Start Date	Electric Capacity (MWe)
Tsuruga-1	BWR	1970/03/14	357
Mihama-1	PWR	1970/11/28	340
Mihama-2	PWR	1972/07/25	500
Shimane-1	BWR	1974/03/29	460
Genkai-1	PWR	1975/10/15	559
Ikata-1	PWR	1977/09/30	566
Ohi-1	PWR	1979/03/27	1,175
Ohi-2	PWR	1979/12/05	1,175
Genkai-2	PWR	1981/03/30	559
Ikata-2	PWR	1982/03/19	566
Onagawa-1	BWR	1984/06/01	524

* Excluding Fukushima Daiichi and Daini NPPs

Conclusions



- The number of aged reactors continue to increase.
- The NRA implements **strict control** of extension of operational period from the view point of **safety**.
- In parallel with extended operation, a number of reactors are decided to be **decommissioned**.
- **Appropriate regulation** for decommission is more and more important.

Thank you for your attention!

