Safety measures at JRR-3 based on compliance with new regulatory standards

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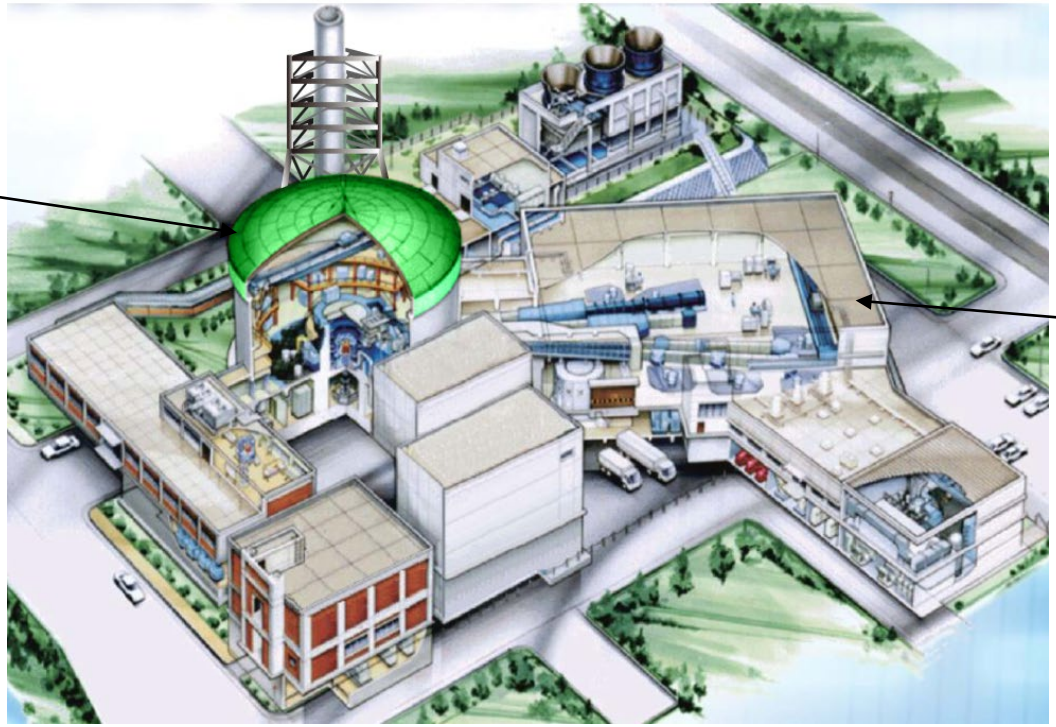
Overview of JRR-3

1962	Reached criticality as the first domestically produced nuclear reactor
1985	Start of modification work for higher performance
1990	Start of operation by the modified JRR-3
1998	Get the licence for fuel densification
2018	Get the license in compliance with new regulatory standards
2021	Re-operate
2025	Cumulative output of about 75,000 MWD

Spec of JRR-3	
Purpose	Neutron beam experiment, RI production, Activation analysis, Material irradiation, etc.
Model	Light water moderation cooling pool type
Fuel element	Plate fuel
Maximum heat output	20,000KW
Mode of operation	26 days continuous operation (1 cycle) 6-7 cycles / year



Strict examination and inspection by the government (1)

2011 March 11th — Great East Japan Earthquake

2012 September 19th — Establishment of the Nuclear Regulation Authority

2013 December 18th — Enforcement of new regulatory standards for research reactors

2014 September 26th — Application for modification in the installment license

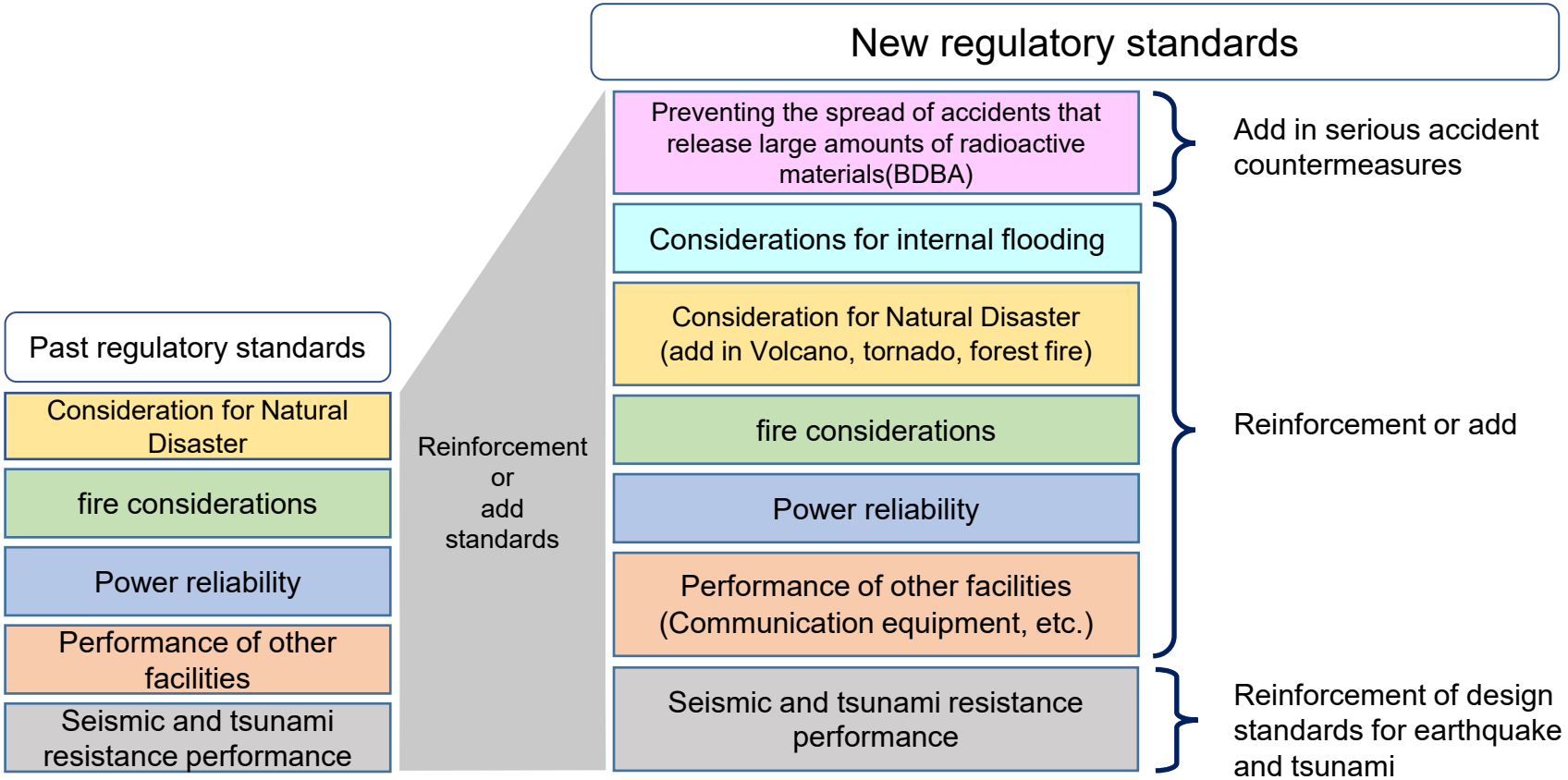
2018 November 7th Getting the license

2019 2021 April～May
- Pre-use inspection
- Seismic reinforcement work, etc.

On September 19, 2012, the Nuclear Regulation Authority was established to take charge of nuclear safety regulations. The Nuclear Regulation Authority created new regulatory rules (new regulatory standards) based on the problems of the accident. Starting in September 2014, we received a conformity review for the new regulatory requirements over a period of about 4 years, and got the license in November 2018.

Strict examination and inspection by the government (2)

Strict examination and inspection by the government is required to install a reactor.



◆ **The new regulatory standards were formulated based on reflection on the accident at Fukushima Daiichi Nuclear Power Station.**

- Obligation to comply with the latest regulatory standards even for facilities that have already got the license.
- Demand protection measures against natural disaster such as tornado and volcano in addition to earthquake and tsunami.
- Added measures against accidents that release a large amount of radioactive materials, etc.

Earthquake measures

- Seismic classification categorized three levels. (S-class, B-class, C-class)
- S-class equipment (fuel, control rods, reactor pool, etc.) became the evaluation result not to fail for the new earthquake (2.5 times the past one).
- B-class and C-class facilities were reinforced so that an earthquake for S-class facilities would not affect the S-class facilities and equipment.
- The major ones are the roof of the reactor building, the steel tower supporting the exhaust stack, and the foundation reinforcement of the building adjacent to the reactor building.

Reinforcement work on the roof of the reactor building

PURPOSE

Prevention of roof fall against earthquake.

Prevent the exhaust stack from falling toward the side of reactor building in the earthquake.

Reinforcement work of exhaust stack

Tornado measures

- JRR-3, all important facilities are installed inside the building.
- Regarding the impact of a tornado, we confirmed the two effects of the tornado's wind pressure and the tornado's flying objects. As a result confirmed that the building has sufficient strength against a tornado.

The tornado's wind pressure

The tornado's flying objects

- We manage the surroundings of the facility so that there are no flying objects that could damage the building.

●Examples of objects evaluated for the impact of flying objects caused by tornadoes

Switchboard

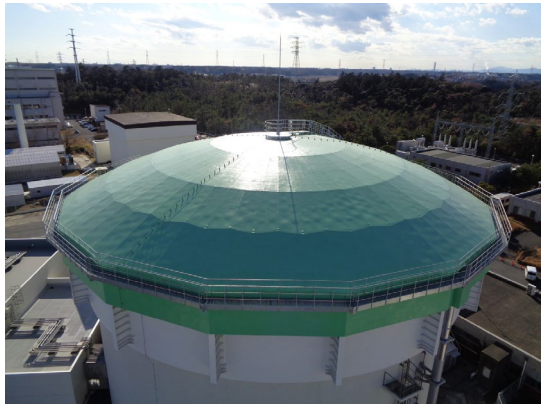
Bicycle

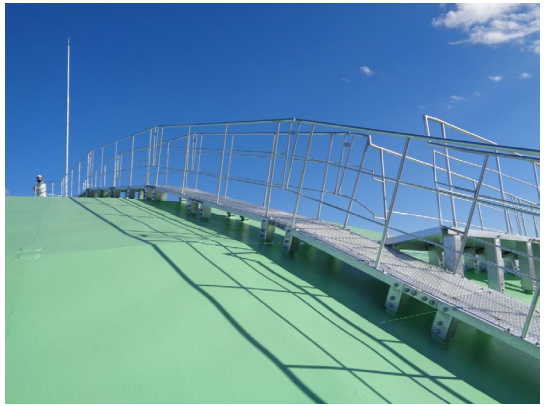
Air conditioner outdoor unit

Volcano measures

◆ Volcano measures

- 13 volcanoes were identified.
- They will not be directly affected by lava, pyroclastic flows, etc. because they are far enough away .
- The amount of volcanic ash reaching us is evaluated as very small, we will shut down the reactor if it affects operations.
- We have prepared materials and equipment to remove volcanic ash.





Install a roof hallway

Volcanoes that may affect facilities

No.	Quaternary volcano	Distance from site
1	Mt. Takahara	88km
2	Mt. Nasu	93km
3	Nantai and Nyoho Volcanoes	105km
4	Mt. Nikko-Shirane	116km
5	Mt. Akagi	127km
6	Mt. Hiuchigatake	130km
7	Mt. Adatara	133km
8	Mt. Sasamoriyama	134km
9	Mt. Bandai	135km
10	Mt. Numasawa	143km
11	Mt. Komochi	144km
12	Mt. Azuma	148km
13	Mt. Haruna	157km

- **The roof of the reactor building has been made four times stronger against volcanic ash.**
- **The roof for ash removal is also improved.**

Internal fire measures

Internal fire protection

- Prevention of fire breaking

  Management of combustible and flammable materials

- Fire detection and extinguishing

  Installation of automatic fire alarm equipment and fire extinguishing equipment

- Reduction of fire influence

  Division with concrete walls and steel doors, multiplexing of cables, physical separation of cables using conduits, etc. Using of non-combustible or flame-retardant materials for equipment and cables

- **Cables with high importance are multiplexed and made independent, assuming that one system may be damaged due to a fire or the like.**
- **The cables near the penetrations of the building were also covered with flame-retardant sheets from the standpoint of cable independence.**

Cable laying condition

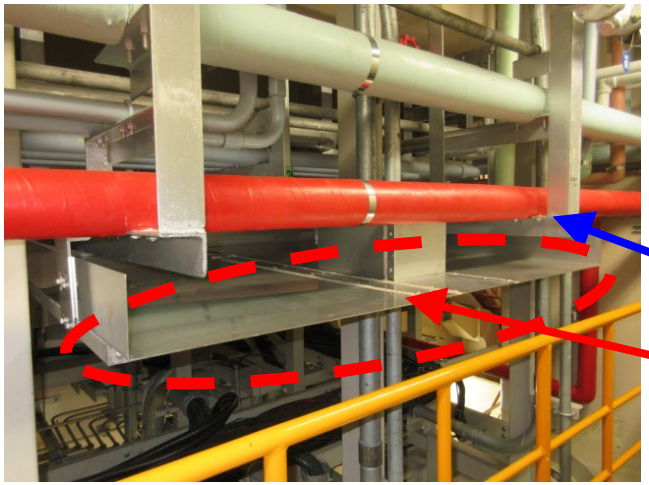
Internal flooding measures

◆ Measures against internal flooding

- There are many pipes in JRR-3. In addition, the reactor pool stock a large amount of water.
- We evaluated that the safety of the nuclear reactor can be ensured even if water leaks from these pipes and equipment.
- By increasing the frequency of inspections within the facility, internal flooding can be detected at an early stage and the reactor will be shut down if it interferes with operation.
- We confirmed that the inside water of the facility does not leak out outside of the facility.

Internal flooding measures are taken for important facilities.

Primary coolant auxiliary pump
(I secure the height of the foundation)



Piping for fire extinguishing water, etc.
(Install a water protection cover)

Preventing the spread of accidents that release large amounts of radioactive materials(BDBA) (1)

➢ Event selection

・Although the frequency of occurrence is low, accidents that may cause excessive radiation exposure to the general public around the site are selected as accidents that release a large amount of radioactive materials (BDBA).

(1) Scram failure events due to earthquakes exceeding the standard seismic ground motion

Failure to insert all control rods, loss of utility power and emergency power, and loss of cooling function due to forced circulation shall all occur.

(2) Loss of core cooling function due to core channel blockage

One fuel element shall be damaged due to flow channel blockage.

(3) Loss of submerged maintenance function due to an earthquake exceeding the design basis seismic ground motion

Failure of the two siphon break valves, loss of utility and emergency power, and loss of decay heat removal functions shall all occur.

Preventing the spread of accidents that release large amounts of radioactive materials(BDBA) (2)

We added new facilities as measures against BDBA.
In addition, we carry out accident response drill and education to simulate BDBA every year.

Portable pumps and generators for pumping up the coolant are preparing in case it is difficult to recover the coolant by the existing facilities due to a break in the piping.

Reactor building

Prepare neutron-absorbing boric acid in case of scrum failure

Portable pumps and generators

Secondary cooling tower
(Source of water)

In case the fuel is damaged and the top of the reactor core is un-accessible, prepared water supply facilities that can supply water by various ways (portable pumps, hydrants, fire trucks, etc.)

Examples of added facilities for reinforced countermeasures

Conducting drill in preparation for accidents

- Education and drill assuming accidents

・Nuclear emergency response drill

(For example) Assuming simultaneous disasters at multiple facilities

Assumed primary cooling water leakage event during JRR-3 operation

・Drill for responding to accidents that exceed expectations

Creating procedure manuals and conducting basic drill to master newly added measures, etc.

・Other drill

Implementation of reporting drill to confirm the contact system outside working hours and the availability of personnel.

Conducting drill to confirm methods for removing body contamination and measures to prevent the spread of contamination.

Nuclear emergency response drill

State of the drill

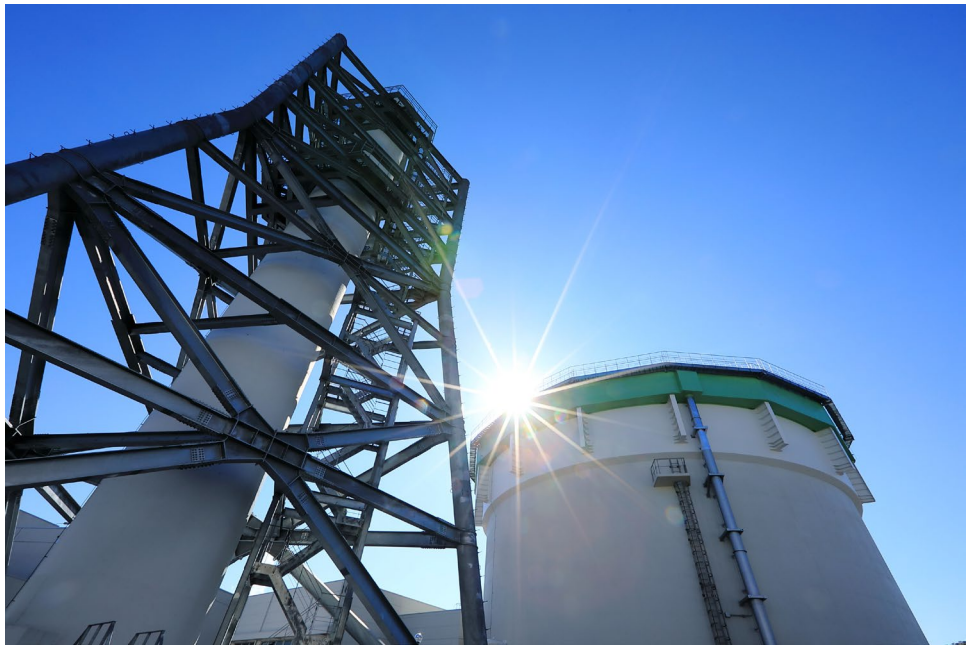
We repeatedly conduct various drills so that we can respond quickly and accurately in the event of a disaster or accident.

Conclusion

・All construction work and necessary inspections were completed in February 2021.

・JRR-3 was restarted for the first time in 10 years.

・Currently, it operates for 26 days continuously (1 cycle), 6 to 7 cycles per year.



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That’s all from me. Thank you for listening.