The Current Status of Safety Enhancement Projects at Kashiwazaki Kariwa Nuclear Power Station

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Nuclear Power & Plant Siting Division

Basic Concepts

① Establish safety enhancement measures along with defense in depth concept.

② Consider not only earthquake and tsunami but also 40 natural events and 20 human induced external events shown in US NUREG* and the IAEA Safety Guide**.

③ Screening of the above mentioned external events based on their cliff edge effect and probability for detailed evaluation and establishment of safety measures.

④ Strengthen measures also against internal flooding and internal fire

⑤ Use of probabilistic risk assessment (PRA) to:

- select accident sequences to be evaluated,
- evaluate effectiveness of the established safety measures.

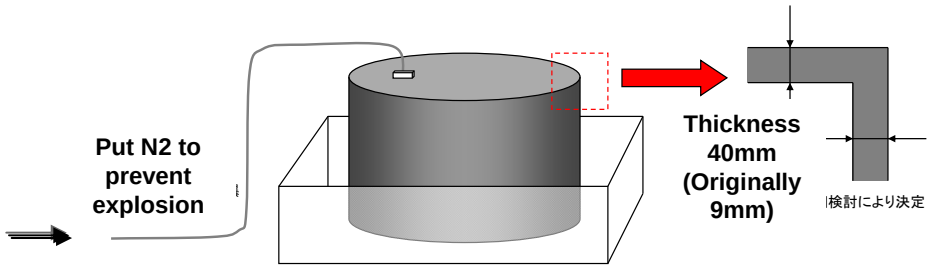
* NUREG/CR-2300 Vol.2, “PRA Procedures Guide”

** IAEA Specific Safety Guide SSG-3, “Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants”

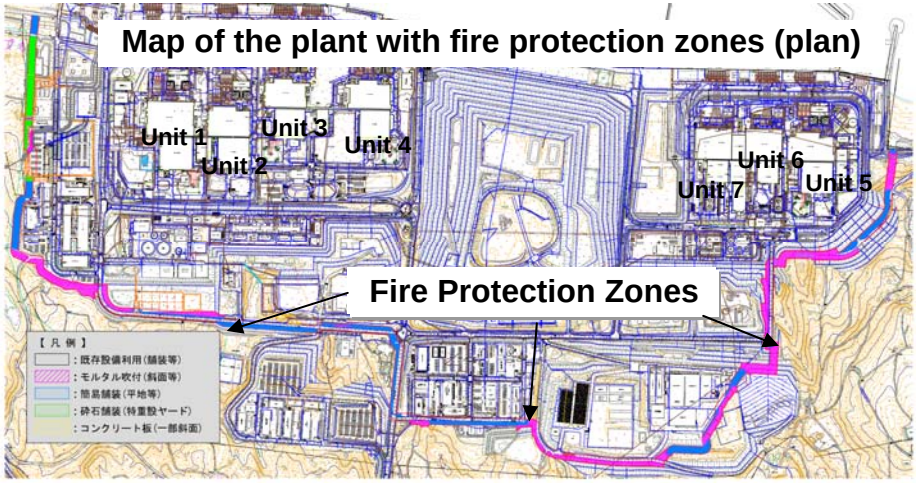
Measures to prevent abnormalities

Measures against tsunami (15m)
Tidal Embankments, Walls, Boards, Water Tight Doors, etc.

Measures against Tornado (Fujita Scale 3
Replacement of the gasoil tanks



Measures against External (Forest) Fire
Creation of the fire protection zones

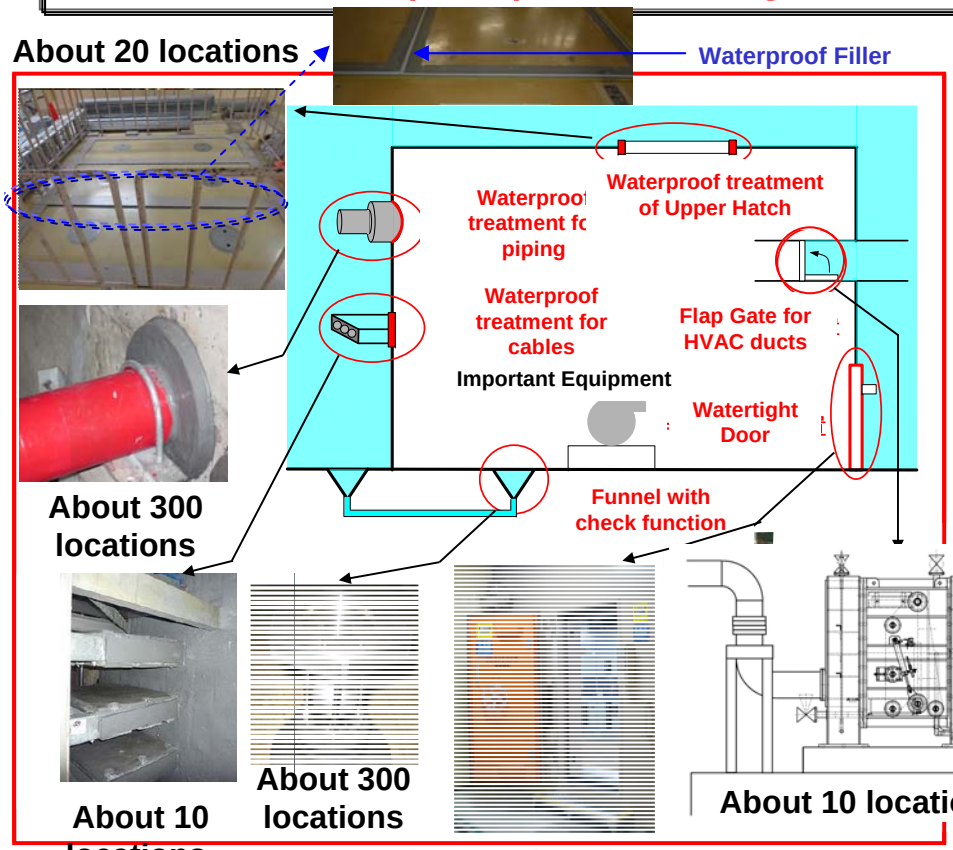


TOKYO ELECTRIC POWER COMPANY

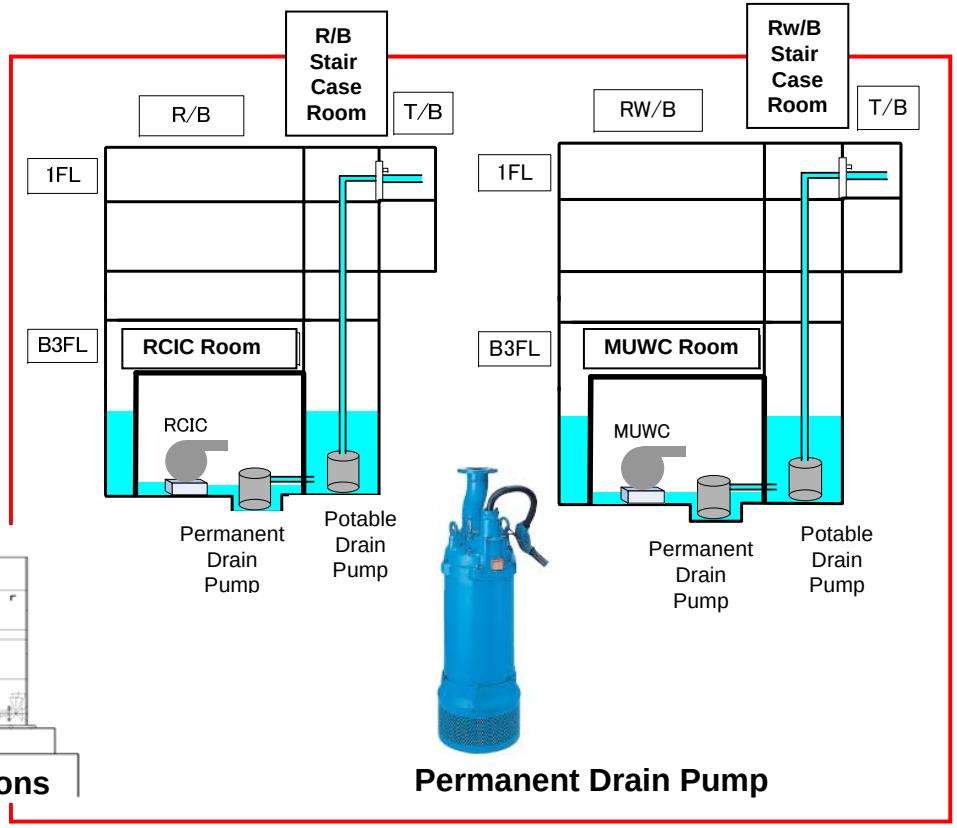
Measures to control abnormalities 1

Measures against Tsunami Flooding and Internal Flooding

- Reduce flooding sources (seismic enhancement of class B/C equipment)
- Waterproof treatments/ flap gates to protect important equipment
- Install drain pumps for design extension conditions



Measures against internal flooding
(Numbers of Locations are for KK7)



Installation of Drain Pumps

Measures to control abnormalities 2

Measures for Fire Protection

➢Prevention

- Fireproof or fire-retardant materials (incombustible cable has been used at KK since construction)
- Rigid management of combustible materials like lubricant oil.

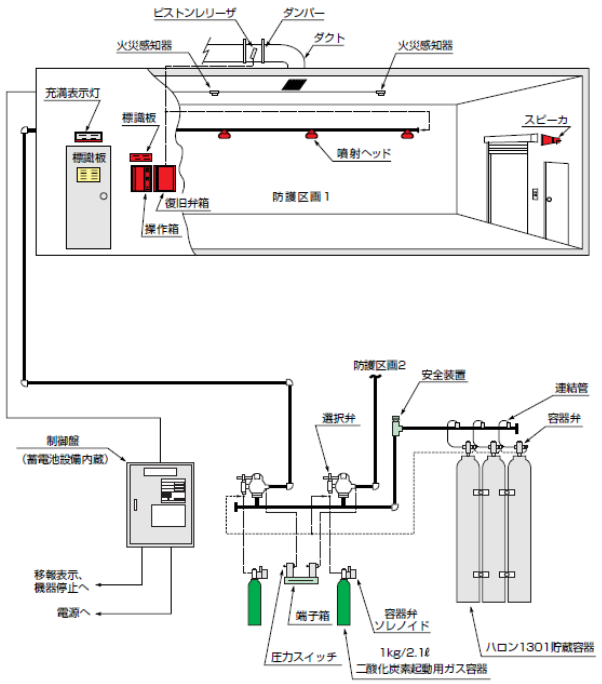
➢Early detection and extinction

- Fire detection devices (for about 230 locations)
- Fixed fire suppression system (for about 100 areas)

➢Mitigation

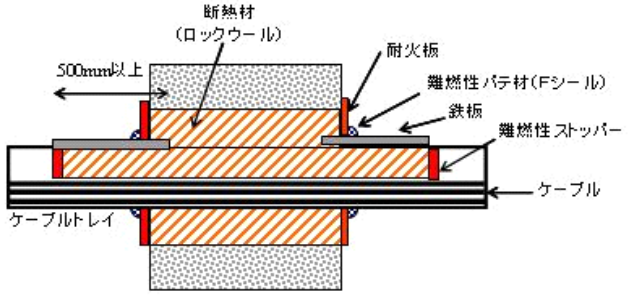
Fire Barriers with 3-h fire resistance capability

- Fire proof dumpers (about 200)
- Fireproof treatment on piping and cable penetrations (for about 2300 cable penetrations and 300 pipe penetrations)
- Cable wrapping (about 100m for cable trays and 300m for cable conduits)



Fixed Fire Suppression System

Cable Wrapping (7 layers)

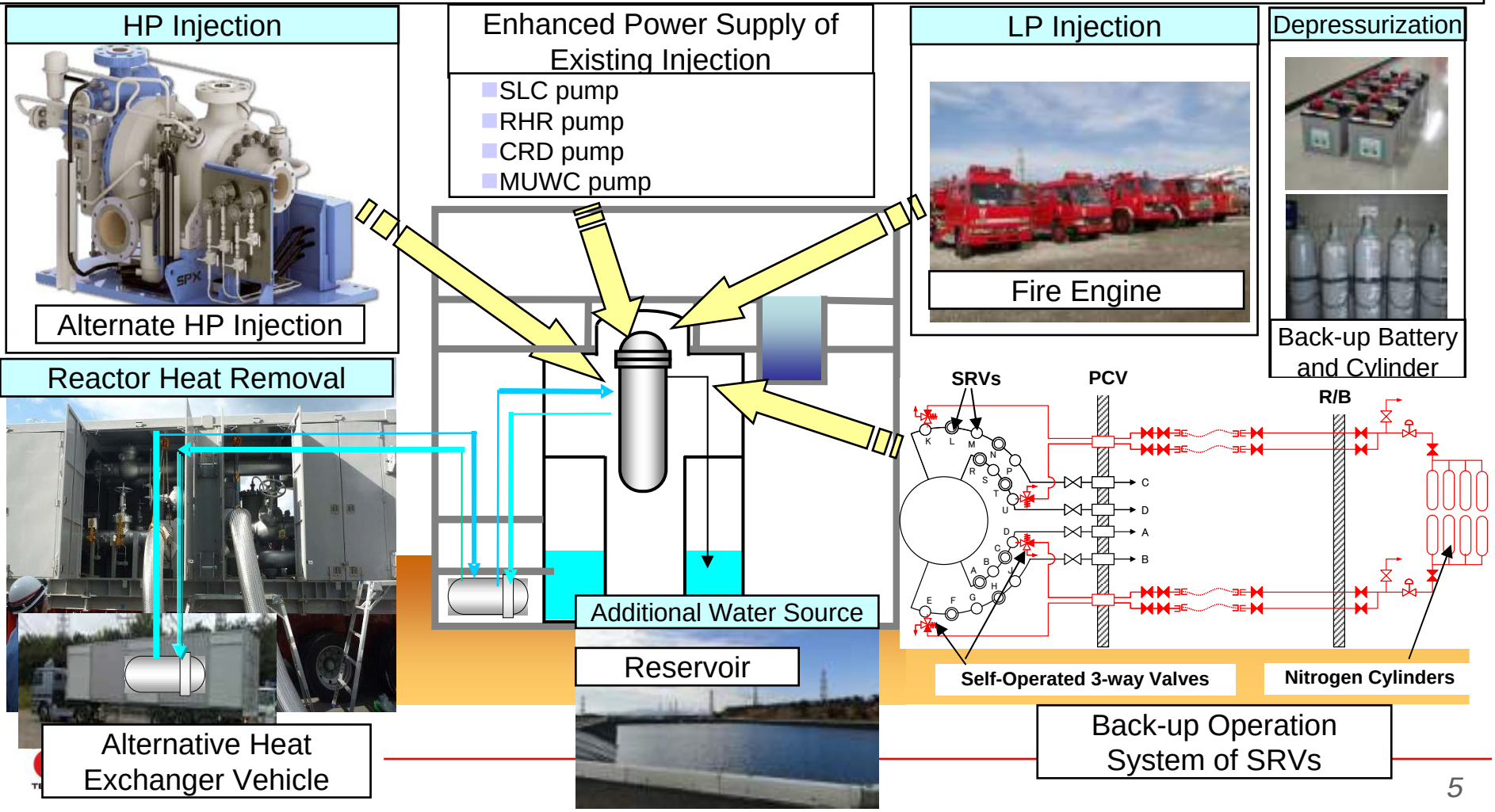


Fireproof Treatment of cable tray

Measures to control accident 1

Water Injection and Heat Removal Functions

- Enhance High Pressure Injection Function: High Pressure Alternate Cooling System
- Enhance Depressurization: Back-up Operation System of SRVs
- Additional Water Source: Reservoir
- Enhance Heat Removal Function: Alternative Heat Exchanger Vehicle

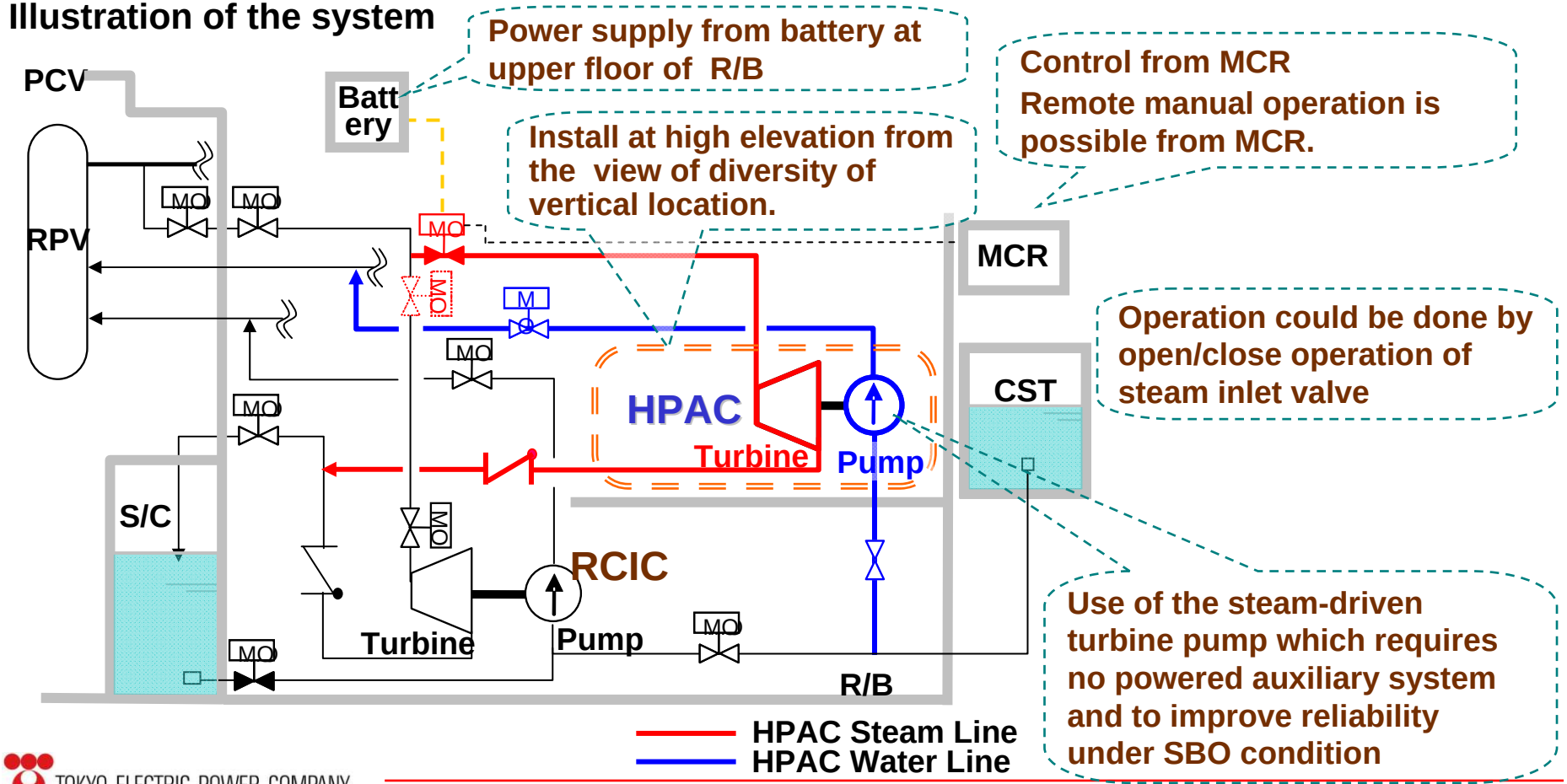


Measures to control accident 2

High Pressure Alternate Cooling System (HPAC)

Back-up system of RCIC to enhance reliability of the high pressure core injection: activated in case of malfunction of the RCIC system to prevent the core damage

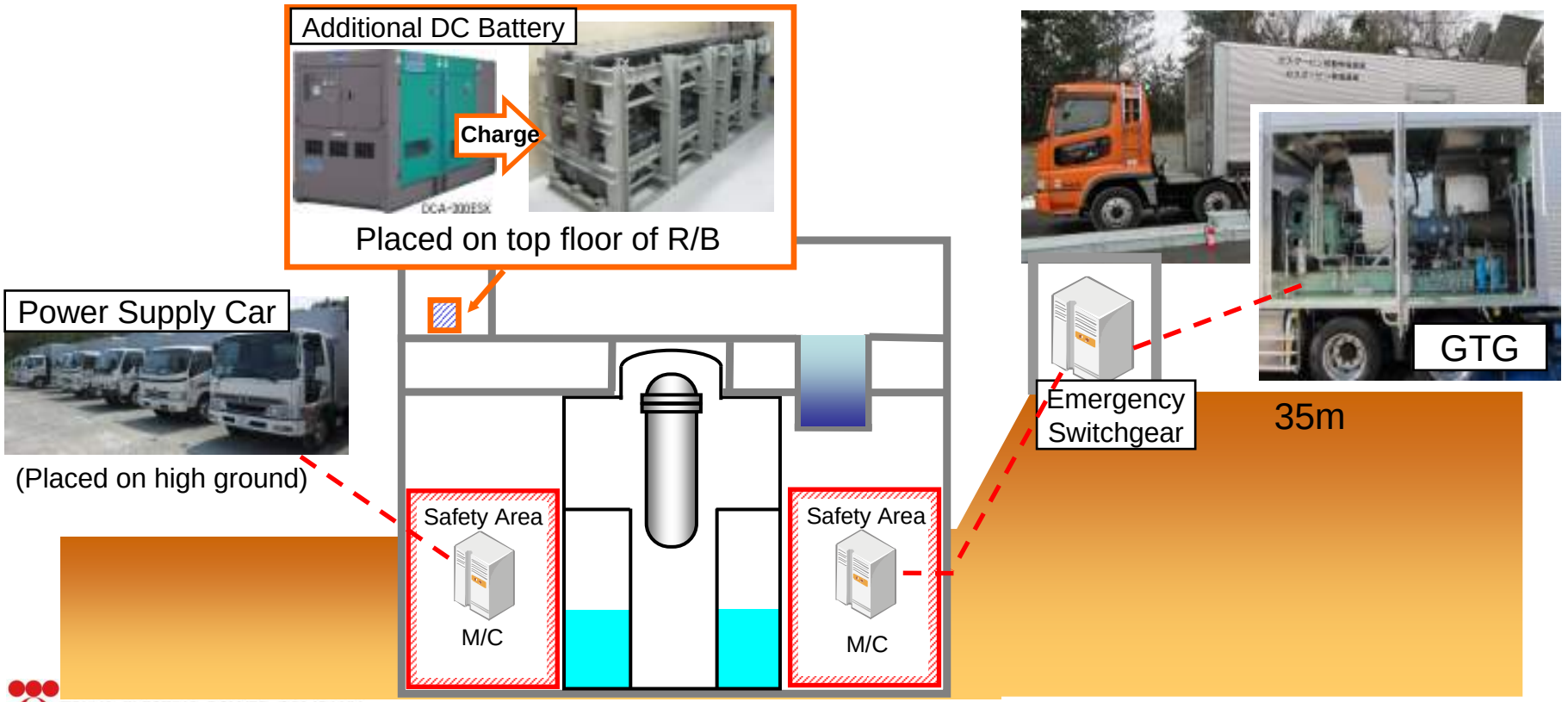
○ **Illustration of the system**



Measures to control accident 3

Power Supply Function

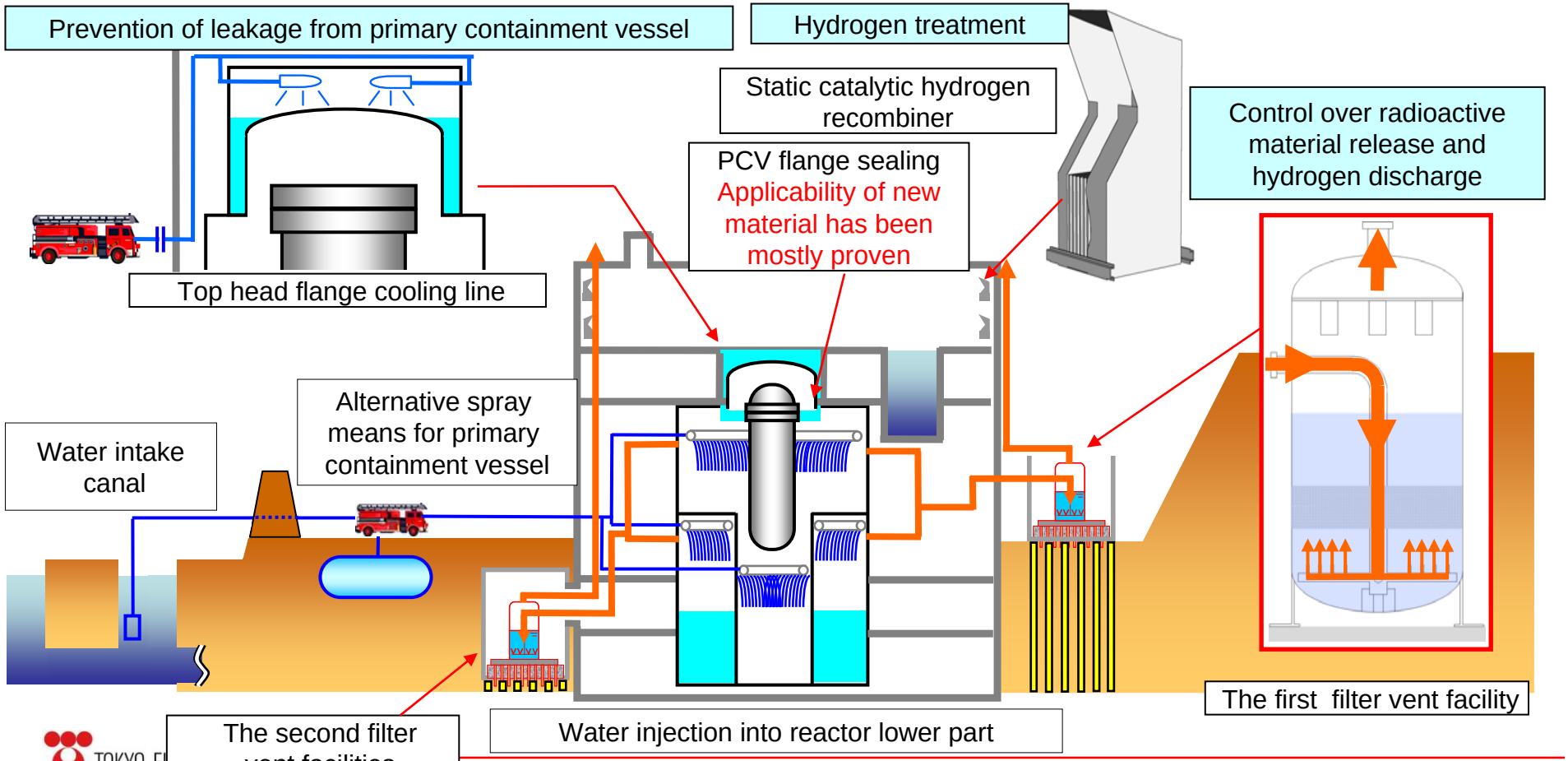
- Measures for quick power supply
  - ➢Gas-turbine generator vehicle, power supply car on a high ground.
  - ➢Emergency switchgear and installed electrical cable.
- Enhancement of DC Power
  - ➢Rechargeable additional DC power on top floor of the Reactor Building.



Measures to mitigate consequences of accident 1

Protection of the PCV and prevention of hydrogen explosion

- Protection of PCV by preventing over-pressure/temperature: RPV Top Head Flange Cooling, PCV Flange Sealing
- Mitigation of Radioactive material release: Filtered Vent
- Prevention of hydrogen explosion: Static catalytic hydrogen recombiner



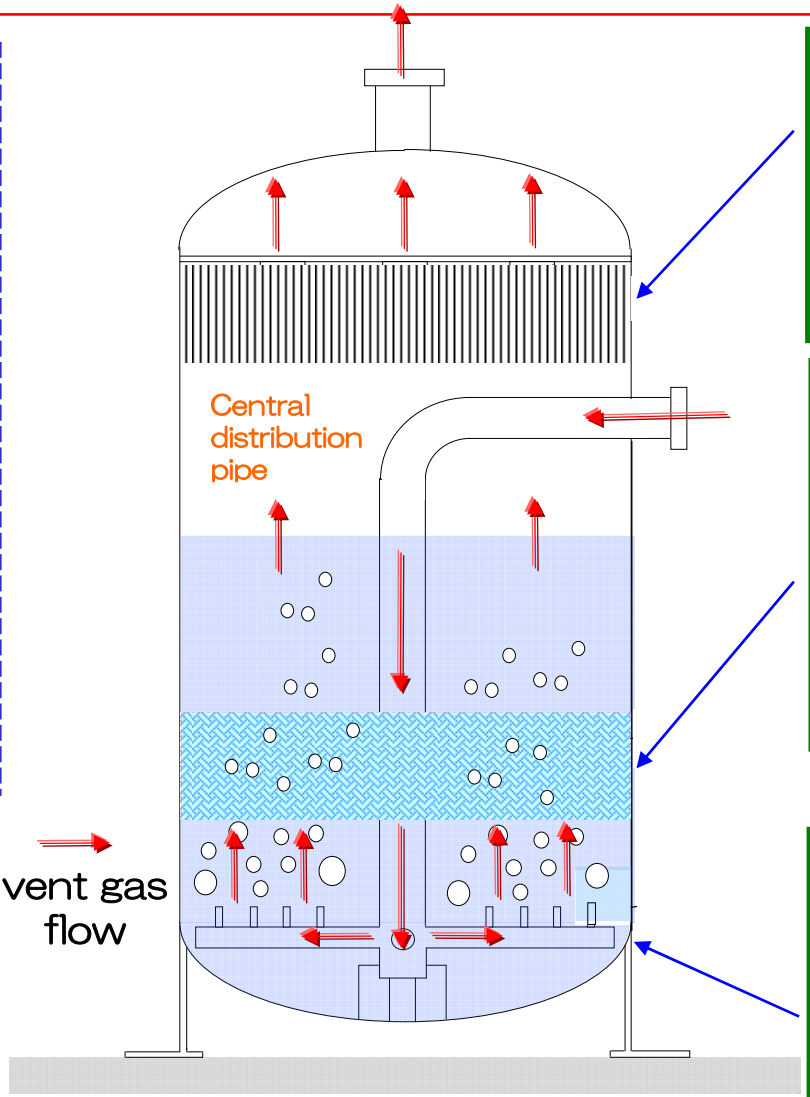
Measures to mitigate consequences of accident 2

Filtered Containment Venting System

(1F accident)
Massive FP release, Long term & contamination of soil

→Prevent PCV rupture by PCV spray and filtered venting system

→DF for particle FP is > 1000



FV unit image

③ Metal filter

Capture aerosol in vent gas. Separate droplet from vent gas

② Mixing elements

Mix Vent gas and scrubber water and atomize bubbles to enhance scrubing ratio

① Scrubber Nozzles

Vent gas is jetted to scrubber water uniformly over whole cross section.