Fundamental Policy for the Reform of TEPCO Nuclear Power Organization

October 12, 2012

Nuclear Reform Special Task Force

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TEPCO

How to Proceed with the Development of the Reform Plan (1)

Measures Adopted After Fukushima Accident

Development of Defense-in-Depth Against External Events

All proposals from various analysis reports covered
- 30 recommendations (NISA)
- Government accident analysis report
- Diet accident analysis report
- Team H2O Project analysis report
- Private accident analysis report
- Internal accident analysis report

○Tsunami measures
○Power source measures
○Water source measures
○High-pressure coolant injection measures
○Depressurization measures
○Low-pressure coolant injection measures
○Reactor & containment vessel cooling measures
○Impact mitigation measures after core damage
○Fuel pool measures
○Earthquake measures
○Measures incorporating other perspectives
○Accident preparation
○Emergency preparation
○Information communication & sharing
○System for procurement & transportation of materials and equipment
○Radiation control system for accidents

See attachments

In addition to looking back at the accident again and strengthening facility aspects and their operation, there is an awareness that further in-depth analysis of management measures is necessary.

Measures So That a Severe Accident Never Happens Again

＜Nuclear Reform＞

○Based upon a profound remorse for the Fukushima nuclear accident, pride and overconfidence in the traditional safety culture and measures has been discarded and we are resolved to reform of management culture.

○Grounded in the resolution that a severe accident will not be allowed to develop no matter what situation arises, we are changing our previous to thinking about safety starting at its basic foundation as we seek out the opinions of experts both inside and outside of Japan.

○Our mandate (mission) as the operators that caused this tragic accident is to communicate to the world the lessons learned at Fukushima.

How to Proceed with the Development of the Reform Plan(2)

- Review the hardware and operational measures implemented in Kashiwazaki-Kariwa (KK) NPS through lessons learned of Fukushima Accident.
- Investigate underlying contributors by looking back on pre- and post-accident conditions, focusing on how the “people” and “organization” thought and acted.
- Accept all suggestions from Accident Analysis Reports and global knowledge and experience.

Fundamental Policy for the Reform

- TEPCO strongly wishes to be “an organization which has the world’s highest level of safety awareness, engineering capabilities and risk communication ability with society” in order to prevent recurrence of Fukushima like accident . (Nuclear Reform).

- Nuclear Reform is defined as a “Evolution from top management of the nuclear power administration.”

- No exceptions and no limitations on areas subject to this activity.

Reform From Nuclear Top Management (1)

Nuclear management will lead the execution of the Reform Plan developed from the four perspectives below.

① Reform from top management

- Exercise sufficient leadership to improve safety
- Strongly recognize risks in nuclear and continuously strive to reduce those risks
- Has management addressed the enormous risks of radiation and nuclear energy? Has it had a strong sense of mission (=safety consciousness) such that it will never allow these risks to manifest?
- Has management continually confirmed that there are no problems concerning the following sorts of perceptions at each level within the Nuclear Power Division?
  - Is there complacency that a severe accident could not occur?
  - Is there sufficient recognition of being responsible for safety?
  - Are personnel’s inability to engage in essential problem-solving overlooked because the frontline workers are overwhelmed with conducting work according to manuals?
- On the other hand, was middle management fully aware of his responsibility for the safety and try to thoroughly fulfill its responsibilities for the management?

Reform From Nuclear Top Management (2)

② Reform to become a self-led organization
  - Cultivate problem-oriented mindset to learn from other divisions, industries, and overseas organizations
  - Develop technical capability to see the overall system
  - Develop capabilities to execute work and propose improvements on our own without depending on external parties

③ Reform of work processes
  - Incorporate speed-oriented countermeasures and not just perfect ones
  - Resolve frontline problems such as workload of creating numerous documents for QA activities thereby creating time for workers to think
  - Build a mechanism which balances economy, safety, and relationship of trust with contractors

④ Reform of relationships with the regulator, siting community, and the public
  - Strive for further improvement on its own initiative without deeming it sufficient to comply with regulations only
  - Maintain a highly transparent relationship with the regulator
  - Have the courage and capability to share problems with the siting community and the public

Problem consciousness of the Nuclear Reform Special Task Force

What should be done so that the Fukushima Accident is never repeated again?

◎When looking back on the accident, the problem was that preparations were not made in advance, so we need a “Reform Plan” that will allow us to be sensitive in capturing opportunities for improvement and safety enhancement and lead to actual measures.

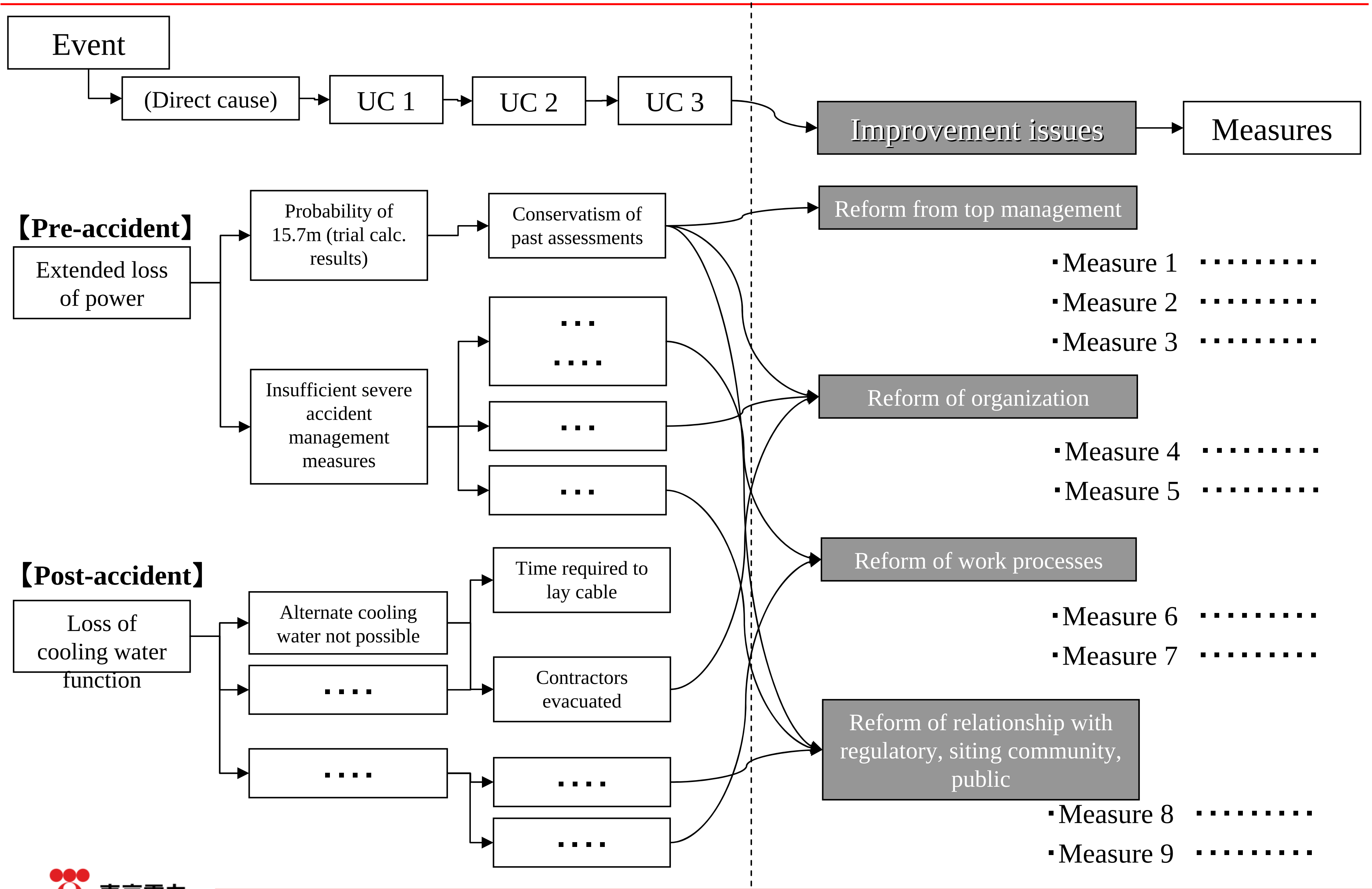
Ⅰ. Could necessary measures have been taken with previous tsunami evaluations?
→It was possible to take action with the principle of defense-in-depth*.

Ⅱ. If severe accident measures had been continually strengthened even after 2002, could that have mitigated the impacts of the accident?
→ It was possible to diversify safety systems by referencing severe accident measures taken in other countries.

Ⅲ. Was it possible to have better mitigated impact during the accident?
→ Instead of training just as a formality, an organization with practical capability to manage accidents should have been designed and trained with allocation of materials/equipment.

*Defense-in-depth
After implementing measures to prevent abnormalities from occurring, assume that the abnormality will occur to implement measures to prevent it from expanding. Based on that, assume that the abnormality does expand to implement measures to reduce its impact. This approach is used in this manner by repeatedly rejecting previous assumptions to ensure a high level of reliability and certainty in ensuring safety when implementing safety measures.

RCA Conceptual Diagram



Event

(Direct cause) → UC 1 → UC 2 → UC 3 → Improvement issues → Measures

【Pre-accident】

Extended loss of power

Probability of 15.7m (trial calc. results)

Conservatism of past assessments

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Insufficient severe accident management measures

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【Post-accident】

Loss of cooling water function

Alternate cooling water not possible

Time required to lay cable

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Contractors evacuated

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Reform from top management

- Measure 1 ・・・・・・・・・
- Measure 2 ・・・・・・・・・
- Measure 3 ・・・・・・・・・

Reform of organization

- Measure 4 ・・・・・・・・・
- Measure 5 ・・・・・・・・・

Reform of work processes

- Measure 6 ・・・・・・・・・
- Measure 7 ・・・・・・・・・

Reform of relationship with regulatory, siting community, public

- Measure 8 ・・・・・・・・・
- Measure 9 ・・・・・・・・・

I. Looking Back on Previous Tsunami Assessment

- There was over-reliance on the JSCE assessment methodology.
  - Management: Emphasized JSCE assessment (authority) to implement practical measures.
  - Tsunami assessor: Historical high was thought to be the 1960 Chile Tsunami (3.1m) and that the assessed value of 5.7m had double the conservatism. There was no awareness that a tsunami exceeding site elevation would directly result in a severe accident.
  - Equipment manager: Took the results from the tsunami assessor as the design conditions and did not verify the conservatism of the assessment method independently.
  - Safety manager: Defense-in-depth was not fully applied to external events.
  - Risk Management Committee: Only discussed tsunamis as a licensing risk.
- Determined that a massive tsunami would not hit because there were no watermarks or records of one.
  - There are only few centuries of tsunami records and about 1,000 years for geological analysis. It was a not possible to predict the scale of a tsunami with only such records.
  - Immature probabilistic methods, such as supplementing shortage of observation data with expert questionnaire survey, led to under-assessment of tsunami occurrence frequency.
- Knowledge from other countries was not promptly incorporated into NPS measures.
  - Information of the 1999 Le Blayais NPS off-site power loss event (caused by flooding) was not used to implement countermeasures.

I. Underlying Contributors to Problems with Tsunami Assessment

Underlying contributors*	Key to resolution
1. Management had insufficient framework to make prompt & adequate decisions on critical problems and give instructions.	■ Reinforce support to assist management decision-making
2. Due to lack of mechanism for interdepartmental sharing of information, it was not commonly recognized that a tsunami was a cliff-edge event.	■ Develop engineers that have an overall view of the system ■ HR measures to overcome compartmentalization
3. There was lack of an attitude to verify whether measures for external events were sufficient from the standpoint of defense-in-depth.	■ Enhance safety measures based on defense-in-depth
4. In developing QA activities, there was increase in workload with unbalanced emphasis on creating process evidence which led to insufficient ability to propose measures emphasizing quick execution.	■ Scrap through work standardization and systemization ■ Improve capability to propose practical improvements by conducting design and work in-house
5. Feared that if tsunami risk studies were disclosed that it would lead to immediate plant shutdown.	■ Enhance risk communication

*: Further in-depth analysis to be performed for underlying contributors

II. Looking Back on Severe Accident Management Measures

- After completing severe accident measures in 2002 including containment venting and power supply cross-ties between units, no further measures for severe accidents were taken.

- There were concerns of back-fitting operating reactors and litigation depending on the recent intention of the Nuclear Safety Commission to regulate severe accident measures.

- There was concern that if new severe accident measures were implemented, it could spread concern in the siting community that there is a problem with the safety of current plants.

- In terms of US anti-terrorism measures (B5b), though there was no official information provided, there was a lack of attitude to independently assume terrorist attacks since 9.11 and lack of sensitivity to US NPS site visit information.

II. Underlying Contributors to Insufficient Severe Accident Measures

Underlying contributor*	Key to resolution
1. There was lack of vigilance in management that severe accidents have very low chance of occurring in Japan.	■ Management has strong recognition of nuclear risks and always takes the lead in fully exercising leadership to reduce that risk
2. There was concern of litigation risks if giving admission that severe accident measures were necessary.	■ Request for required legal framework to be developed
3. There was concern that by implementing severe accident measures, it would exacerbate siting community and public anxiety and add momentum to anti-nuclear movements.	■ Enhance risk communication
4. There was a latent fear that plant shutdown would be required until severe accident measures were put in place.	
5. There was increase in unbalanced workload to create documents in developing QA activities.	■ Scrap through work standardization and systemization
6. There was insufficient ability to propose measures emphasizing quick execution.	■ Improve capability to propose practical improvements by conducting design and work in-house

*: Further in-depth analysis to be performed for underlying contributors

III. Looking Back on Accident Response

- Unable to share information on status of important equipment which did not lead to prompt and adequate action. On the other hand, various information regardless of its importance was brought to the table, hindering prompt/adequate decision-making.
- Lack of engineers that were experts in system design, operation and lay-out.
- Inability to conduct in-house work such as connecting temporary batteries and compressors promptly and smoothly.
- On-site workers were exhausted due to response to extended accident of multiple units.
- Confusion in response actions due to orders from headquarters and the Prime Minister’s Office.
- On top of shortage of materials/equipment, there was no prompt resupply.

III. Underlying Contributors for Issues on Accident Response

Underlying contributor*	Key to resolution
1. Management had not instructed to prepare assuming simultaneous disaster at multiple units.	■ Management prepares for contingencies independently and enhance accident response framework ■ Analyze wide-ranging risks for natural disasters and terrorism to adopt measures ■ Prepare necessary goods and develop a transport system
2. Training was insufficient to begin with, but critique from trainings was not translated into necessary improvements.	■ Review emergency organization/framework ■ Review mechanism for information sharing ■ Enhance organization/framework to support managers ■ Clarify requirements for each team leader and provide training
3. Insufficient experience through routine practical work	■ Enhance capability to conduct field work in-house ■ Organize division of roles with contractors and cooperative framework
4. Ambiguous chain of command and insufficient pre-coordination with regulator and Prime Minister's Office.	■ Clarify internal division of roles and division of roles with central and local governments.

*: Further in-depth analysis to be performed for underlying contributors

Direction of Future Considerations (1)

Reform From Top Management	**【Reform From Top Management】** ■Risk management recognizing nuclear risks including disaster preparedness ■Change behaviors (Questioning Attitude to address the unexpected) **【Support required for executive management】** ■Clarify requirements and staff allocation so that management can made decisions comparable to risks of nuclear power stations
Reform for Self-Led Organization	**【Reform Emergency Organization】** ■Develop organization to respond to accidents at the same level 24 hours a day, 365 days a year (introduce ICS), and change normal organization and work administration accordingly (expand two-shift work) as well as headquarter organization ■Simple chain of command, clear division of roles (responsibilities and authorization), smooth transition from normal status (organization similar to emergency situations) ■Organize roles of headquarters, site, external organizations (SDF, etc.) ■Obtain cooperation from vendors and contractors (such as improving multi-tiered outsourcing) ■Utilize external organization for planning, implementation and AAR (After Action Review) of training (ex. US Forces in Japan, SDF) **【Review HR Development Program】** ■ For each position during normal times and emergencies, clarify the function and requirements. ■Expand scope of in-house work to respond to emergencies and to maintain/improve individuals' competencies (For example, be able to conduct work required within 72 hours after the accident in-house. In addition, aim to conduct about 10% of all work in-house to prepare for contingencies.) **【Reform to Become an Organization Has Layered Defense-in-Depth (reject assumptions)】** ■Establish and give authority to a dedicated organization to evaluate and improve NPS risks ■Establish evaluation metric to evaluate the organization improving safety

Direction of Future Considerations (2)

Reform of Work Processes	**[Shift From Perfect Measures to Promptly Implemented Measures]** ■Organize measures chronologically into short-, mid-, and long-term to shift to efforts to start implementing measures that can be implemented **【Develop Mechanism Conducive to Layering Defense-in-Depth (rejecting assumptions)】** ■By standardizing and systemizing work, create more leeway for workers so improvement activities are revitalized ■Develop mechanism conducive to balancing safety and economy (such as mechanism to always allocate certain level of investment into safety improvement) **【Review HR Development Program】** ■Develop training program for each position during normal times and emergencies (ex. crisis management, disaster psychology), HR rotations according to relevant positions ■Reinstall foreman system to maintain emergency organization and for HR development (flat organization→tiered organization)
Reform Relationship with the Regulator, Siting Community, and the Public	**【Enhance Risk Communication—Improve Transparency】** ■Develop, update, and disclose risk map that would lead to reactor core damage ■Transparency of interactions with regulator ■Participate in meetings with local residents and conduct house visits ■Enhance “technical capability” “communication capability” to be able to cope with such information disclosure and dialogue

Current Status of Safety Measures

Currently, efforts are being made to develop defense-in-depth for external events at Kashiwazaki-Kariwa.

- Covers all recommendations from various analysis reports
  - 30 recommendations (NISA)
  - Government accident analysis report
  - Diet accident analysis report
  - Team H2O Project analysis report
  - Private accident analysis report
  - INPO Report
  - Internal accident analysis report

- As part of the measures adopted following the Fukushima Accident, the Nuclear Reform Special Task Force will verify measures pertaining to equipment and operational aspects which are being implemented at the Kashiwazaki-Kariwa Nuclear Power Station, and aim to achieve greater safety through continuing improvements.

- An international third-party review will be conducted to incorporate global knowledge and experience. (Ex. Invite International Atomic Energy Agency (IAEA) Operational Safety Review Team (OSART)).

Summary

- Plan to compile a Reform Plan in relation to the following four items. Furthermore, effective and ineffective lesson learned from past TEPCO reforms and changes will be identified and incorporated in the Reform Plan.

  - Reform from top management
    - Take the initiative to fully exercise leadership to improve safety. In order to do so, clarify requirements and reinforce staffing to support management.
    - Assume the unexpected and develop capabilities during normal times to respond to contingencies.
  - Reform to become a self-led organization
    - Restructure emergency organization (implementation of ICS)
    - Review HR development program
    - Reform to become an organization that can layer defense-in-depth (rejecting assumptions)
  - Reform work processes
    - Shift from perfect countermeasures to quickly implemented measures
    - Develop mechanisms conducive to layering defense-in-depth (rejecting assumptions)
    - Review HR development program
  - Reform relationships with the regulator, siting community, and the public
    - Enhance risk communication (improve transparency)

- **This Reform Plan is not goals; but checks for progress and review as part of unceasing effort to improve safety.**

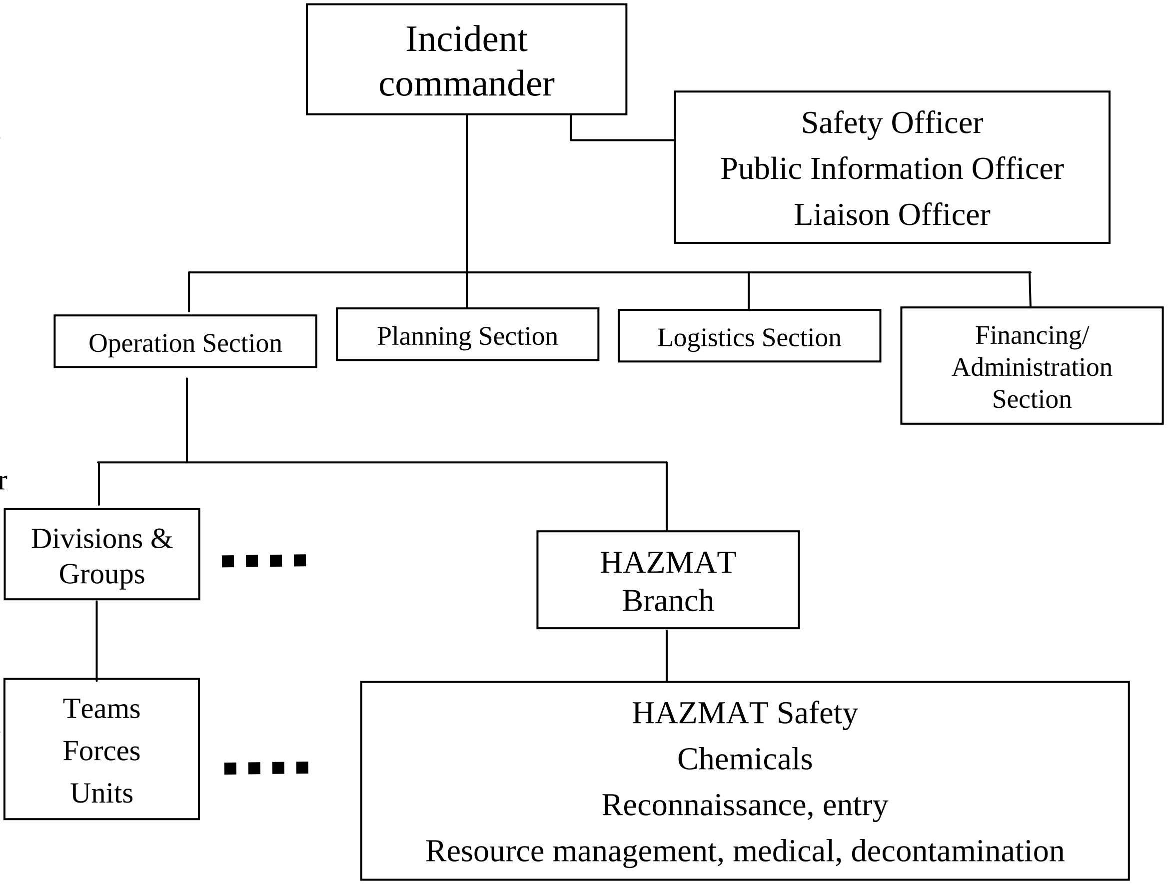
ICS（Incident Command System）

A US standardized management system for field command of disaster sites or accident/crime scene (such as for fire department, police, military)

【Characteristics】

- Supervision limit: about 5 people
- Use of common language: Do no use jargon between departments
- Expandable organization framework: Organization allows deployment of forces as required by the scale of response
- Single and clear chain of command: Clarify who is instructing who
- Unified communication: Unification of telecommunication/operation procedures, and central control of information to resident/ mass media
- Reliable response plan: Documented response plan
- Field command center: Establish primary command center and secondary command center
- Comprehensive resource management: Comprehensive resource management including all people, goods, material/equipment
- Accurate information collection, management, communication: Share information organization-wide and not just through vertical chain of command

Image of organization



Reference

ICS Issues to Consider

The following issues should be considered in the future to develop an emergency organization system incorporating the concept of ICS.

- Presumed conditions in considering the system
  - Respond to SBO (including loss of DC power) without citing causes
  - Measures already implemented (power supply cars, fire engines, etc.) are available for use
  - Presume one fire and one severely injured person
  - Initial 72-hour response after the accident is conducted by station workers only
  - Based on the above conditions, increasing the number of on-site member is needed to continuously presuming a simultaneous disaster at several plants.

  However, it is necessary to respond flexibly according to accident conditions and contingencies.
- Maintain the same level of emergency organization 24 hours a day, 365 days per year while also premising the normal organization and work administration on smooth transfer from normal conditions.
- Functions, qualifications, and development method for each group and position in the emergency organization (consider transitional measures and HR rotations as well)

Points at Issue in Accident Response（Hardware）

○**Protection against a tsunami exceeding assumptions was vulnerable.**

○**Sufficient preparations had not been made for cases where all power sources would be lost nor had there been adequate means provided for the subsequent response (cooling water injection, depressurization, low pressure water injection, heat removal, injection of cooling water into fuel pool, securing water sources, etc.). Workers were forced to respond while thinking about these issues on the spot.**

○**Means for mitigating the impact after reactor core damage had not been prepared (preventing primary containment vessel damage, controlling hydrogen, preventing release of large amounts of radioactive materials into the environment, etc.).**

○In addition to limited **lighting and communication tools, monitoring and measuring means** were also lost and the plant status was no longer able to be ascertained.

○Due to severe aftershocks, concerns about tsunami accompanying aftershocks, scattered debris and so on, **accessibility and workability in the yard was reduced**.. These and other factors leading to a deterioration of the work environment made it difficult to respond to the accident.

Issues Learned from Accident and Response Strategy (Hardware)

Issues Learned from Tsunami and Subsequent Escalation of Accident

Flow of Defense in Depth

(A) Prevent problems from arising

① Implement thorough tsunami countermeasures (multiplex tsunami countermeasures)

(B) Prevent escalation into an accident

- Assure shopping/shutting down functions (emergency insertion of control rods, etc.) (operated without problem at both Fukushima Daiichi and Daini)

(C) Prevent damage to reactor core during accident

② Reinforce various means of supplying power

③ Reinforce water sources (fresh water, sea water) required for injection of cooling water

④ Strengthen means for high pressure injection of cooling water with the capability to be implemented promptly

⑤ Strengthen means for depressurization prior to loss of means for high pressure injection of cooling water

⑥ Strengthen means for stable low pressure injection of cooling water prior to depressurization

⑦ Assure heat removal means
  - Reinforce means of removing heat using seawater
  - Reinforce reliable means of venting primary containment vessel (removal of heat through atmospheric release)

(D) Mitigate impact after accident

⑧ Strengthen means of mitigating impact after reactor core damage

② Reinforce various means of supplying power

③ Reinforce water sources (fresh water, sea water) required for injection of cooling water

(E) Accident prevention countermeasures

- Evacuation-related measures (measures comprising the core of the operational side)

Other

Fuel pool cooling

⑨ Strengthen **means of removing heat and injecting cooling water into fuel pool**

② Reinforce various **means of supplying power**

③ Reinforce **water sources (fresh water, sea water)** required for injection of cooling water

Further aseismic reinforcement

⑩ Implement **measures for improving aseismicity** from the standpoint of further enhancing safety

Strengthen support functions

⑪ Implement other measures essential for supporting accident response
  - Enhance **means of measurement** necessary for plant operation and parameter monitoring
  - Improve **capability (work environment) of the main control rooms and seismic-isolated buildings for responding during an accident**
  - Reinforce **communication tools** usable even during an accident
  - Secure **access routes** to the yard

Commitment to Safety Measures (Ex. of Kashiwazaki-Kariwa NPS)

- 🟩 Measures based on the Fukushima Daiichi accident
- 🟨 Measures based on the Niigata-Chuetsu-Oki Earthquake
- ▨ Accident management measures in place prior to Fukushima Daiichi accident
- ☐ Facilities adopted in basic design

Classification of measures	Tsunami	Power source	Water source	High pressure cooling water injection	Depressurization	Low pressure cooling water injection	Reactor , PCV cooling (heat removal)	Mitigation of impact after core damage	Fuel pool	Earthquake	Other perspectives
Specific items	🟩 Tsunami warning system constructed	🟩 Further augmentation of power sources on high ground									🟩 Reinforcement of seismic-isolated buildings
	🟩 Measures against Inundation of heat exchanger, building, etc.	🟩 Reinforcement of storage batteries and other DC power sources					🟩 Installation of handle for manual PCV venting		🟩 D/DFP enhanced		🟩 Strengthen plant Parameter monitoring Functions (instrumentation)
	🟩 Measures against inundation around transformers	🟩 Installation of underground diesel tanks					🟩 Deployment of auxiliary motors for seawater pumps		🟩 Deployment of concrete pumping vehicles		🟩 Strengthening communication facilities
	🟩 Cover on auxiliary intake channels	🟩 Installation of power supply facilities on high ground (distribution switch boards, etc.)	🟩 Preparation of procedures for using seawater			🟩 D/DFP enhanced	🟩 Deployment of alternative underwater pumps		🟩 Monitoring camera & water level meter		🟩 Deployment of heavy machinery for debris removal
	🟩 Installation of tidal wall around switchyard	🟩 Deployment of power supply cars on high ground	🟩 Preparation of procedures for CSP injection from Outside building	🟩 Installation of alternative high pressure cooling water injection facilities		🟩 Installation of External connection to MUWC	🟩 Deployment of Alternative Heat Exchanger equipment	🟩 Installation of H2 control facility In R/B	🟩 Deployment of fire engines (for cooling water Injection) on high ground	🟩 Reinforce aseismicity of Switchyards and transformers	🟩 Enhancement of Monitoring functions
	🟩 Drainage measures for reactor and other buildings	🟩 Deployment of air-cooled gas turbine generator vehicles on high ground	🟩 Installation of wells	🟩 Preparation of procedures for RCIC manual start up	🟩 Deployment of SRV-driven air compressors	🟩 Deployment of fire engines on high ground for cooling water injection)	🟩 Preparation of procedures for manual PCV spray without AC power source	🟩 Installation of filing water facility for PCV top	🟩 Installation Of external cooling water injection piping	🟩 Reinforce aseismicity of fresh water tank	🟩 Improvement of main control room environment
	🟩 Waterproofing of important areas	▨ Interchangeable power sources from adjacent units	🟩 Installation of reservoirs	🟩 Preparation of procedures for emergency utilization of control rod-driven Water pressure system	🟩 Deployment of SRV-driven Auxiliary cylinders	▨ Diesel-driven fire protection system (D/DFP)	▨ Reinforce PCV pressure resistant venting facility	🟩 Installation of densitometers for hydrogen in buildings	☐ Make-up water condensate system (MUWC)	🟩 Assessment of fundamental stability of transmission towers	🟩🟨 Reinforcement of access roads
	🟩 Installation of tidal walls and tidal boards around buildings	☐ DC power sources (storage batteries)	☐ Filtered water tanks	🟩 Preparation of procedures for emergency utilization Of SLCS	🟩 Deployment of auxiliary batteries for SRV operation	▨ Motor-driven fire protection system	▨ Augment PCV spray means	🟩 Installation of filtered venting equipment	☐ Fuel pool Make-up water system	🟩 Strengthen aseismicity of MUWC piping	🟨 Placement of FP system piping aboveground
	🟩 Installation of flooding embankments	☐ Emergency diesel generators	☐ Pure water tank	☐ Stream-driven HPCI system （RCIC）	▨ Automatic depressurization system	▨ Make-up water condensate system （MUWC）	☐ RHR system (removal of reactor heat)	🟩 Installation of equipment for top venting of R/B	☐ RHR (removal of fuel pool heat)	🟨 Reinforcement of aseismicity※2	🟨 Deployment of fire engines for fire reponse
	※1	☐ Off-site power	☐ Condensate storage pool （CSP）	☐ Motor-driven HPCI system （HPCS, etc.）	☐ safety relief valve (SRV)	☐ Motor-driven low pressure water injection system	☐ Condenser (removal of reactor heat)	▨ Injection of Cooling water into lower part of pressure vessel (pedestal)	☐ Fuel pool cooling and purification system	☐ Earthquake-resistant design※3	🟨 Installation of seismic-isolated buildings

※1: Ensure height of installation of facilities and equipment against inundation from outside

※2: Based on knowledge from the Niigata-Chuetsu-Oki Earthquake, conservatively configure the Design Basis Seismic Ground Motion Ss and strengthen earthquake resistance so that there is additional margin of resistance

※3: Aseismatic design according to Regulatory Guide for Reviewing Seismic Design

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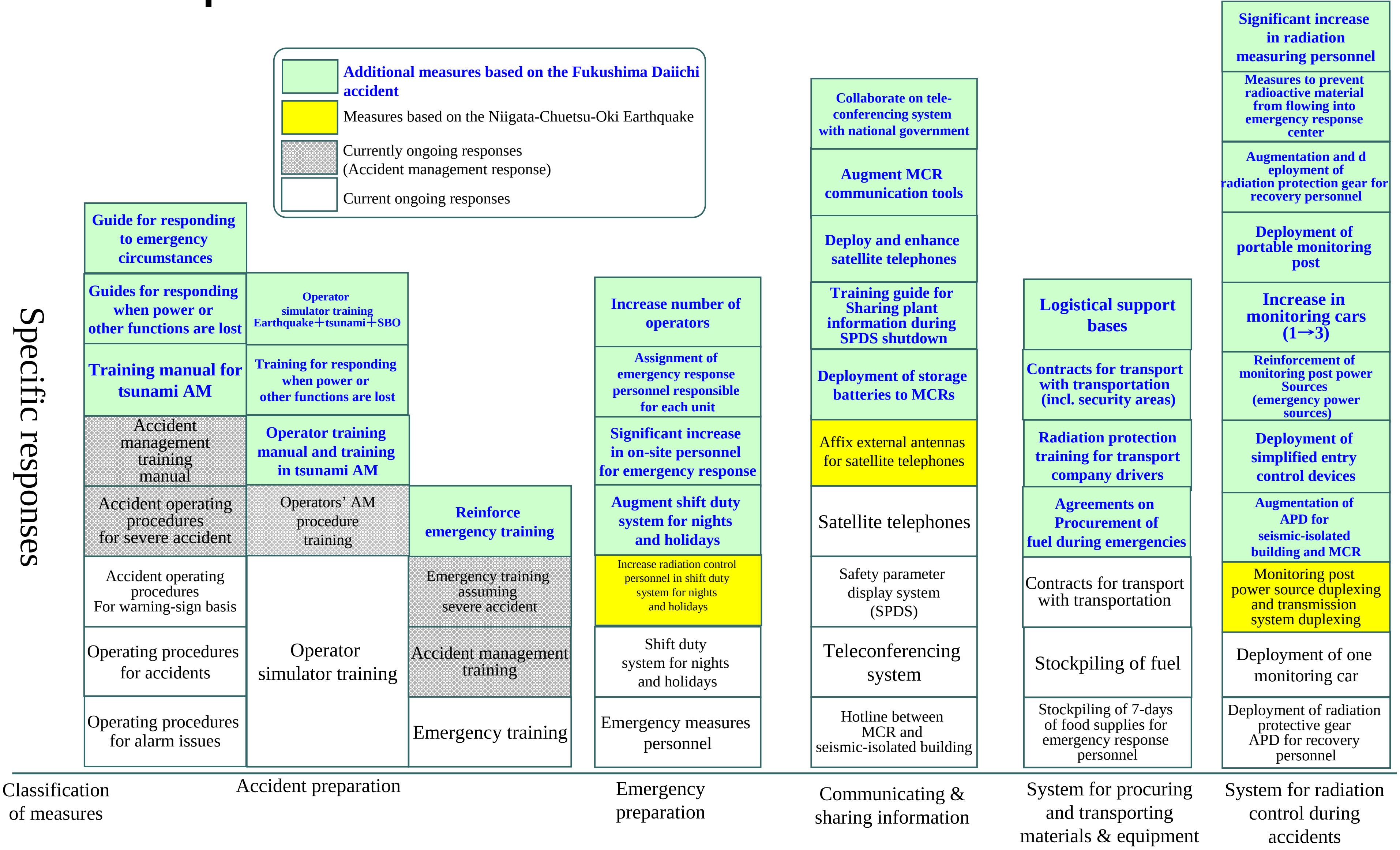
Commitment to Safety Measures (Ex. of Kashiwazaki-Kariwa NPS)



🟩 **Additional measures based on the Fukushima Daiichi accident**

🟨 Measures based on the Niigata-Chuetsu-Oki Earthquake

▨ Currently ongoing responses (Accident management response)

☐ Current ongoing responses

Specific responses

Classification of measures

Accident preparation

- 🟩 **Guide for responding to emergency circumstances**
- 🟩 **Guides for responding when power or other functions are lost**
- 🟩 **Training manual for tsunami AM**
- ▨ Accident management training manual
- ▨ Accident operating procedures for severe accident
- ☐ Accident operating procedures For warning-sign basis
- ☐ Operating procedures for accidents
- ☐ Operating procedures for alarm issues

- 🟩 **Operator simulator training Earthquake＋tsunami＋SBO**
- 🟩 **Training for responding when power or other functions are lost**
- 🟩 **Operator training manual and training in tsunami AM**
- ▨ Operators' AM procedure training
- ☐ Operator simulator training

- 🟩 **Reinforce emergency training**
- ▨ Emergency training assuming severe accident
- ▨ Accident management training
- ☐ Emergency training

Emergency preparation

- 🟩 **Increase number of operators**
- 🟩 **Assignment of emergency response personnel responsible for each unit**
- 🟩 **Significant increase in on-site personnel for emergency response**
- 🟩 **Augment shift duty system for nights and holidays**
- 🟨 Increase radiation control personnel in shift duty system for nights and holidays
- ☐ Shift duty system for nights and holidays
- ☐ Emergency measures personnel

Communicating & sharing information

- 🟩 **Collaborate on tele-conferencing system with national government**
- 🟩 **Augment MCR communication tools**
- 🟩 **Deploy and enhance satellite telephones**
- 🟩 **Training guide for Sharing plant information during SPDS shutdown**
- 🟩 **Deployment of storage batteries to MCRs**
- 🟨 Affix external antennas for satellite telephones
- ☐ Satellite telephones
- ☐ Safety parameter display system (SPDS)
- ☐ Teleconferencing system
- ☐ Hotline between MCR and seismic-isolated building

System for procuring and transporting materials & equipment

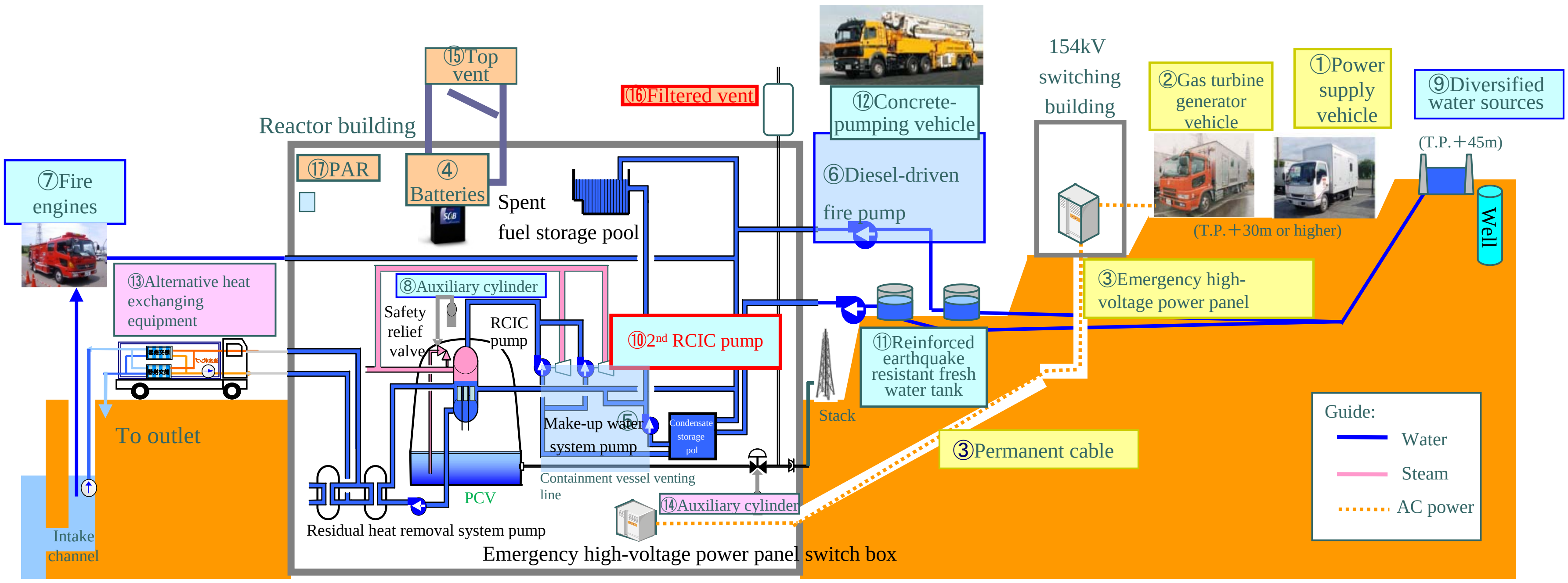
- 🟩 **Logistical support bases**
- 🟩 **Contracts for transport with transportation (incl. security areas)**
- 🟩 **Radiation protection training for transport company drivers**
- 🟩 **Agreements on Procurement of fuel during emergencies**
- ☐ Contracts for transport with transportation
- ☐ Stockpiling of fuel
- ☐ Stockpiling of 7-days of food supplies for emergency response personnel

System for radiation control during accidents

- 🟩 **Significant increase in radiation measuring personnel**
- 🟩 **Measures to prevent radioactive material from flowing into emergency response center**
- 🟩 **Augmentation and d eployment of radiation protection gear for recovery personnel**
- 🟩 **Deployment of portable monitoring post**
- 🟩 **Increase in monitoring cars (1→3)**
- 🟩 **Reinforcement of monitoring post power Sources (emergency power sources)**
- 🟩 **Deployment of simplified entry control devices**
- 🟩 **Augmentation of APD for seismic-isolated building and MCR**
- 🟨 Monitoring post power source duplexing and transmission system duplexing
- ☐ Deployment of one monitoring car
- ☐ Deployment of radiation protective gear APD for recovery personnel

Attachment distributed at Oct. 12, 2012 The First Nuclear Reform Monitoring Committee

Commitment to Safety Measures (Ex. of Kashiwazaki-Kariwa NPS)



【Power source-reinforcement measures】
①Deployment of power supply vehicles
②Introduction of gas turbine generator vehicles
③Installation of emergency high voltage power panels and laying of permanent cable
④Augmentation of DC battery capacity and installation of small diesel generators for recharging
○Reinforcement of earthquake resistance of 500kV switchyards

【Cooling water injection reinforcement measures】
⑤Securing means of injecting cooling water using make-up water system pumps
⑥Augmentation of diesel-driven fire pumps
⑦Securing means of injecting cooling water using fire engines
⑧Installation of backup nitrogen gas cylinders for safety relief valve
⑨Diversification of water sources (installation of reservoirs, wells)
⑩Installation of 2nd reactor core isolation cooling (RCIC) system pump
⑪Reinforced earthquake resistance of water purification and filtrate tank
⑫Positioning of concrete-pumping vehicle for injecting cooling water into fuel pool
○Conversion of ECCS so it is able to be used if seawater pump fails

【Heat removal reinforcement measures】
⑬Installation of alternative seawater heat exchanging facility
⑭Installation of backup nitrogen cylinders for operation of containment vessel venting valves

【Hydrogen explosion countermeasures】
⑮ Installation of top vent
⑯ Installation of filtered vents
⑰ Installation of PAR (Passive Autocatalytic Recombiner)

Red indicates measures which will take time to implement

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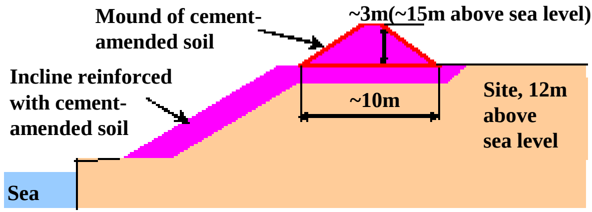
Tsunami Measures (Ex. of Kashiwazaki-Kariwa NPS)

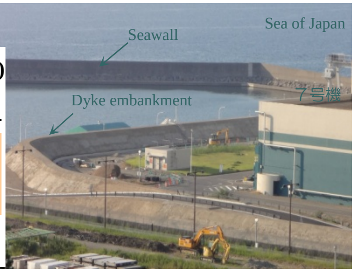
Even if a tsunami exceeding assumptions were to strike the power station, a flooding embankment rising 15m above sea level will reduce inundation of the site and hedge against the tsunami's impact on buildings and other structures.

Seawall (dyke) by Units 5~7

◆On a site approximately 12m above sea level, the seaside incline and embankment have been reinforced with cement-amended soil adding an additional 3m to the height.

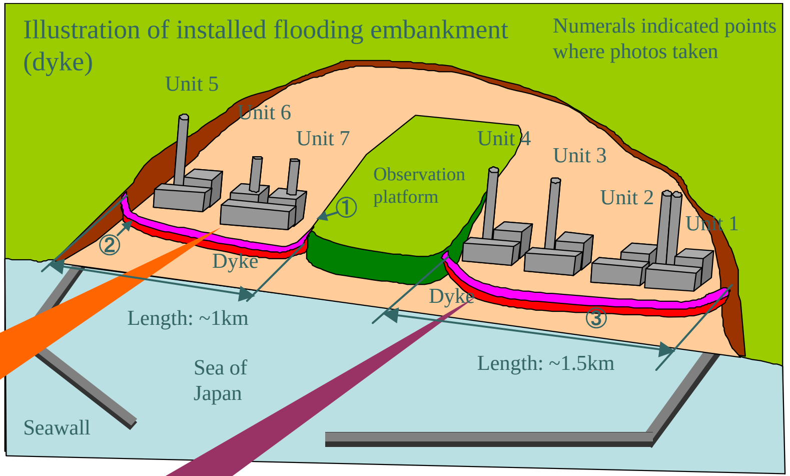
◆The surrounding area will be developed by the end of FY2012



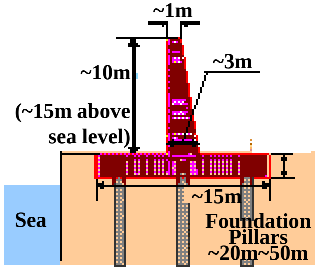


①From observation platform (August 28)

② From the seaside (August 28)



Seawall (dyke) by Units 1~4



③Unit 3 seaside (August 28)

◆A reinforced-concrete dyke is being built which is approximately 10m high a anchored securely with foundation pillars on a site 5m above sea level.

◆The placement of a total of 891 pillars was completed on August 28th and a portion of the wall was also finished.

Power Source Measures (Ex. of Kashiwazaki-Kariwa NPS)

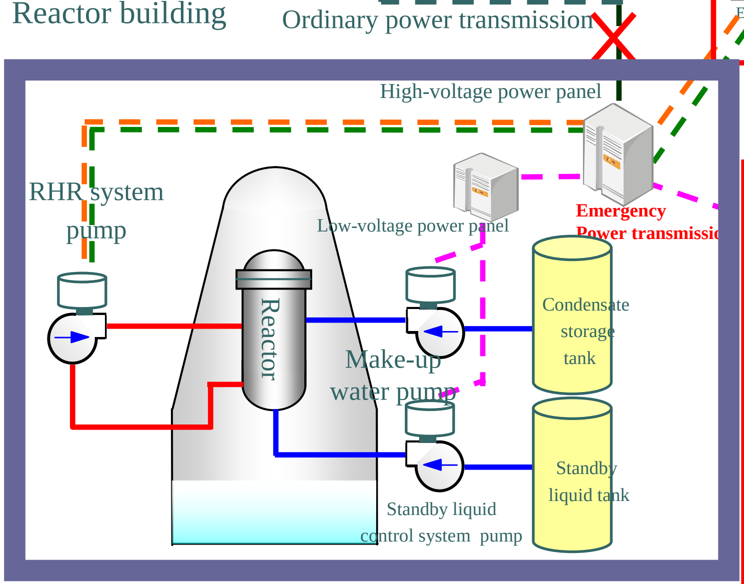
So that power for important equipment will be able to be promptly ensured even when there is a station black out, high-capacity air-cooled gas turbine generator (air-cooled GTG) vehicles have been deployed on high ground. In addition, underground light oil tanks has been installed for fuel supply. Also, emergency high-voltage power panels have been installed on high ground so that power can be supplied rapidly, and permanent cables have been laid to each unit. In addition to the air-cooled GTG vehicles, many power supply vehicles have been deployed to high ground in preparation for a worst case scenario.

- Air-cooled GTG vehicles: 2 units deployed
- Power supply vehicles: 14 units deployed
- Motor generators: deployed
- Other materials & equipment (connecting cables, etc.): deployed (As of the end of August, 2012)

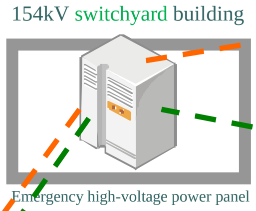
66kV switching station

Reactor building

Ordinary power transmission



Installation of power facilities (power panels, etc.) on high ground



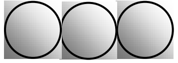
🟧 🟩 🟪 Power

Emergency power transmission

Power supply vehicles deployed on high ground

Air-cooled GTG vehicle deployed on high ground

~35m above sea level

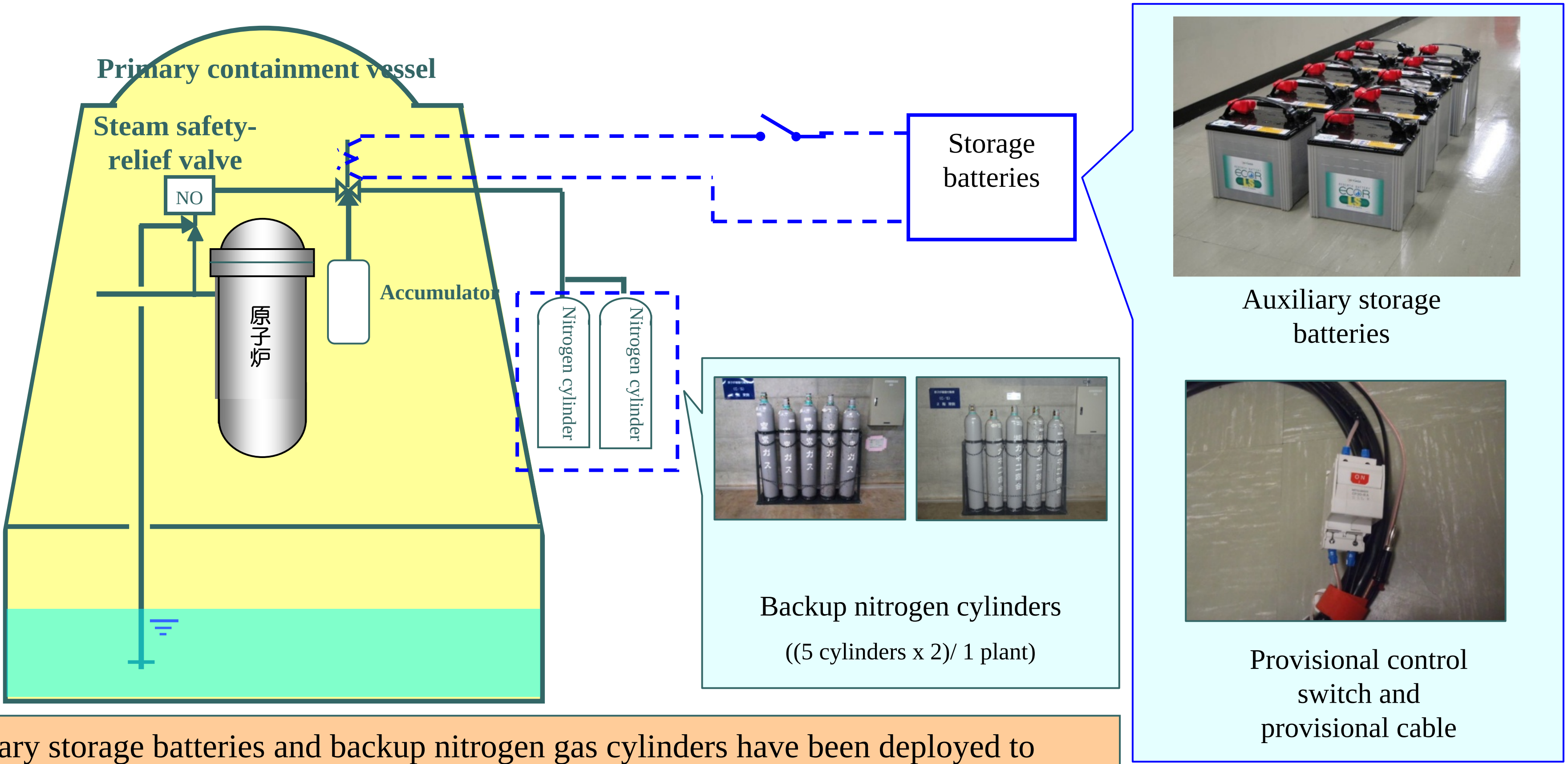


Underground light oil tanks installed

As backup for the GTG vehicles, connection boxes, to which multiple power supply vehicles (max. 15) can be easily connected, have been installed to augment emergency power and speed up recovery.

Depressurization Measures (Ex. of Kashiwazaki-Kariwa NPS)

Even in a situation where all AC and DC power has been lost, **backup nitrogen cylinders and auxiliary DC power sources (auxiliary storage batteries)**, which are required for such operation, have been deployed so that the steam safety-relief valve operates reliably. Also, effectiveness is confirmed through the development of new procedures and training in supplying DC and AC power on site.



Auxiliary storage batteries

Backup nitrogen cylinders

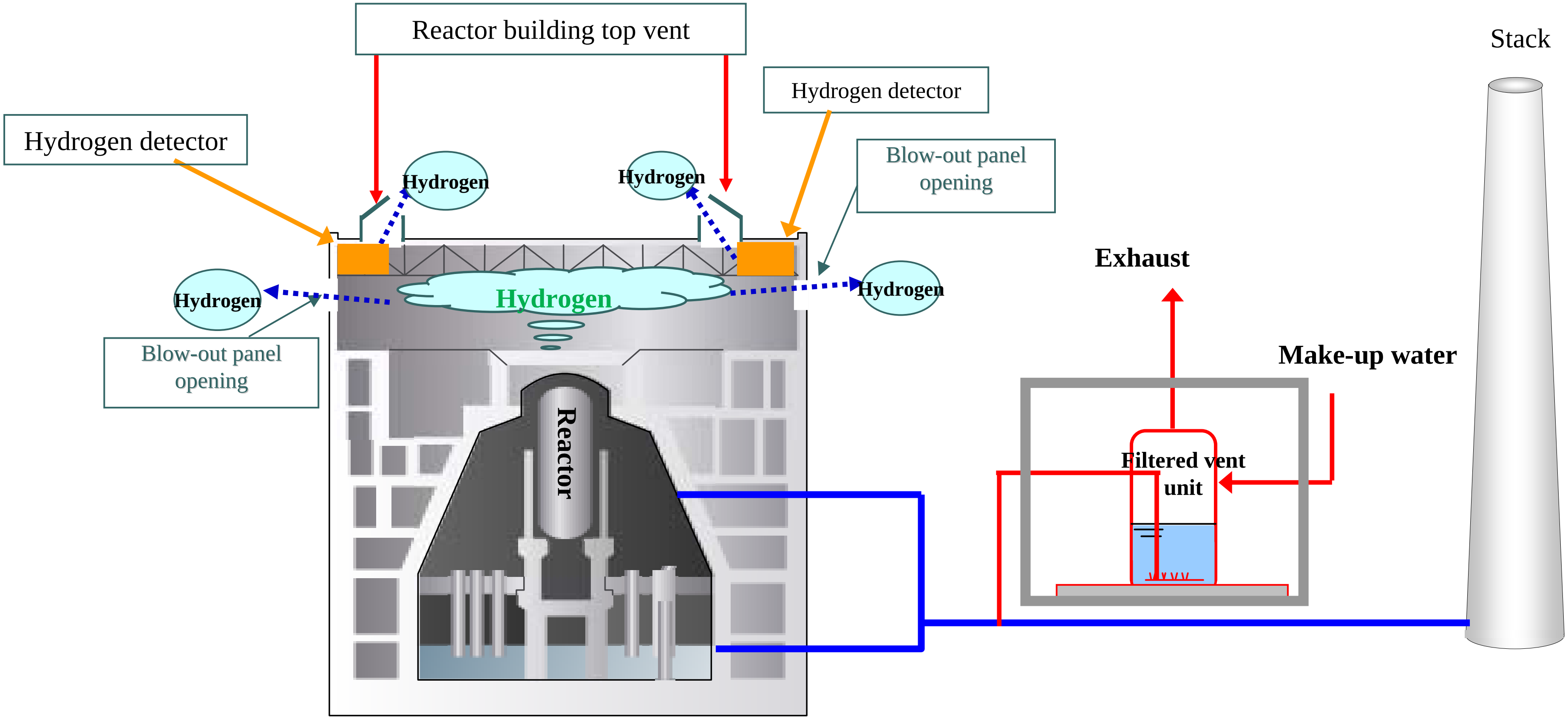
((5 cylinders x 2)/ 1 plant)

Provisional control switch and provisional cable

Auxiliary storage batteries and backup nitrogen gas cylinders have been deployed to serve as the driving force for the steam safety-relief valve.

Measures Mitigating Impact after Core Damage
(Ex. of Kashiwazaki-Kariwa NPS)

In order to decrease any emission of radioactive materials after core damage, filtered venting equipment has been installed. Filtered venting devices make it possible to prevent hydrogen from being retained in the reactor building so that hydrogen which has accumulated inside the containment vessel can also be released to the atmosphere. Even if the emission of hydrogen through filtered venting is inadequate, an explosion caused by the retention of hydrogen leaking into the reactor building can be prevented by the reactor building top vent or other means.



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Fuel Pool Measures (Ex. of Kashiwazaki-Kariwa NPS)

Even if ordinary cooling functions or operations for injecting cooling water into the spent fuel pool are lost due to a blackout or damage to the reactor building, concrete-pumping vehicles are to be deployed which have the capability to inject cooling water directly into the spent fuel pool from outside the reactor building.

Number of vehicles to be deployed:

- 70m class X 1 unit (arm length: 70m): scheduled to be deployed by end of year
- 50m class X 2 units (arm length: 52m): scheduled to be deployed in 1st quarter of FY2013

Vehicle with 70m arm length

Vehicle with 52m arm length

Accident Preparation (Ex. of Kashiwazaki-Kariwa NPS)

○Challenge: To prepare for an accident exceeding assumptions

●Response:

①Develop procedures for responding to an accident which considerably exceeds assumptions conventionally held about tsunami, loss of all power sources or other such events, and conduct such training repeatedly.

②Acquire the required certifications so that personnel are able to respond by operating heavy machinery.

Principal procedures developed

- Tsunami Accident Management Manual
  ～Manual for supplying power using power supply vehicles or other means and injecting cooling water into the spent fuel pool and reactor during a station blackout
- Guides for responding when power sources or other functions are lost
  ～ Guide for on-site work to supply power using power supply vehicles or gas turbine generator (GTG) vehicles.

Example of procedures developed

Training conducted

- Integrated training: 5 times Total of ~930 participants
- Individual training: Total of 16 times
  (as of the end of August, 2012)
  Training in operating power supply vehicles, training in operating GTG, training in injecting coolant with fire engines, emergency monitoring training, etc.
- In the future, blind training will be conducted assuming a severe accident as part of the integrated training

Training scene: Supplying power using GTG

Certifications acquired

Personnel who have obtained the following licenses as of August 2012:

Oversized vehicle license: 45

Special oversized vehicle license: 21

Oversized tractor license: 15

Emergency Response Preparation (Ex. of Kashiwazaki-Kariwa NPS)

○ Challenge: To prepare for multiple disasters at multiple plants occurring simultaneously

● Response:

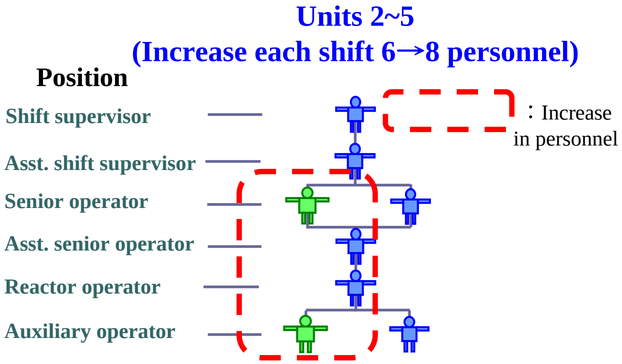
① Significantly increase the number of technical support personnel for emergencies so that a response can be mounted to handle multiple plants and long-term accidents.

② Even at headquarters, set up two technical support rooms in the emergency response center so that a response can be mounted to handle the simultaneous occurrence of a nuclear accident and natural disaster (power failure).

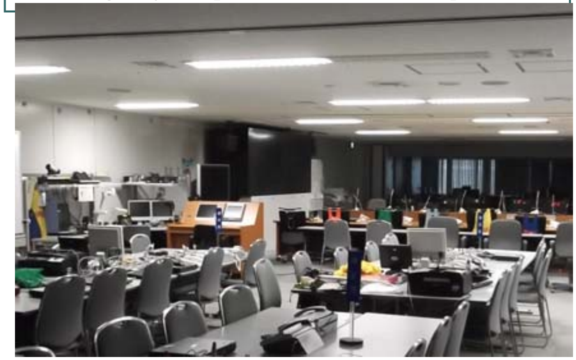
Power station operators & night duty and emergency response personnel

The plan is:

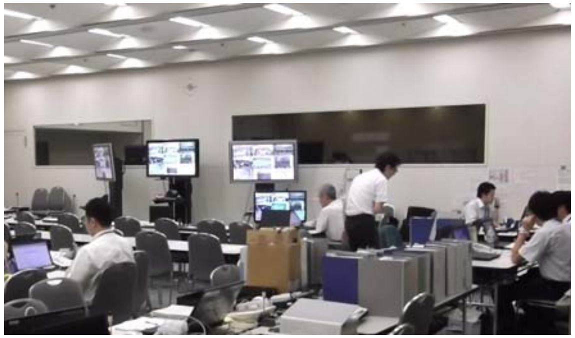
- Based on the on-site response operation after the tsunami, to increase power station operators by 60 personnel; personnel increase (205→265)(full crew)
- To take into consideration shifts and increase the number of technical support personnel for emergencies (324→649)
- To assign personnel responsible for the unit to the generation team and restoration team in the Emergency Response Center
- To augment the night duty system so as to strengthen the functions of collecting plant information and external communications immediately after a disaster strikes (6 →8 personnel)
- To have on the personnel necessary for responding early to restore emergency power, inject cooling water or take other such action on standby at the power station 24 hours a day.



Emergency Response Center at Headquarters



2nd floor technical support room at ERC



3rd floor technical support room at ERC