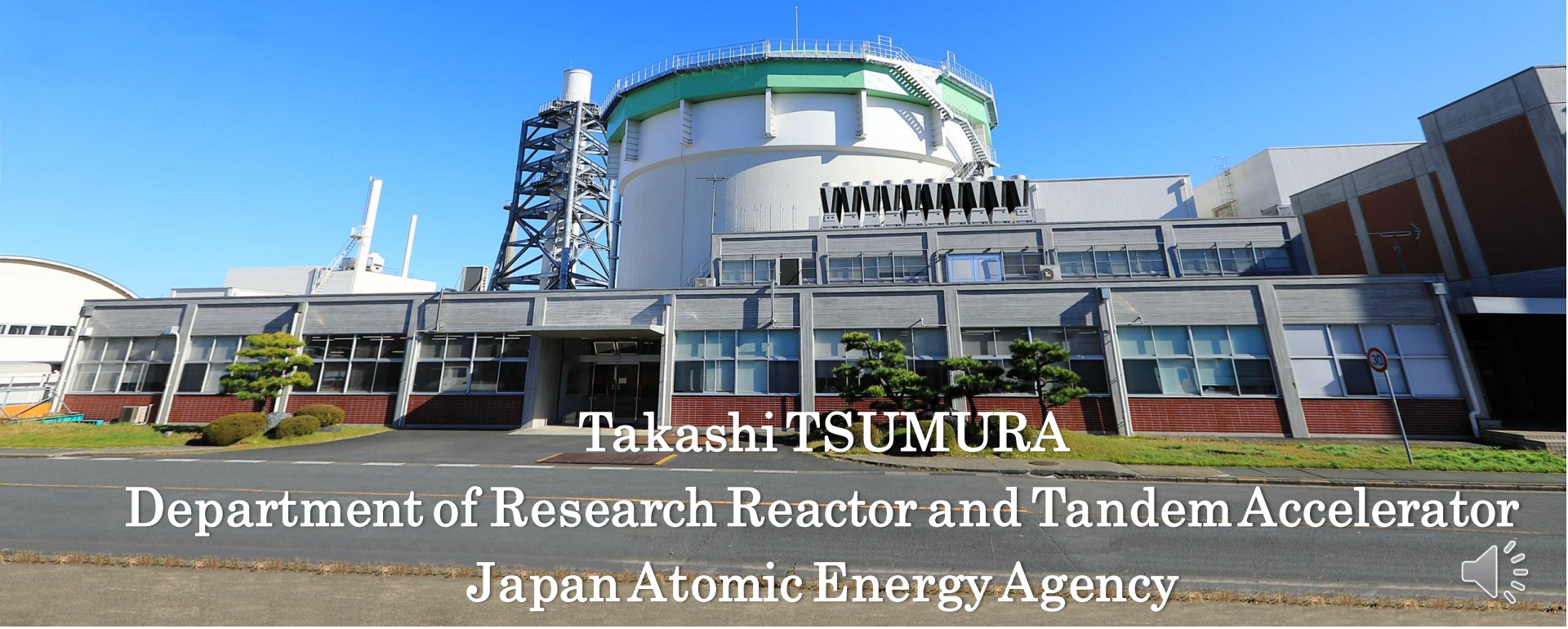
IGORR Conference and IAEA Technical Meeting
on Research Reactor Ageing Management,
Refurbishment and Modernization

TOWARDS THE RESTART OF JRR-3 OPERATION



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Introduction

JRR-3 resumed operation and achieved 20MW thermal power on 26th February 2021.

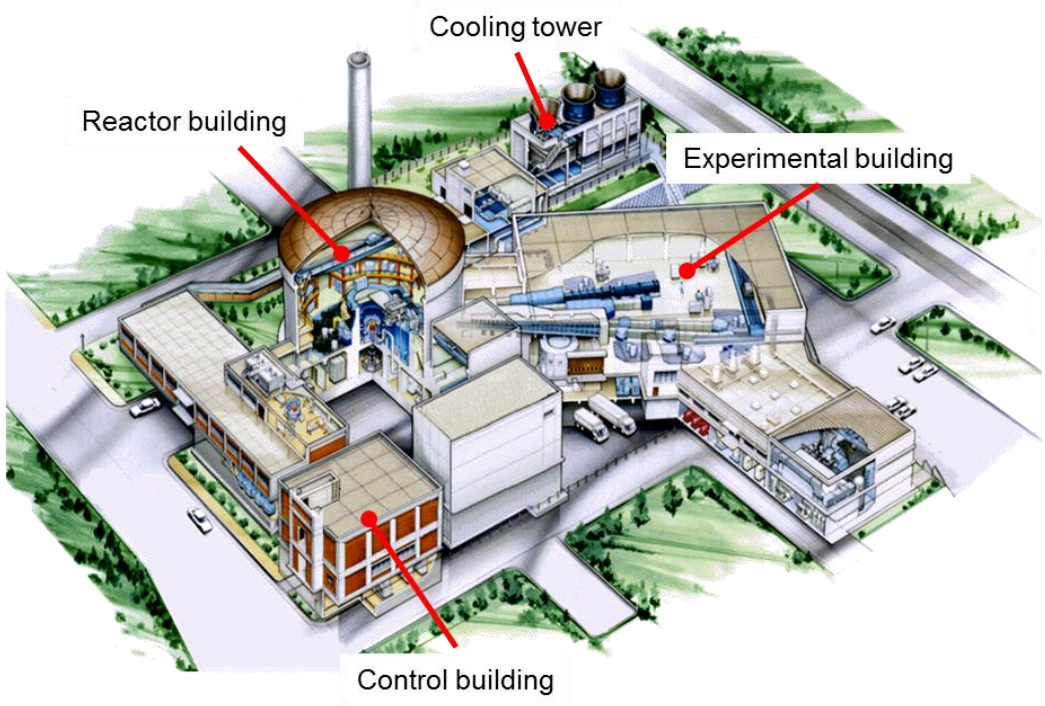
- JRR-3 stopped operation after the Great East Japan Earthquake in 2011.
- A lot of time and effort was put to restart JRR-3.

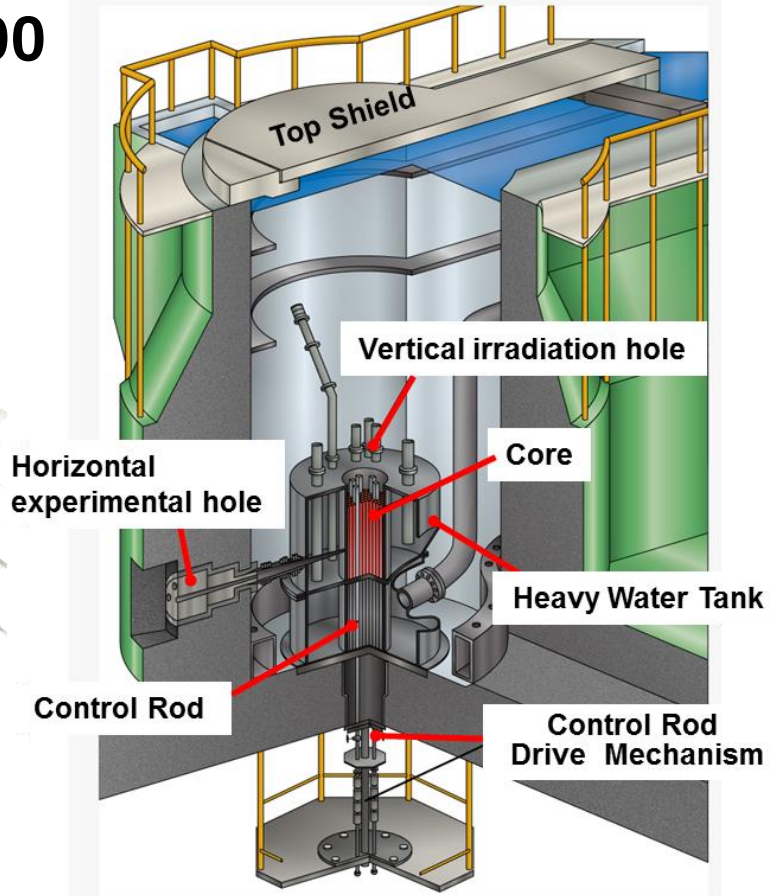
Contents

1. The road to restarting operations
2. Safety measures based on
   the new regulatory requirements
3. Other initiatives during the shutdown
4. The Future

1.1 JRR-3 (Japan Research Reactor No.3)

- **Reactor Type: Swimming pool type**
- **Thermal Power: 20MW**
- **1st criticality: March 22nd,1990**





1.2 Safety Characteristics of JRR-3

- The thermal power of JRR-3 is 1/100 of power rector.
- Cooling water is under ordinary temperature and normal pressure.
- The safety protection systems are designed with redundancy.
- The reactor is shut down automatically without power supply in case of accidents.
- The fission product decay heat can be removed by natural circulation of the cooling water.
- JRR-3 has a successful accessibility .

1.3 Timeline for the resumption of operation

Mar. 11, 2011
Earthquake & Tsunami
Mar. 12-14, 2011
Fukushima Dai-ichi Accident

Sep. 19, 2012
NRC established in Japanese government
Dec. 18, 2012
Enforcement of New Regulatory Standards for nuclear reactor facilities for testing and research

Sep. 26, 2014
Application of Reactor installation change permission

- 6th revised
- 53th review meeting

Nov. 7, 2018
Reactor installation change permission was approved

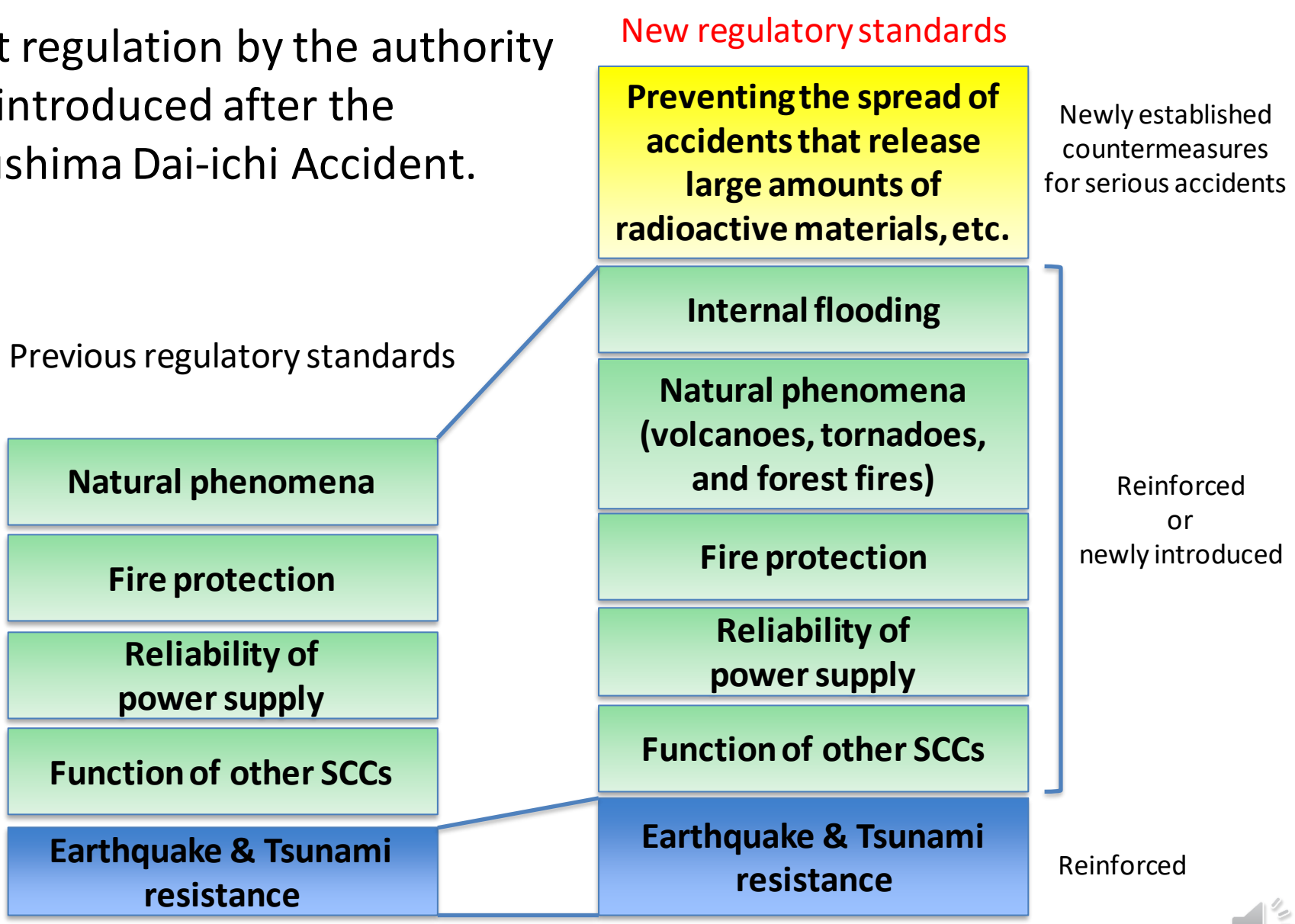
- Seismic retrofitting work
- Pre-use inspection

Feb. 24, 2021
Receive a certificate of pre-use inspection

Feb. 26, 2021
Re-operation

2.1 New Regulatory Requirements for Research Reactor

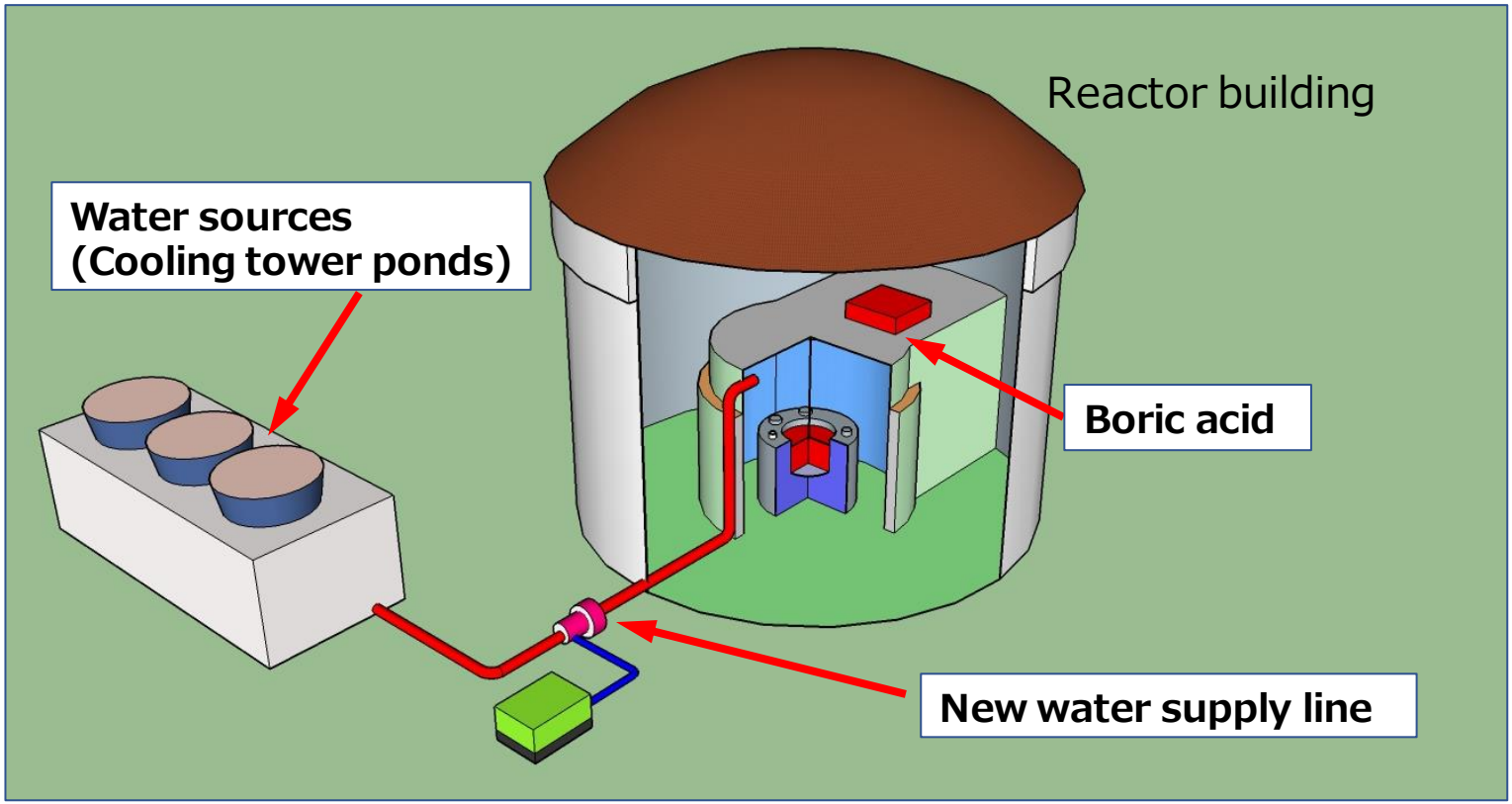
Strict regulation by the authority was introduced after the Fukushima Dai-ichi Accident.



2.2 Preventing the spread of BDBA

- Loss of shutdown function: All control rods cannot be inserted.
  Prepare boric acid with a negative reactivity effect (neutron absorption effect).

- Loss of cooling function: Primary cooling water leakage.
  Prepare water supply equipment (portable pump, portable power supply equipment, water supply line) from inside and outside the reactor building.



2.3 Safety Measures against volcanic eruption

- The nearest volcano is 88 km away from JRR-3 site.
- According to volcanic activity records, there is no risk of volcanic damage due to lave or pyroclastic flow.
- A volcanic event to consider at the JRR-3 is volcanic ash fall.

If the ash fall is confirmed on the site,
- Shut down the reactor;
- Ash removal work will be carried out.

Calculation of allowable sedimentary load of each building roof.

Facility	Allowable Load
Reactor building	3,672N/m^2 (sediment amount: 25cm)
Spent fuel storage building	2,685 N/m^2 (sediment amount: 22cm)
Beam hall	2,303N/m^2 (sediment amount: 19cm)

Equipment
for deashing worker

2.4 Safety Measures against tornado

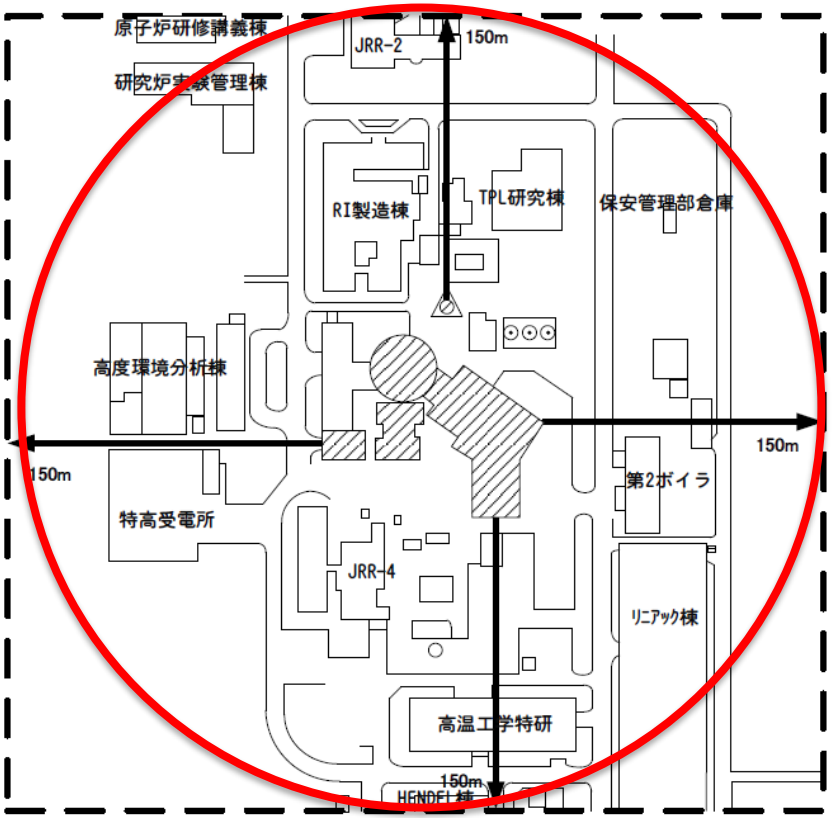
- A design basis tornado has been defined based on the maximum wind speed 49 m/s of tornados previously occurring around JRR-3.
- The reactor building of JRR-3 would not be ruined by the tornado or flying objects.

Flying objects control within a 150 m radius

Speaker

Bicycle

Outdoor unit



Switchbox

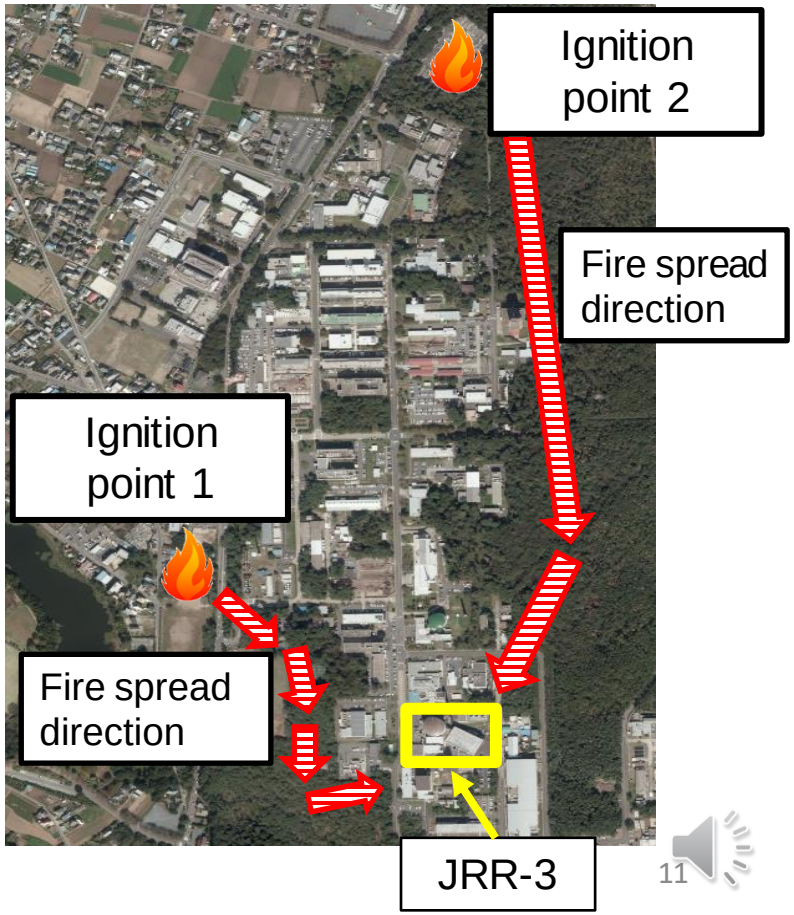
Signboad

2.5 Safety Measures against forest fires

It was confirmed that the surface temperature of the building of the JRR-3 facility due to the forest fire was less than the allowable temperature (concrete: 200℃) and that there was no impact on the safety of the facility.

Results of forest fire impact assessment

Ignition point	1	2
Building	Control building	Cooling tower
Wall temperature	92℃	118℃



(Preparing for forest fires)

- Control the trees around the building
- Firefighting is possible 24 hours a day by the self-defense fire department
- Deployment of chemical fire trucks

Chemical fire truck

2.6 Safety Measures against fires in building

Physical separation of cables of high importance

- Cables of high importance (safety protection system, emergency power supply system, neutron instrumentation, and process instrumentation) should be multiplexed into two systems in order to maintain their functions even if one system loses its function due to fire.
- Cables should be made of flame retardant materials, and should be isolated by steel cable ducts.
- Separated and different penetration frames are installed for the penetrations in the reactor building.

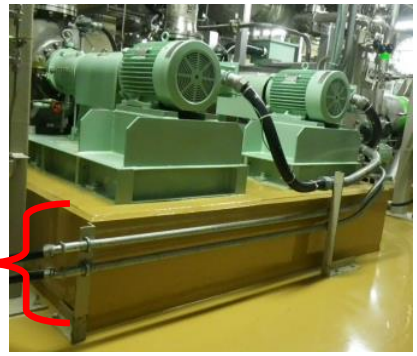
(Response to a fire)
If it is recognized that a fire occurring in JRR-3 may interfere with the operation of the reactor, the reactor will be manually shut down in an emergency.

2.7 Safety Measures against Internal flooding

- **Safety functions will not be lost due to the effects of water overflow caused by earthquakes (damage to equipment, sloshing of the reactor pool, etc.) and internal flooding.**
- **Water overflow caused by damage to the vessel or piping will not leak into the controlled area.**

(Internal water overflow measures)

- The primary coolant auxiliary pumps are drip-proof.
- The primary coolant auxiliary pumps are installed on a high base.
- Install a water protection cover on the power supply panel of the primary coolant auxiliary pumps.

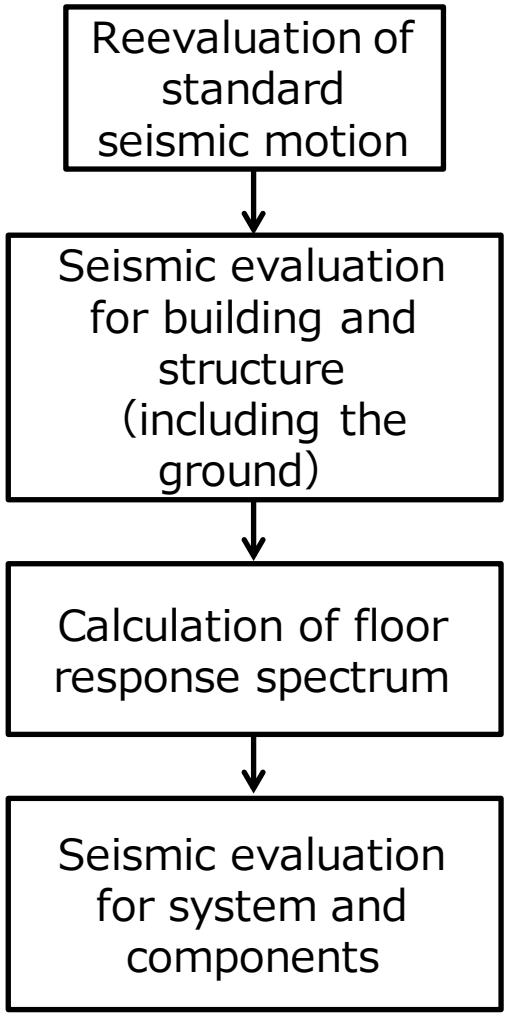


Primary coolant auxiliary pumps

Above power supply panel

2.8 Earthquake resistance

Flow of seismic evaluation



- Standard seismic motion: 952 cm/s^2
  Maximum acceleration is more than double that of the past.
- Results of evaluation
  Structures, facilities and equipment important for safety have enough strength.

But,

Roof of reactor building, stack, beam hall may be damaged.

Considered top priority to safety, decided seismic reinforcement work.

New roof installation to reactor building

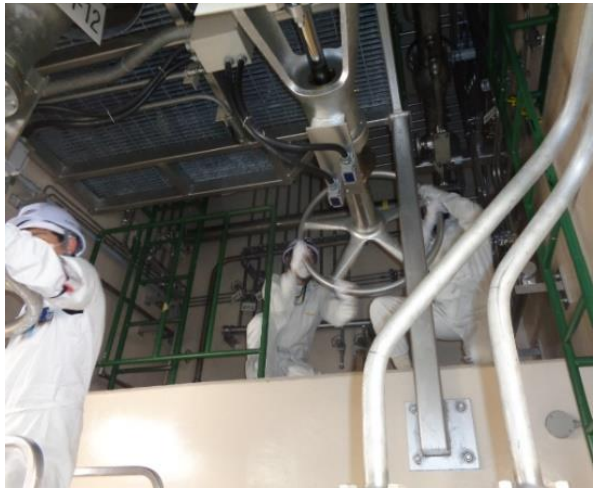
Stuck reinforcement works

Beam hall foundation reinforcement works

3.1 Maintaining the skills of drivers

- Training on reactor operation using simulators.
- Younger staff inspected the facility and maintained the equipment together with experienced operators.
- Participation in seminars on handling of radioactive materials and nuclear reactors.
- Preparation of manuals and training for accident response.

Training using simulators



Training in manual operation of valves

Piping collection training

3.2 Measures against aging

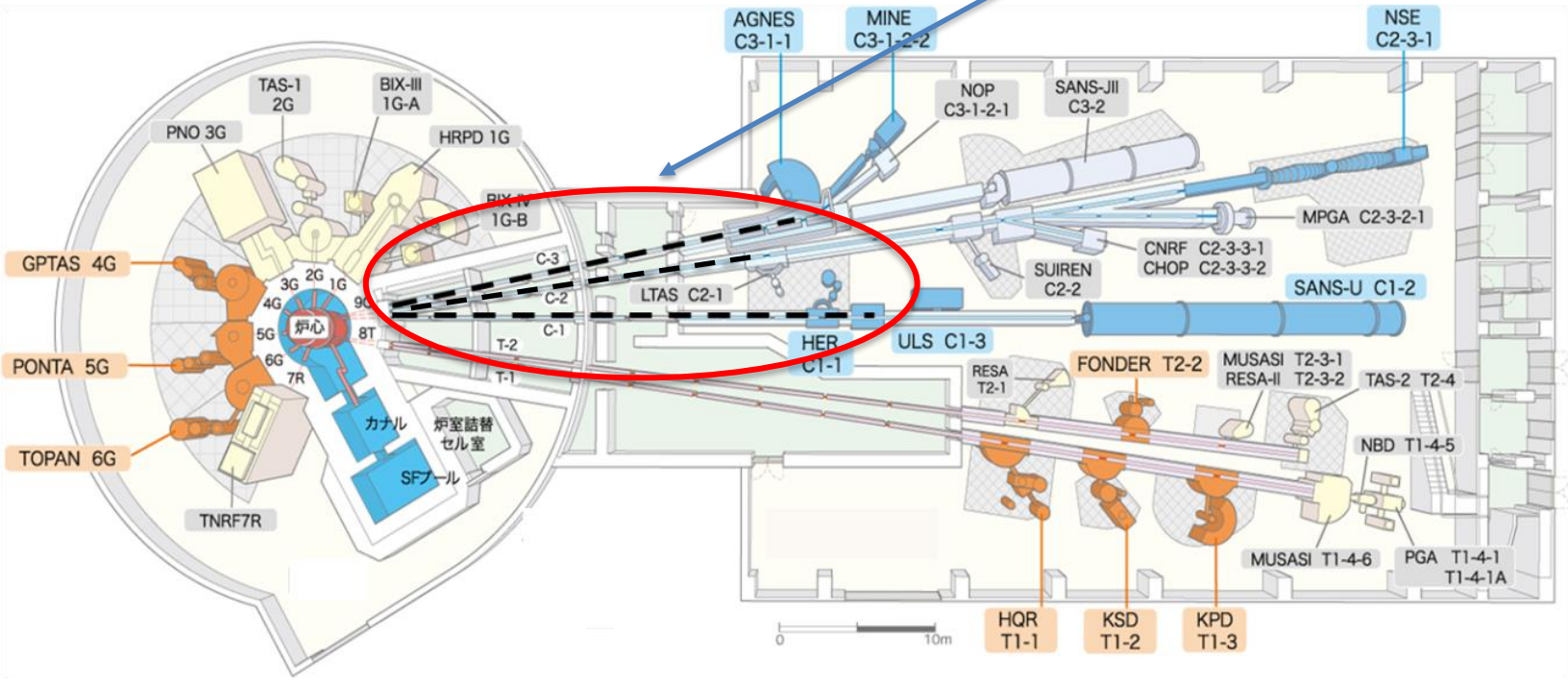
- Renewal of the process control computers,
- Renewal of the control rod drive units (movable coil),
- Renewal of the power supply units of the safety protection system control panel,
- Open inspection of the primary coolant heat exchangers,
- Disassembly and inspection of primary coolant main pumps and auxiliary pumps,
- Disassembly and inspection of primary coolant main valves and siphon break valves,
- Inspection of communication and liaison equipment.

Open inspection of the heat exchanger

Renewal of the movable coil

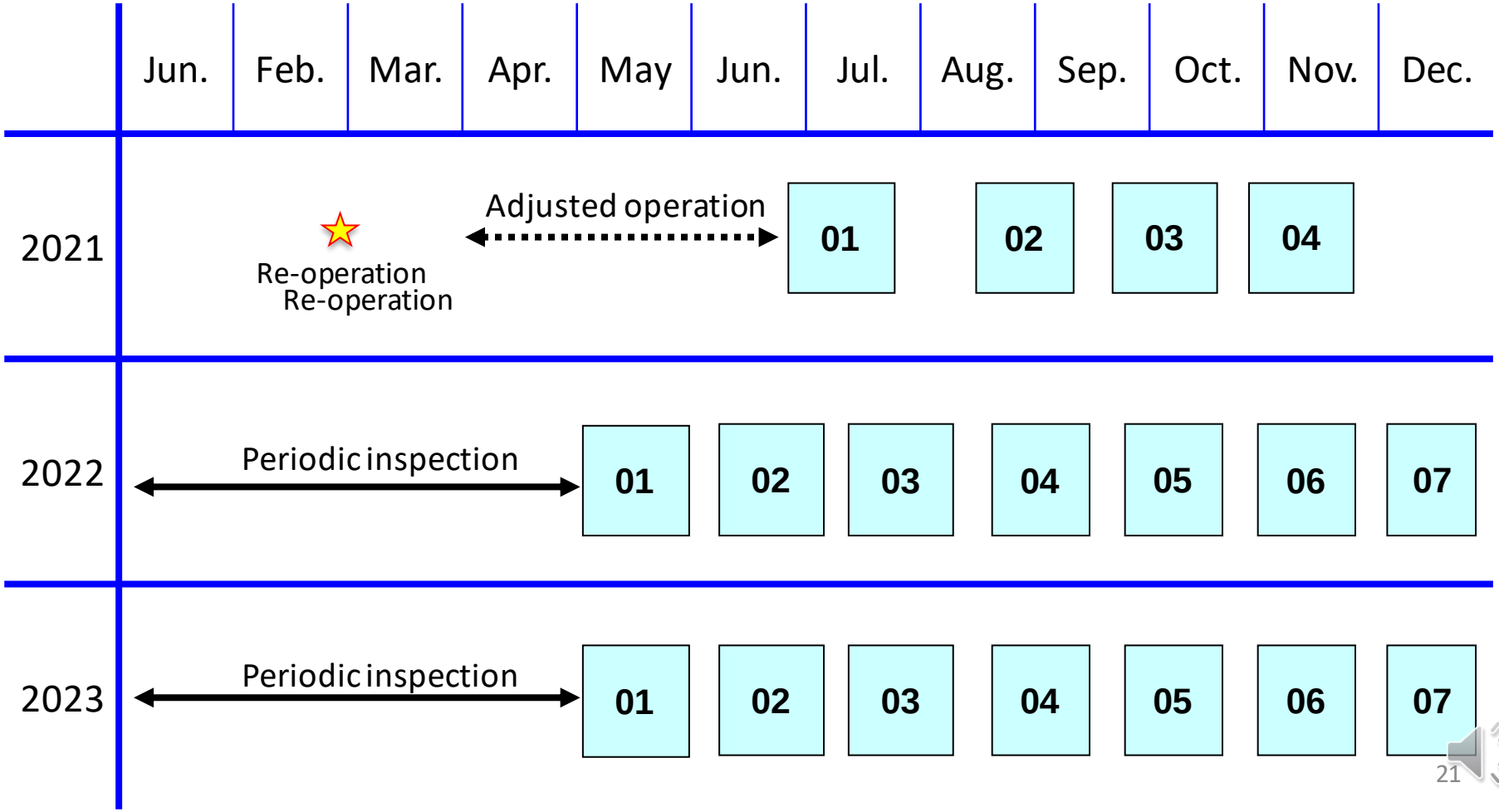
3.3 Upgrade of Cold neutron beam

- Current Ni mirror in three cold neutron guide tubes C1, C2 and C3 were replaced with Ni/Ti super mirror.
- The gross neutron intensity increased about 2.5 times with Ni/Ti supper mirror.



4. JRR-3 service operation schedule

- During adjustment operation in a variety of power including daily operation now.
- 4-cycle service operation until November in this year.
- From next year, 7-cycle service operation between May and December.



Thank you!!

祝 JRR-3 運転再開

令和3年 2月26日