

# THE HUMAN ASPECT OF THE FUKUSHIMA DAIICHI ACCIDENT

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**Tokyo Electric Power Company**

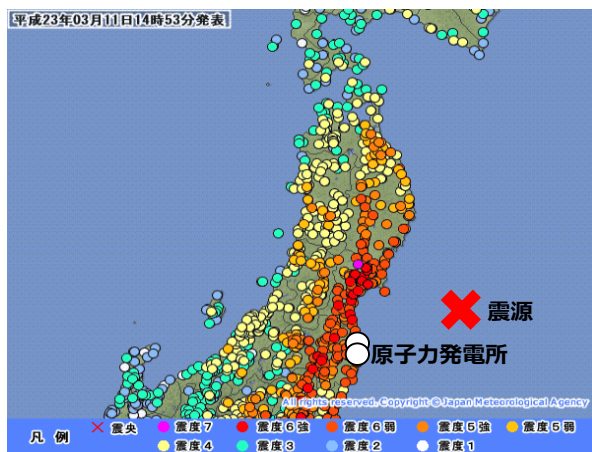


TOKYO ELECTRIC POWER COMPANY

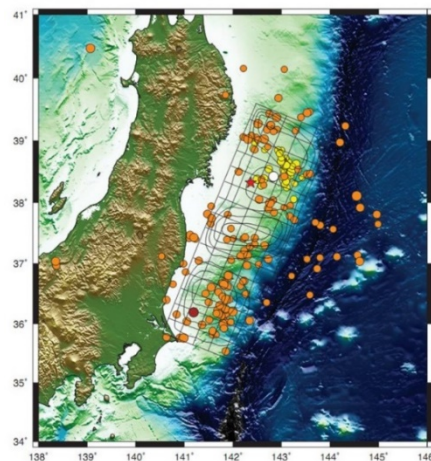
# Magnitude of Earthquake and Tsunami

Earthquake time: March 11, 2011 (Friday), 2:46 PM

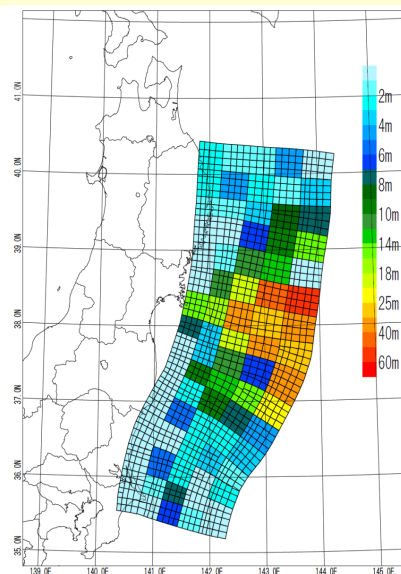
- Site of occurrence: Off the Sanriku coast (lat.  $38^{\circ} 06.2'N$ , long.  $142^{\circ} 51.6' E.$ ), Focal depth: 24 km
- Magnitude of earthquake: 9.0
- Intensity at each location: Kurihara City, Miyagi Prefecture - Intensity 7
- **Intensity 6 Upper: Naraha, Tomioka, Okuma and Futaba town in Fukushima Prefecture**
- **Intensity 6 Lower: Ishinomaki City and Onagawa town in Miyagi Prefecture, Tokai village in Ibaraki Prefecture**



Seismic intensity distribution of present earthquake



Source area of present earthquake  
(Created by Earthquake Research Institute, University of Tokyo)



Source of present tsunami  
(Created by TEPCO)

# Damage to Fukushima Daiichi NPS (1)



# Damage to Fukushima Daiichi NPS (2)



Unit 5 sea side seawater pump area



Unit 1 containment seawater cooling system pump

Confirmation result for the main flooding route by on-site confirmation surrounding the building

- (1) Building entry/exit
- (2) Equipment hatch
- (3) Emergency D/G air supply louver
- (4) Trench, duct (penetration of cables) etc.

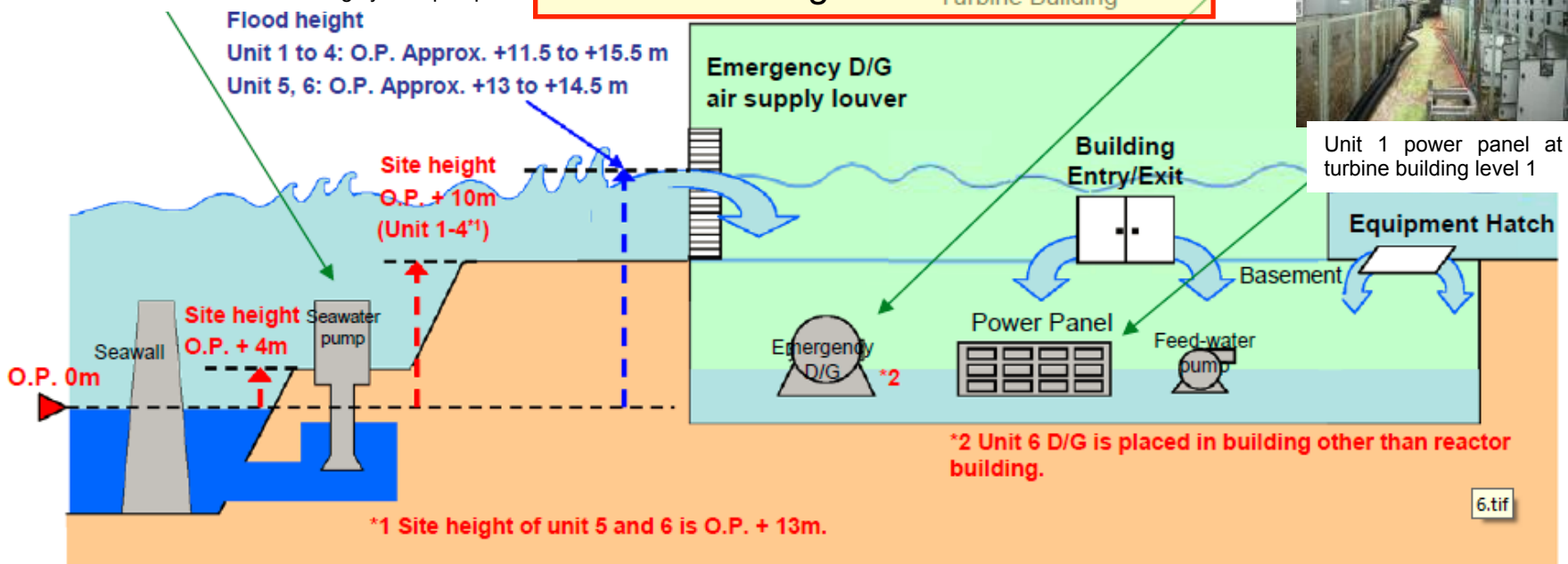
⇒ Flooding of D/G, electric panel room etc. through these.



Unit 1 D/G (1B)

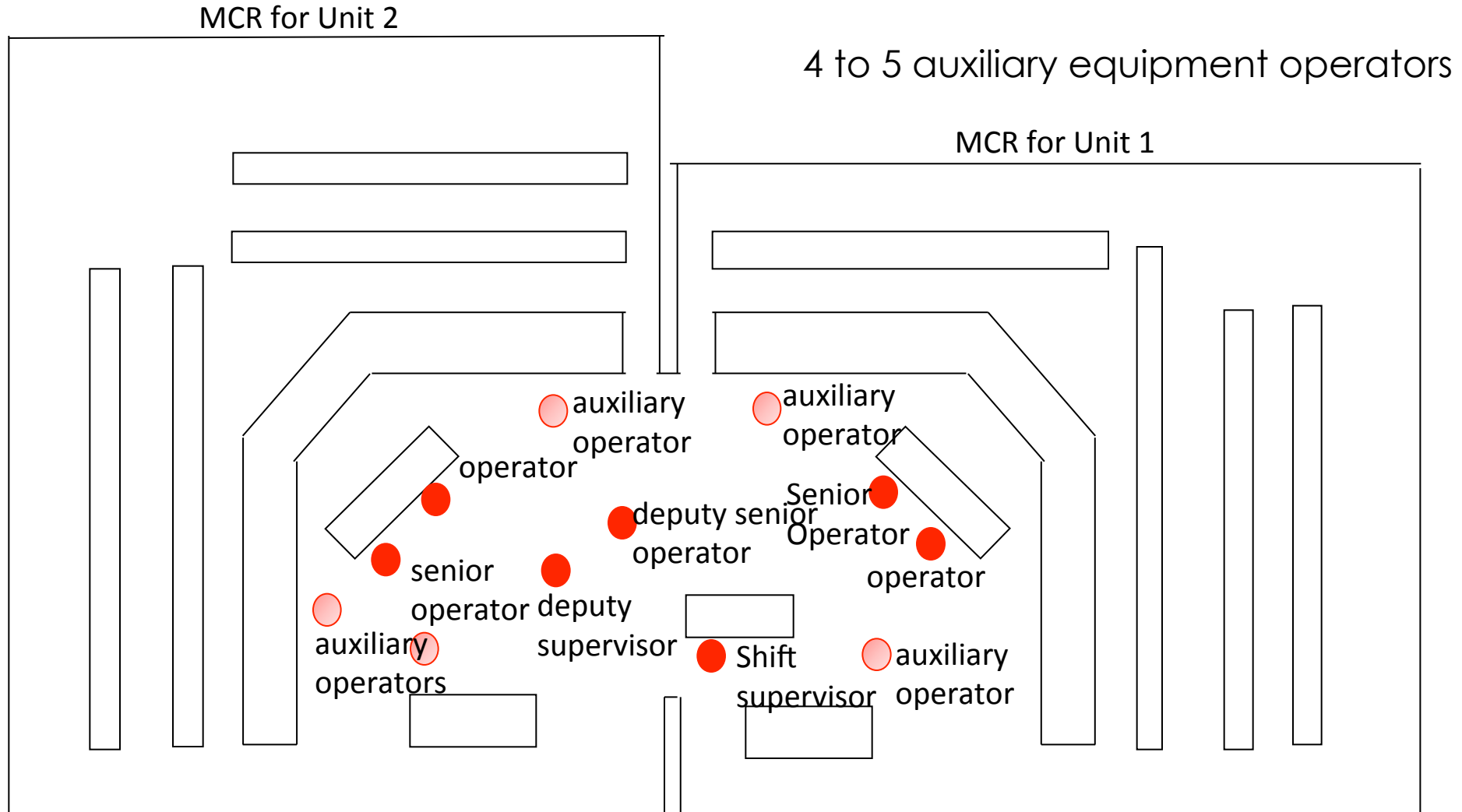


Unit 1 power panel at turbine building level 1

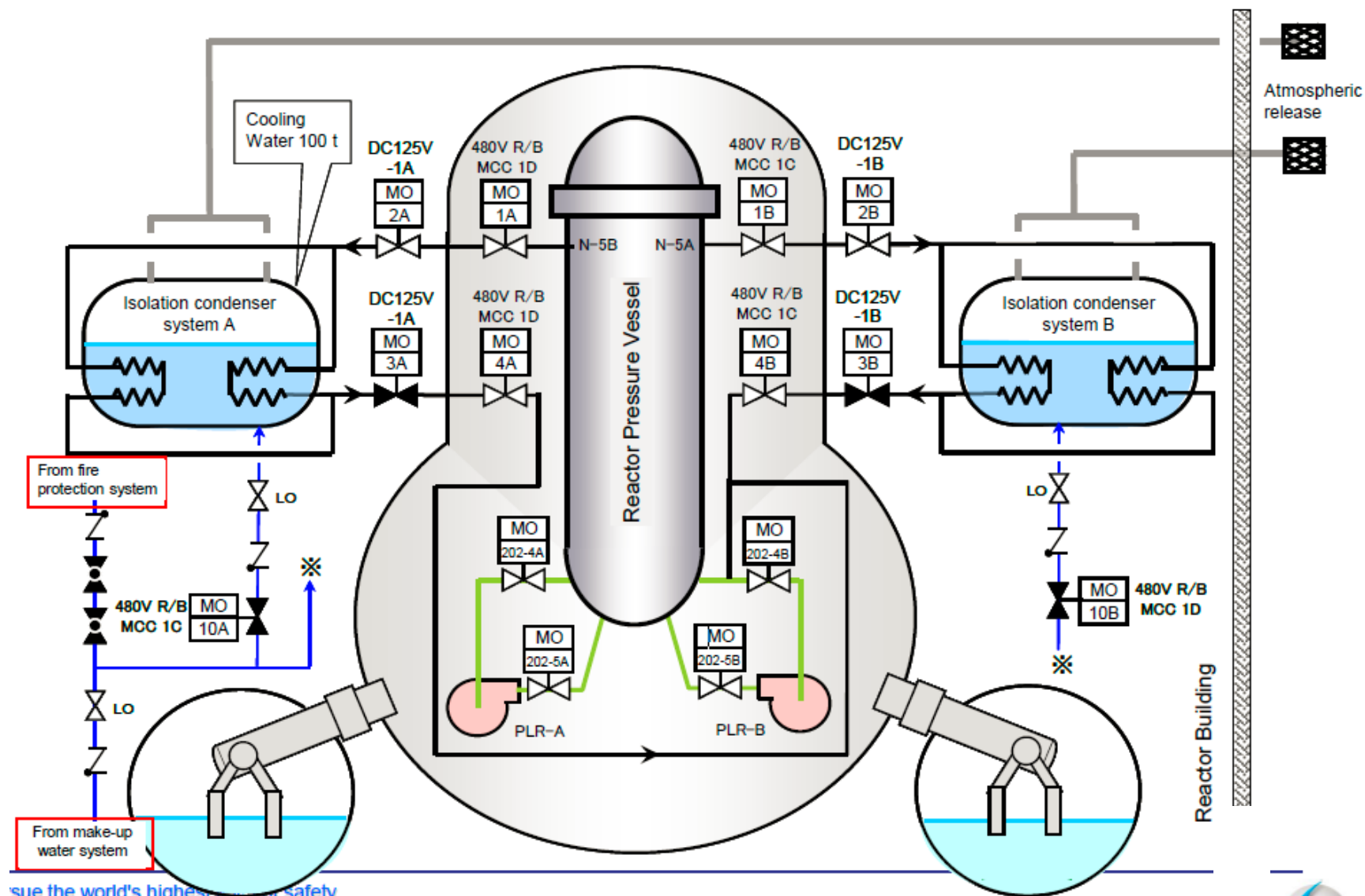




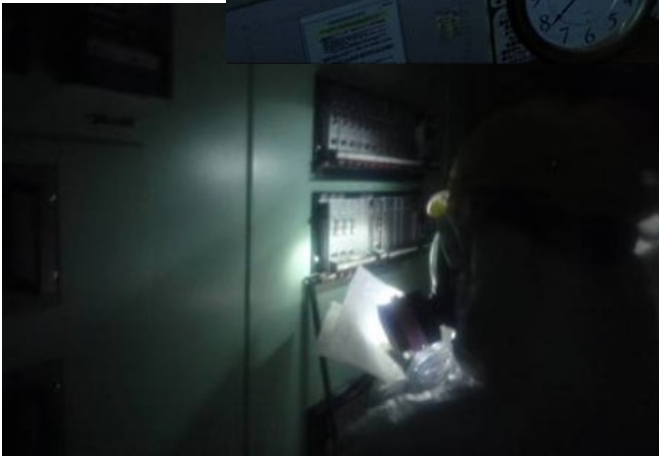
# MCR Layout at the time of the Accident



# Isolation Condenser (IC)



# Damage to Fukushima Daiichi NPS (3)

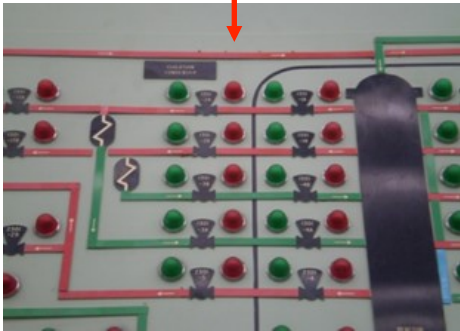
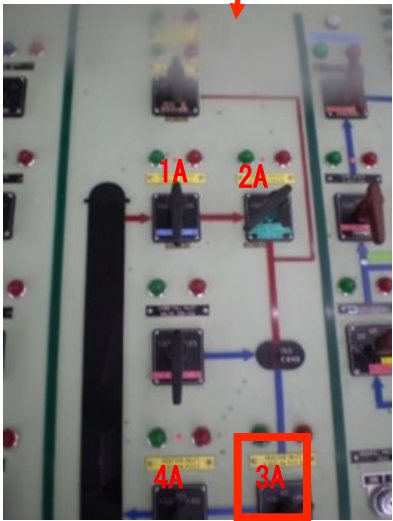
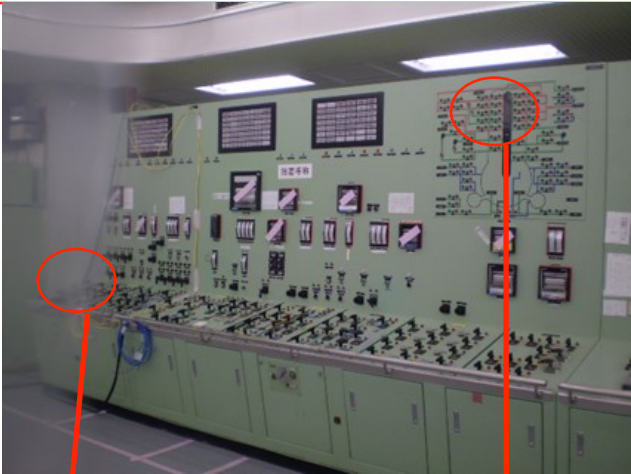


Tsunami that hit the power station

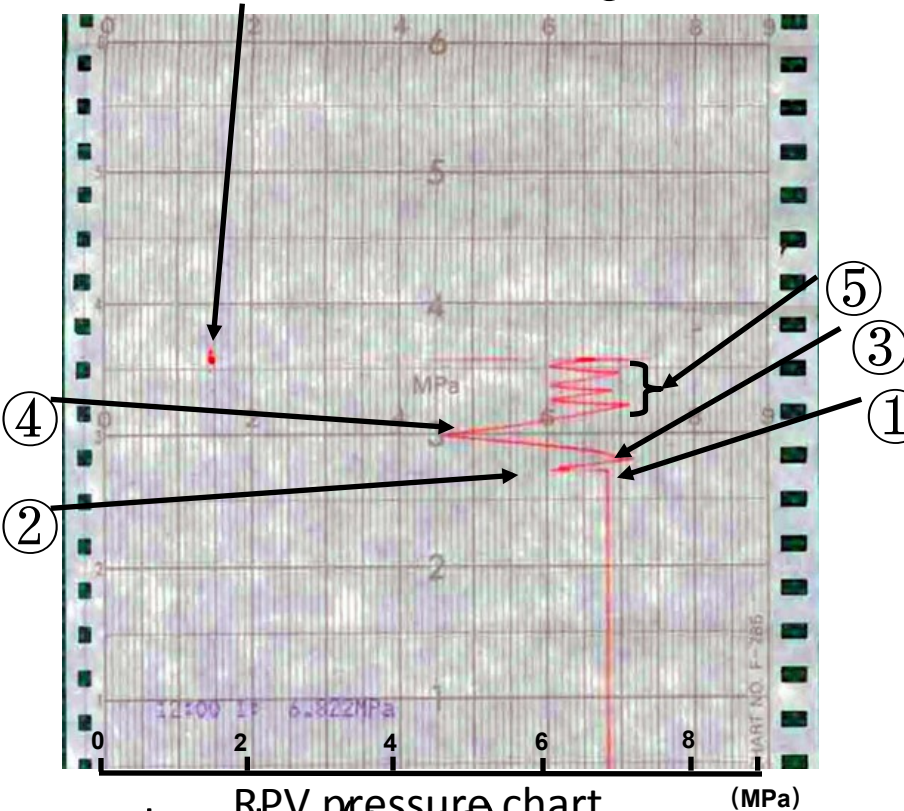
Operating Staff had to work at MCRs  
with very limited lightning

# IC operation after the Earthquake

Unit 1  
MCR



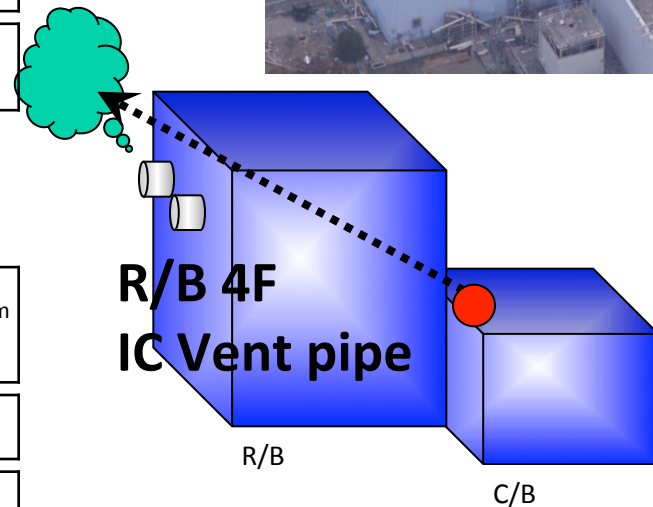
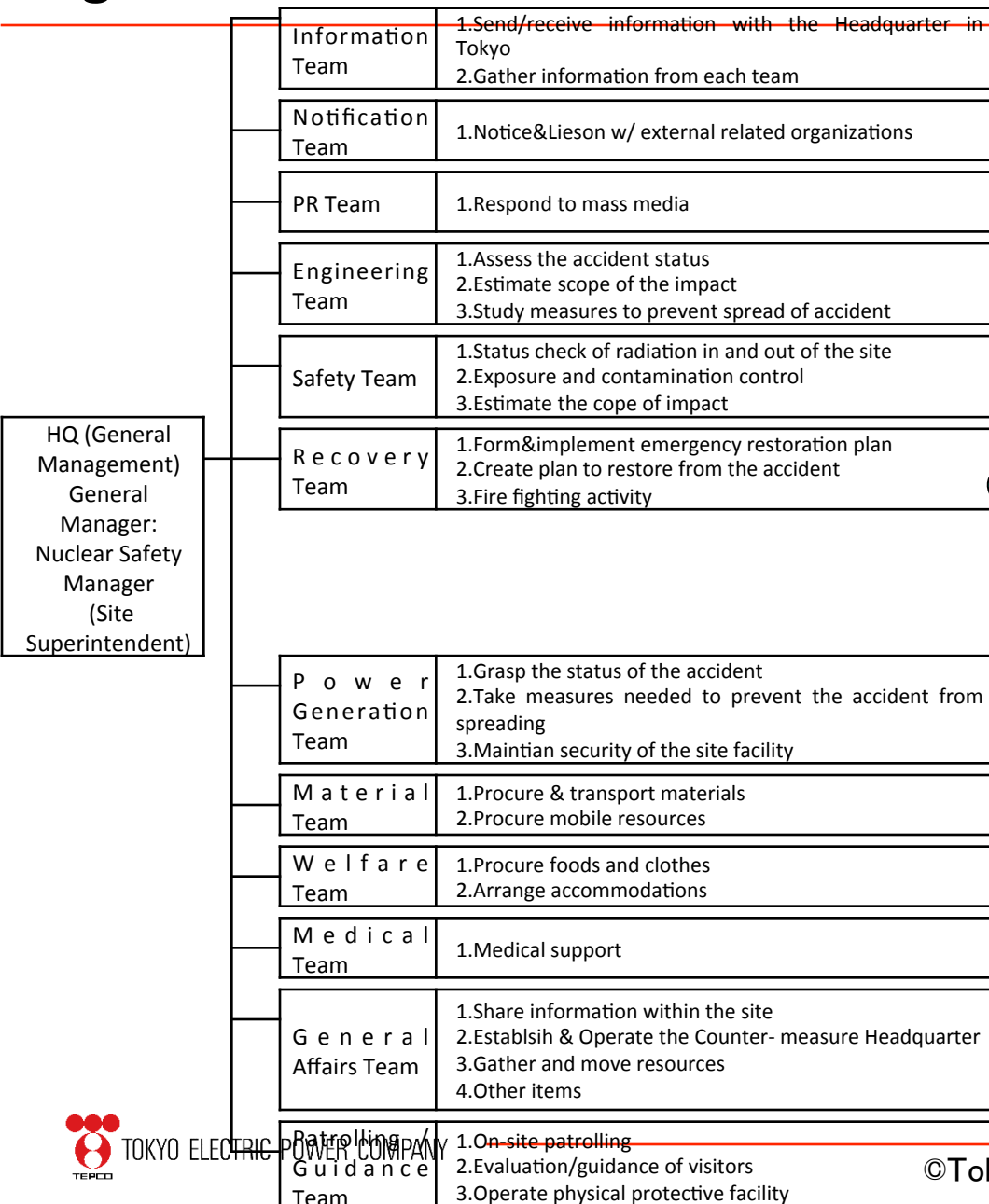
around 15:30:  
end of data recording



- ① Scram by the earthquake (14:46)
- ② Pressure increase due to MSIV closure
- ③ Depressurization due to IC operation (14:52)
- ④ Pressure increase due to stop of IC
- ⑤ pressure change related to IC operation

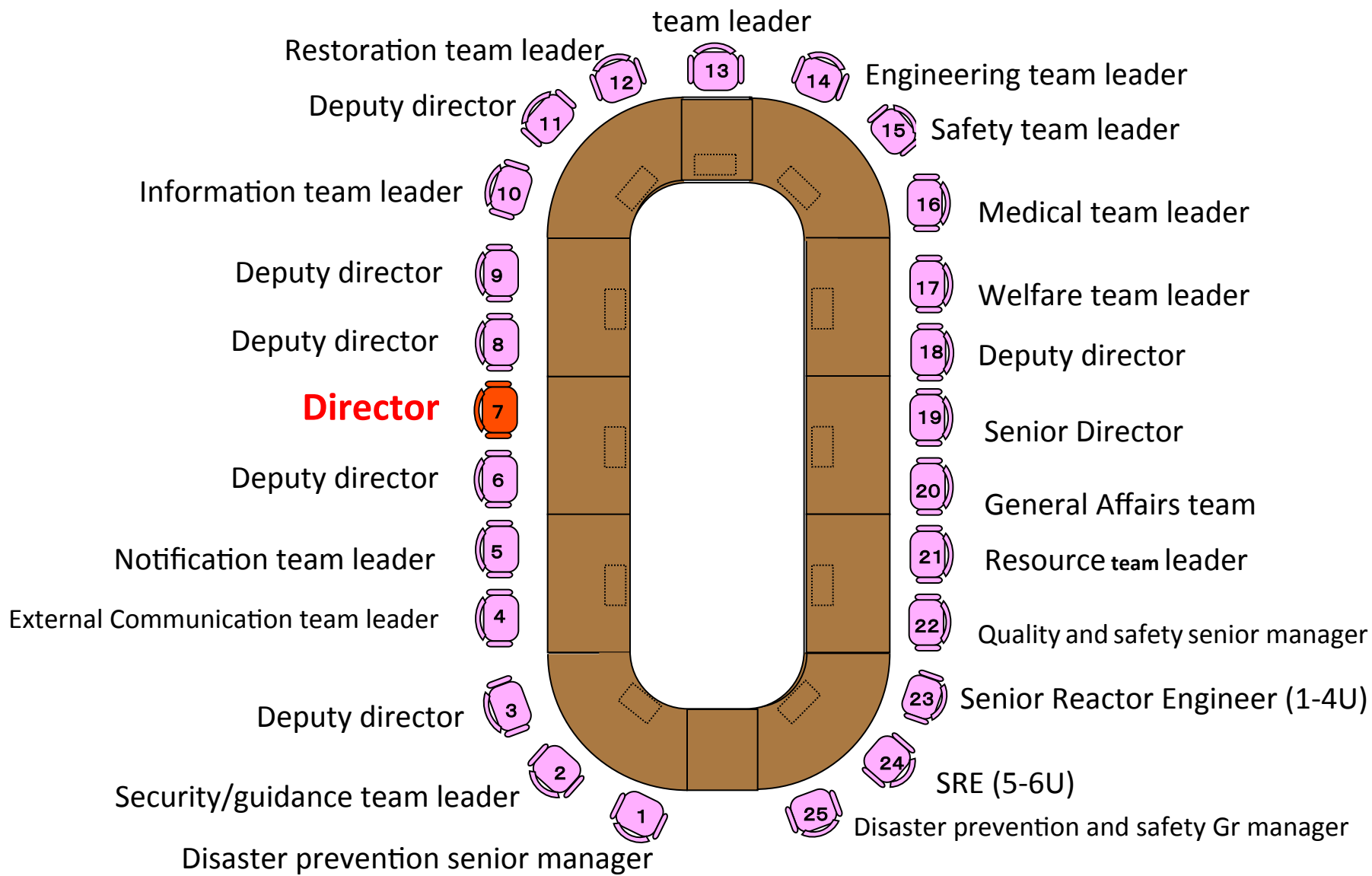


## Organization chart of site ERC



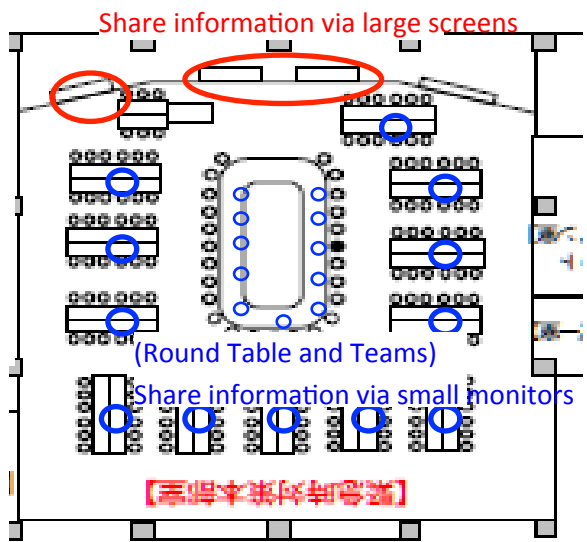
# Floor plan at the site ERC

Power generation

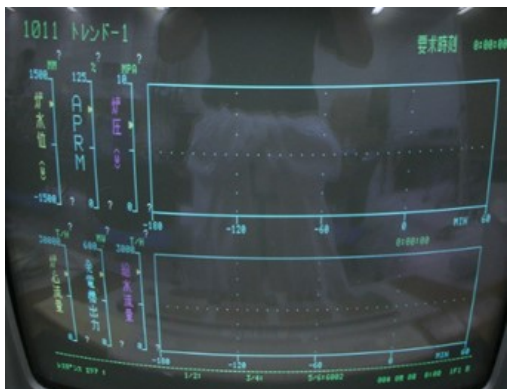
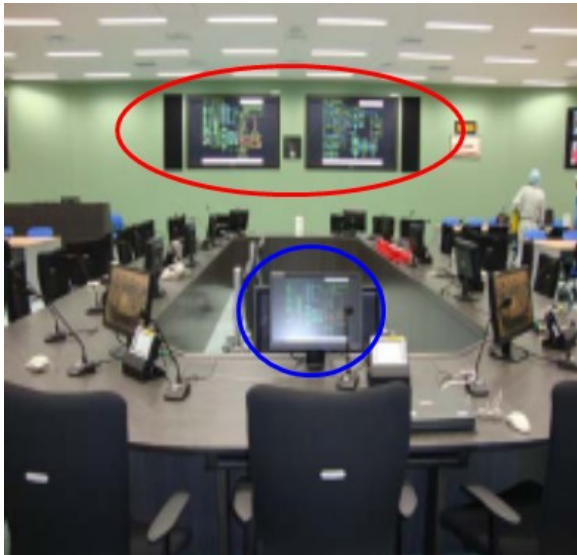


# Reference) communication during normal operation

Emergency  
Response  
Center



SPDS information (safety parameter display system) is displayed in large-sized screens, round table and small monitors for each team. Staff can check and monitor the latest status of the plant.



# IC operation after the Tsunami



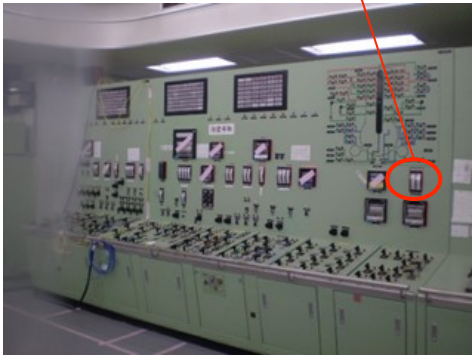
16'41 水位不明 - 90cm 水位不明

(仮設) W/C 水位 水位不明

16'55 水位不明

17' 水位不明 (16'55) 水位不明 (-150cm) 水位不明

Handwritten notes on the right:  
 ① DD7P - ランダムに水位不明  
 7/8 地下 全水位不明 (水位不明)  
 ② 1/6 地下 全水位不明 (水位不明)  
 SWPP (1) 水位不明  
 CWP (2) 水位不明 (-150cm)



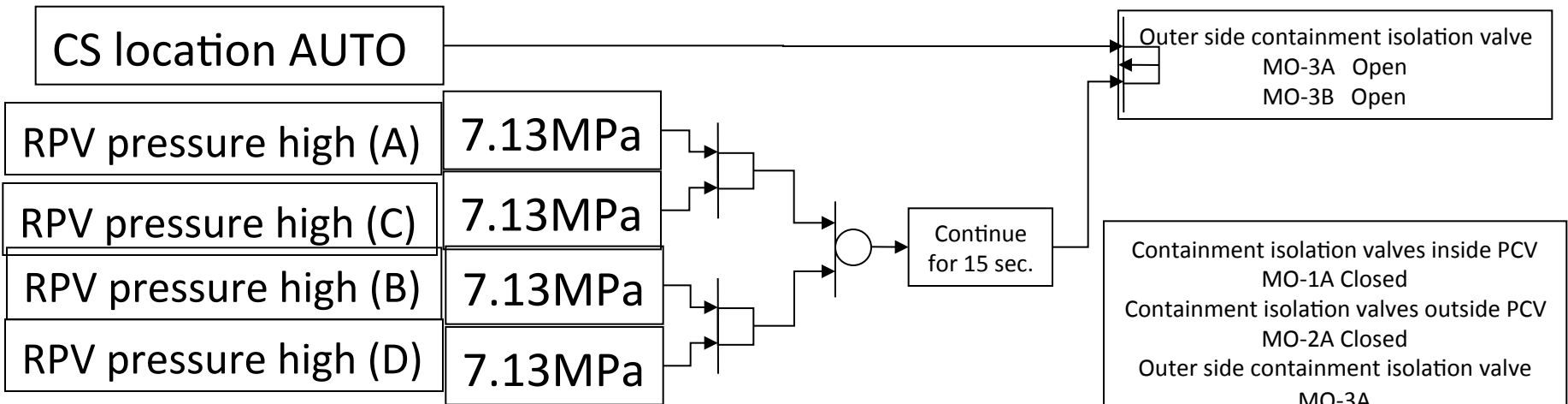


# Double doors

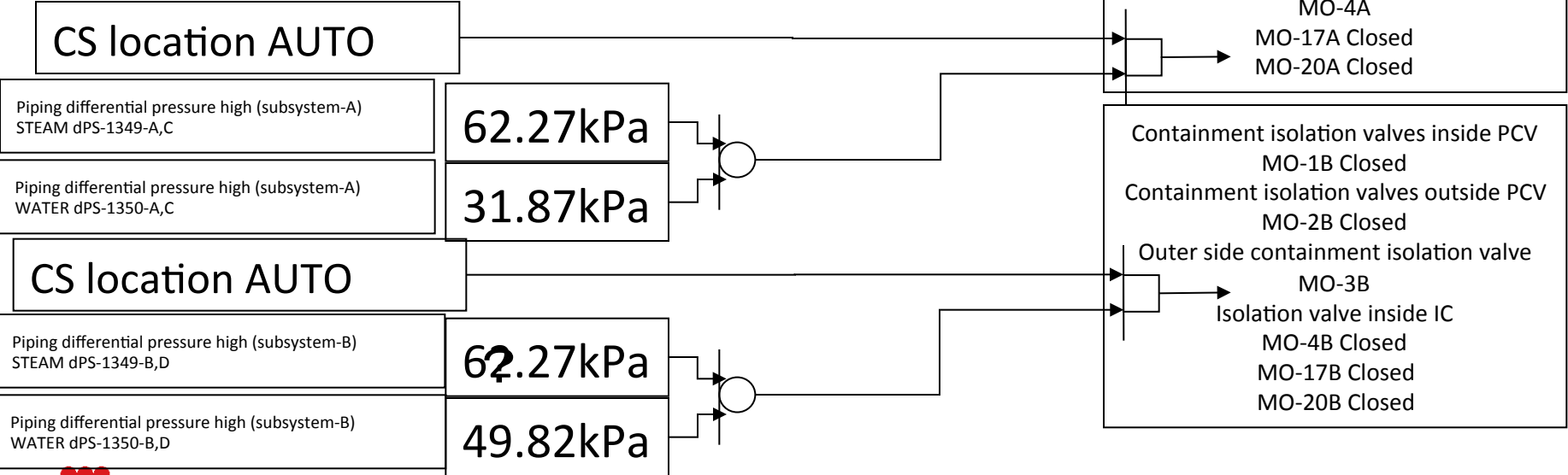


# Logic sequence of IC operation

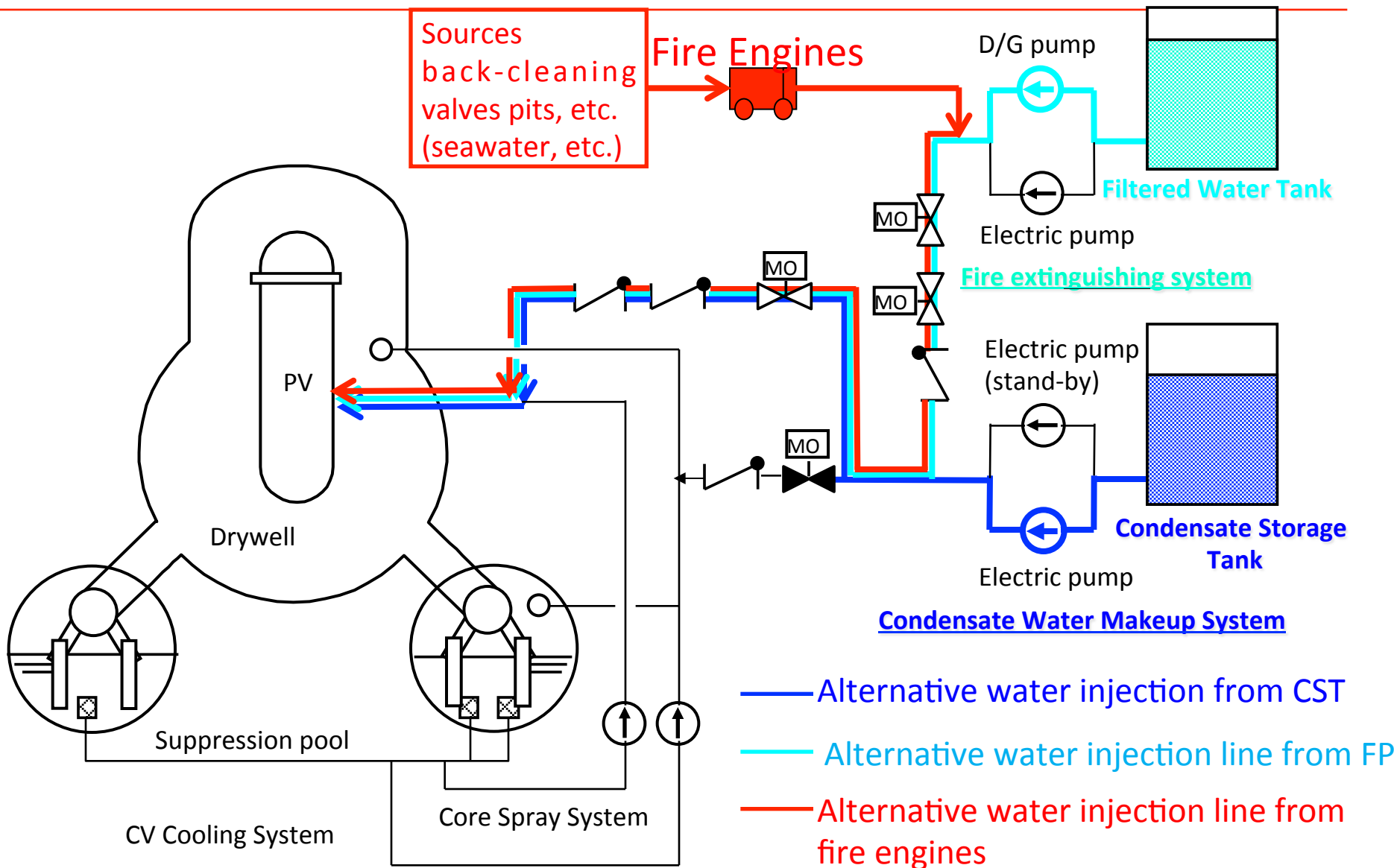
## ◆ Automatic Start



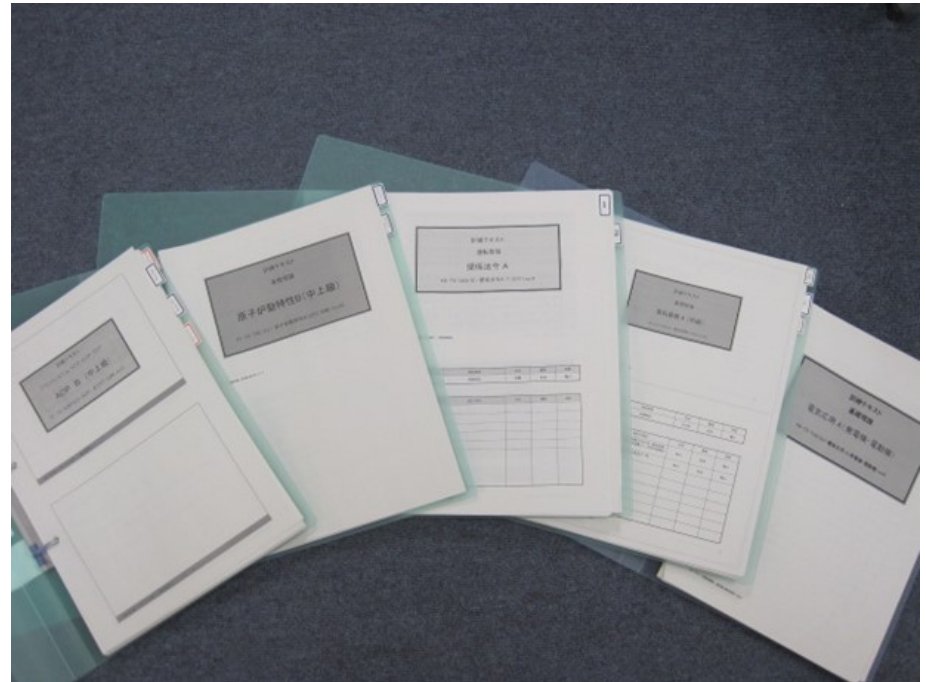
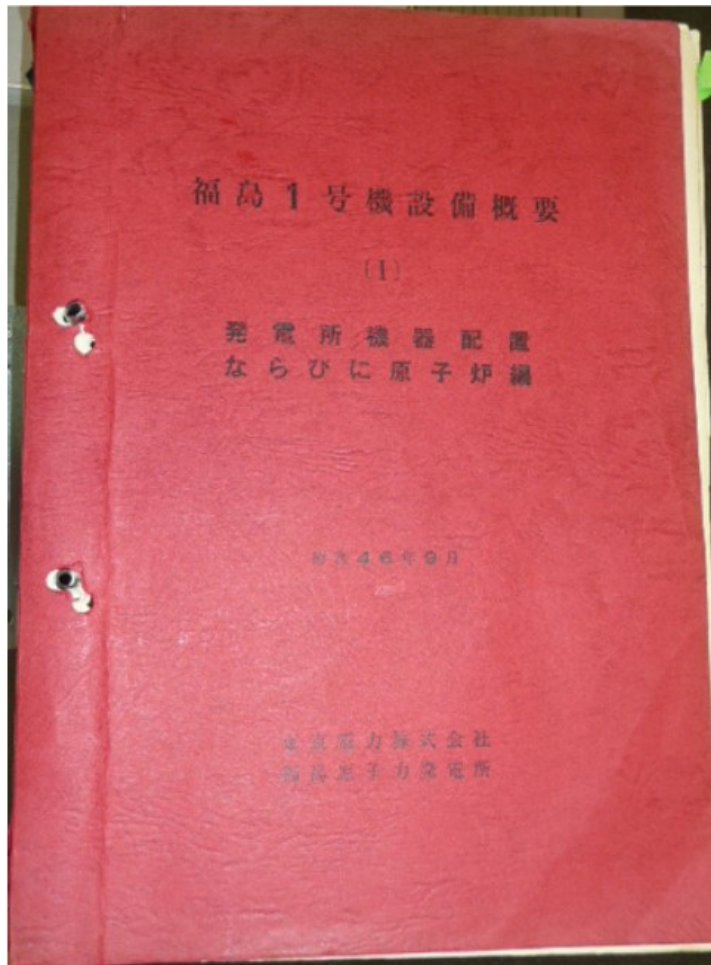
## ◆ Automatic Shutdown



## Alternative water injection lines



# Design document and Training material for Operators



Design documents and training manuals for operators

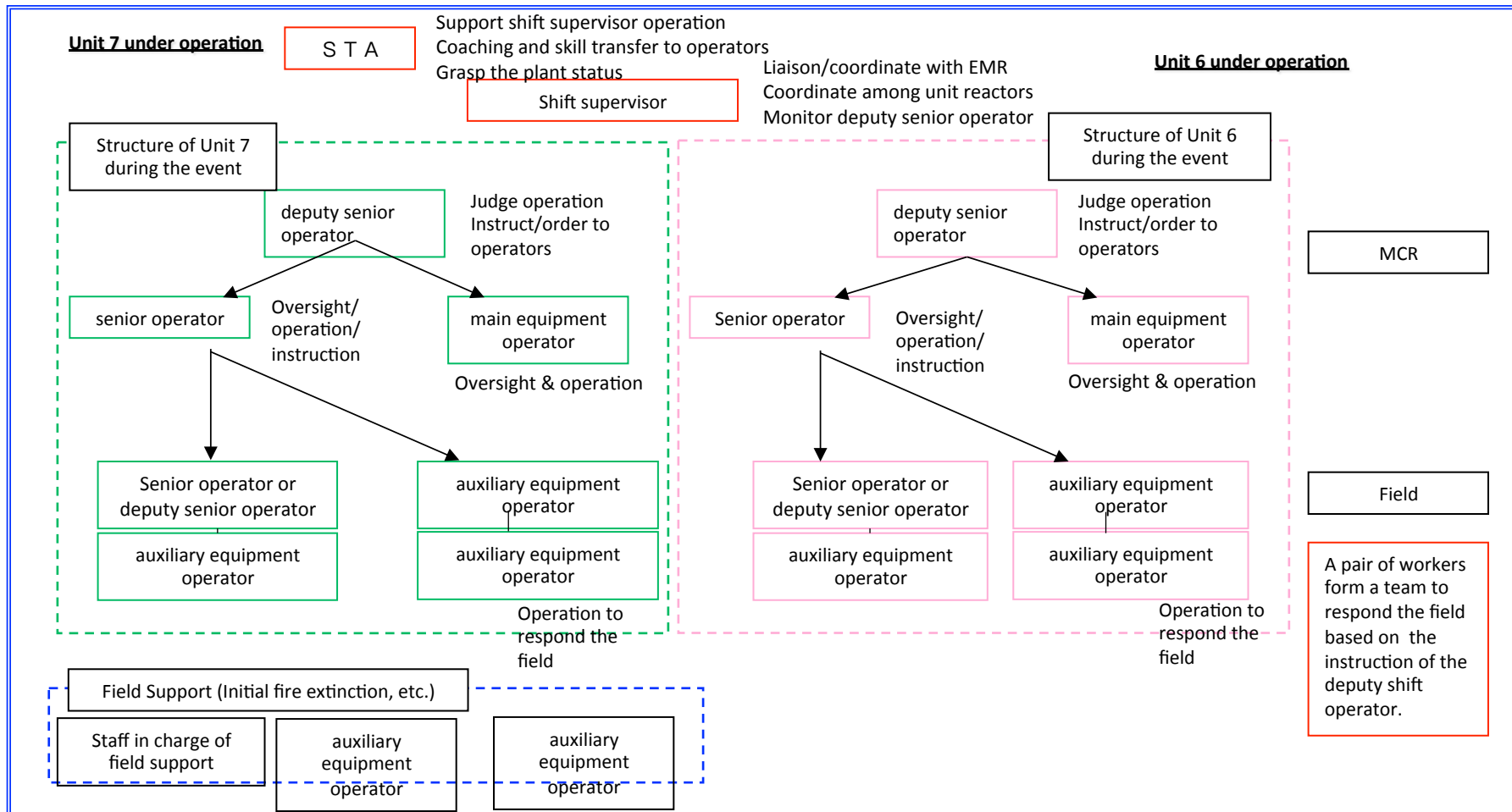


# IC operation

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Movie when IC is activated

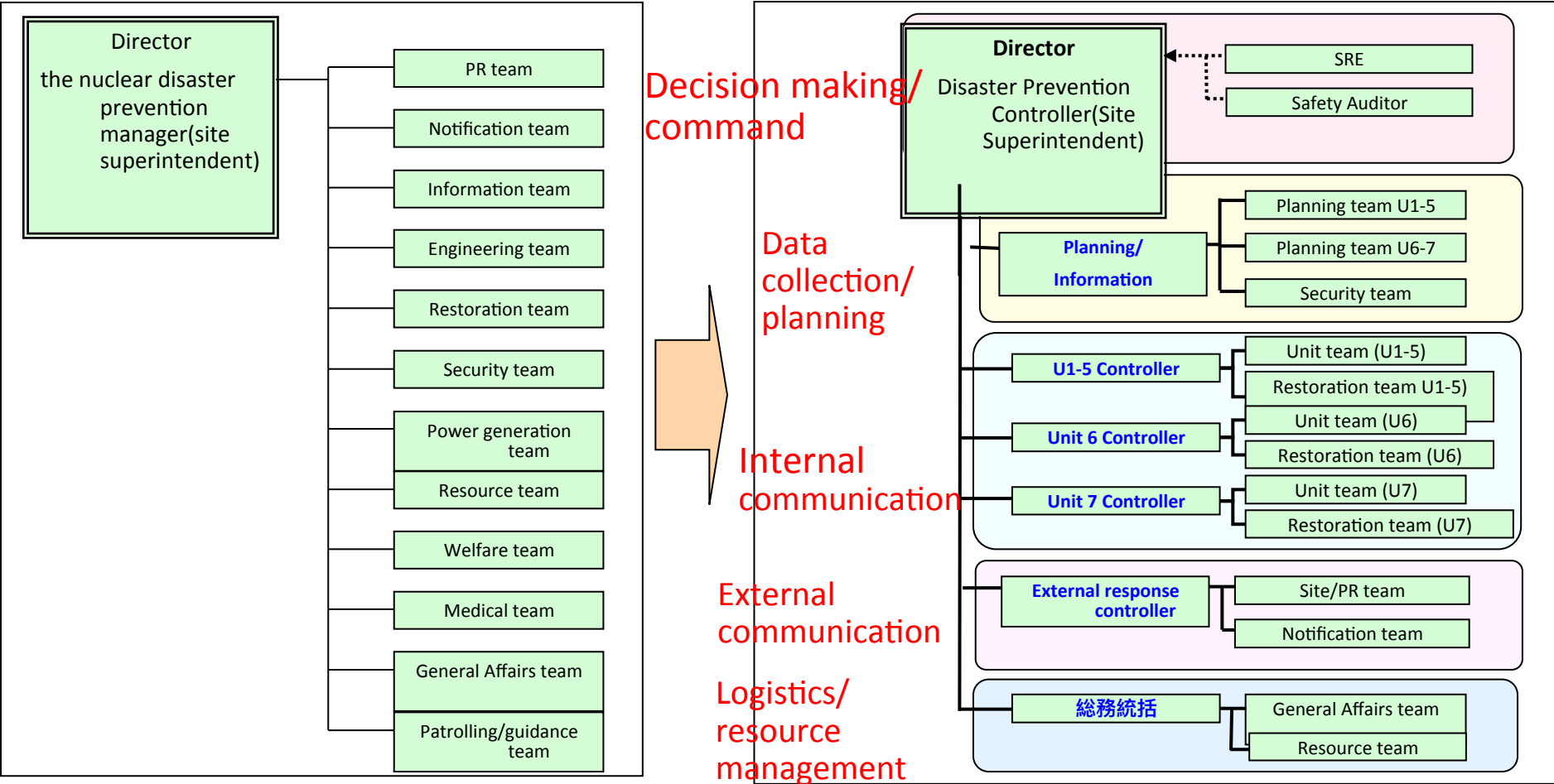
# Improved operating crew staffing



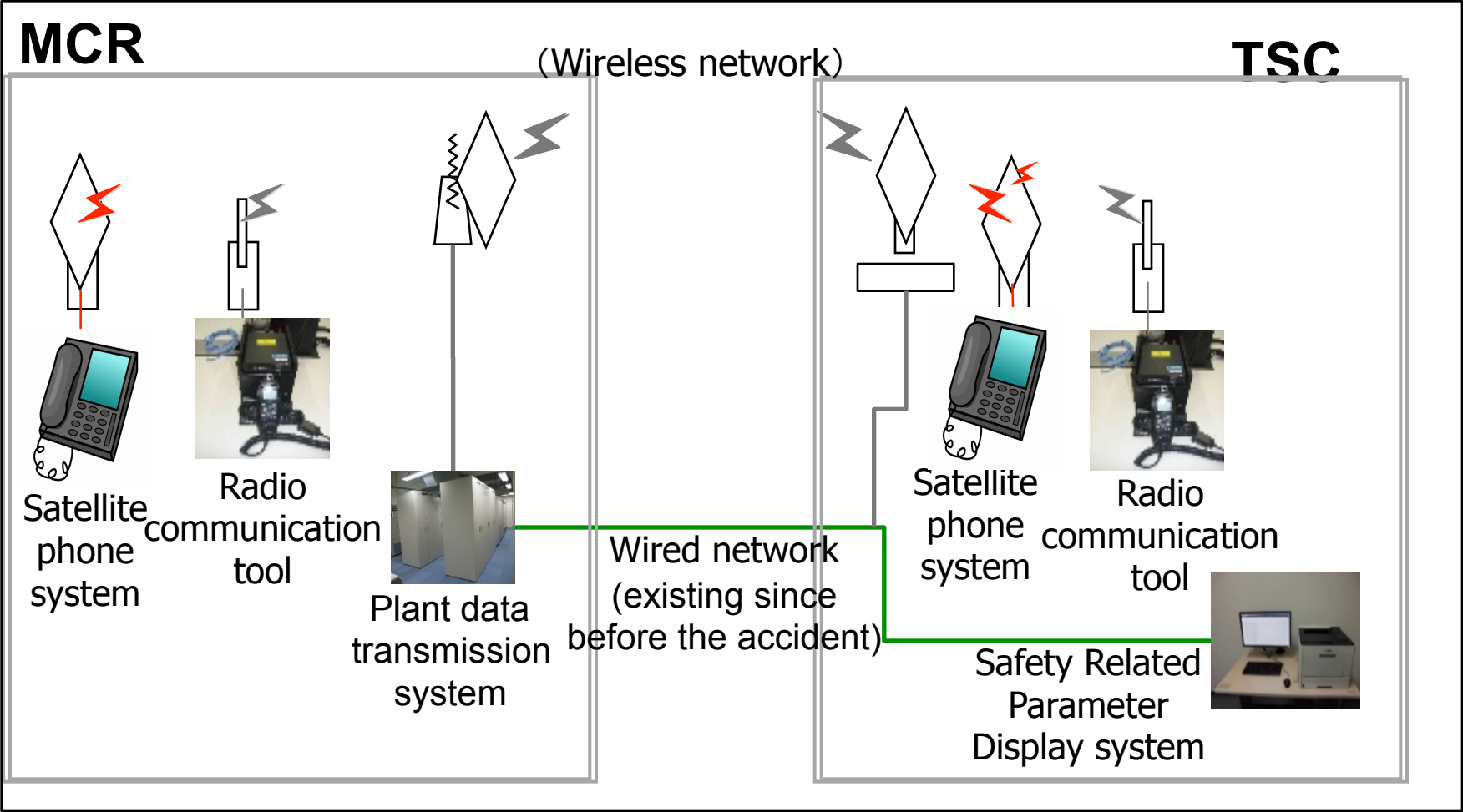
(when 2 plants are in operation: 18 crew + 1 STA)

# Introduction of ICS concept

(Before) Build 12 functional teams in parallel under the Director.  
(After) Narrow the Director's span of control and stratify groups by function



# Improved communication tools



Enhanced diversity of communication tools between MCRs and TSC

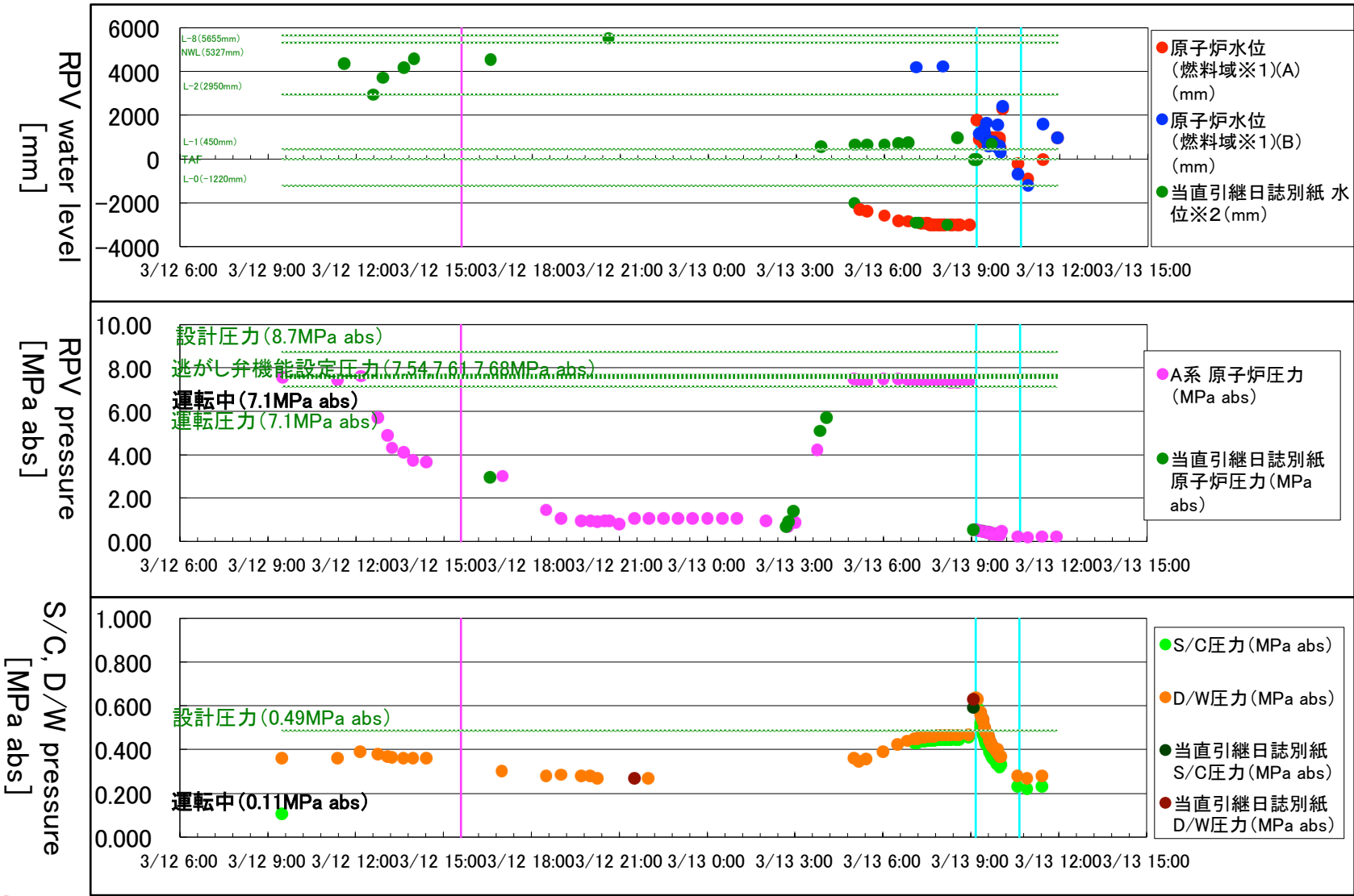


# HPCI data chart at Unit 3

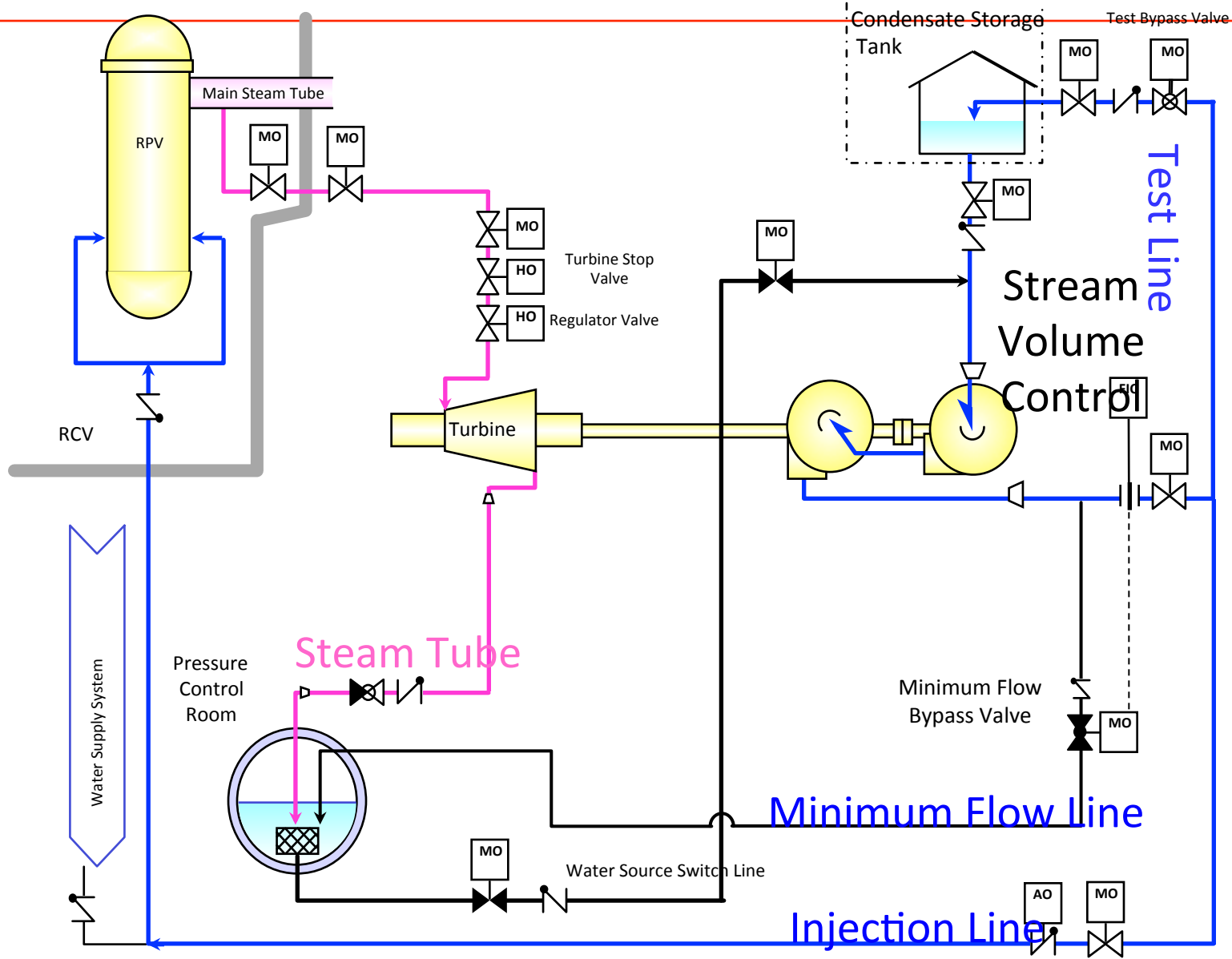
<MAAP解析>

1号機原子炉建屋爆発(15:36)

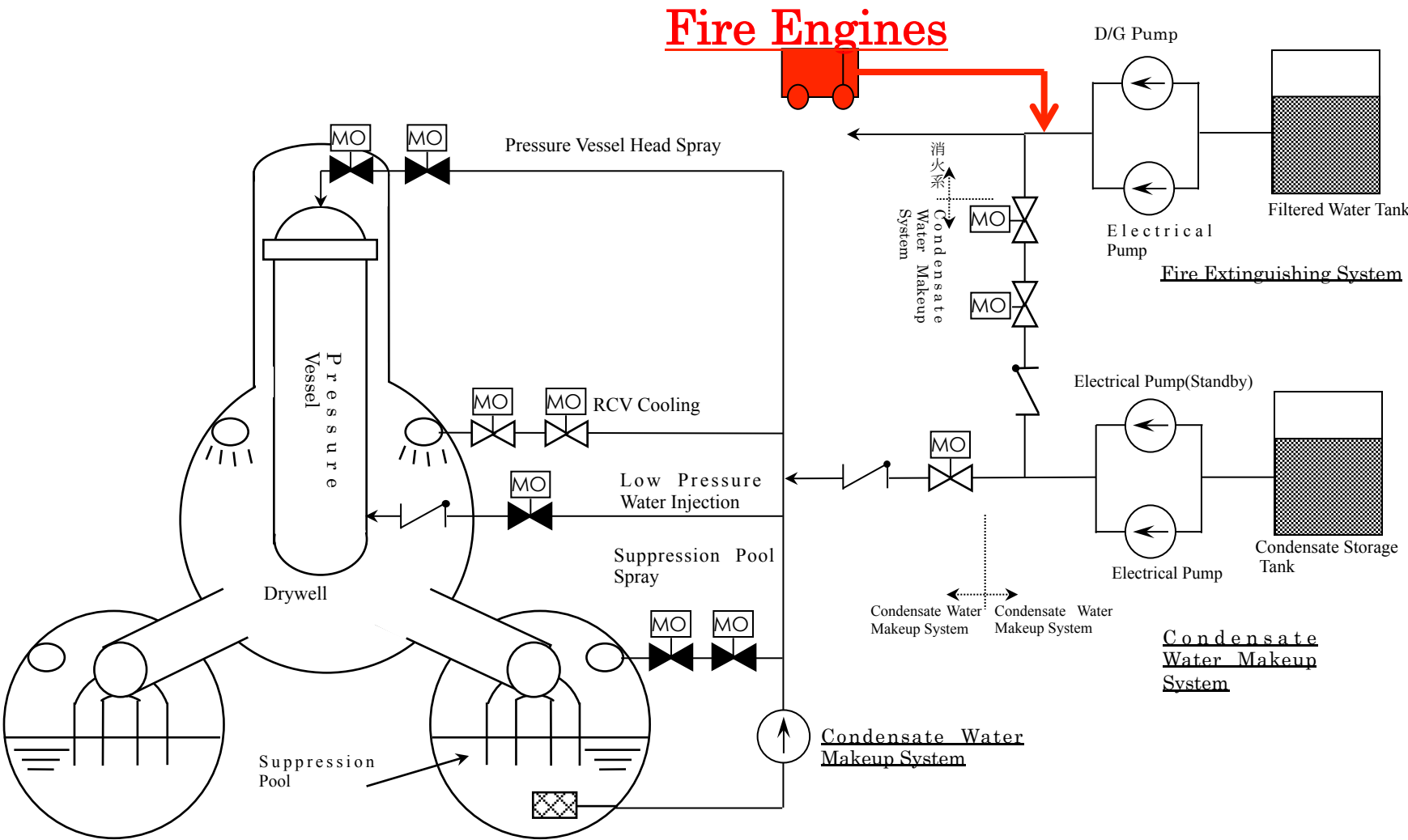
TAF到達<地震発生後約42時間>(9:10頃) 炉心損傷開始[水素発生開始]  
<地震発生後約44時間>(10:40頃)



# HPCI (High Pressure Core Injection) system at Unit 3



# Water injection by fire engines



# Lessons from HPCI operation at Unit3

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## 【HPCI Shutdown and Responses Afterwards】

- Operators thought they could manually open SRV only with the light of the indicator lamp. The status should have been carefully checked,
- They should have prepared necessary gas (nitrogen cylinder) to start-up and D/C power to drive the solenoid valve in advance.
- Depressurizing should have been conducted with keeping HPCI's operation, and then inject cooling water via D/D FP.
- Similar to the situation we had with IC, risk analysis of the HPCI shutdown was not sufficient.

## 【On information sharing before HPCI shutdown】

- The idea to stop HPCI was shared among shift team and TSC Power Generation team, while it took one hour for the entire TSC to recognize it .

○ It is necessary for the site to have a structure that can endure simultaneous events in multiple units and continuous response for the long term.

# Conclusions

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Our Resolution:  
We will never forget the Fukushima Nuclear Accident. We will increase the level of safety today more than yesterday and tomorrow more than today, and we will become a nuclear operator that continues to create unparalleled safety.

## Our Resolution

We will never forget the Fukushima Nuclear Accident. We will increase the level of safety today more than yesterday and tomorrow more than today, and we will become a nuclear operator that continues to create unparalleled safety.

To improve Nuclear Safety

● ● ● Our Approach ● ● ●

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7. Measuring the progress of Nuclear Safety Reform