



环境保护部核与辐射安全中心
Nuclear and Radiation Safety Center

Post-Fukushima Safety Improvement Measures for NPPs in China

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WEBSITE

<http://www.chinansc.cn/>



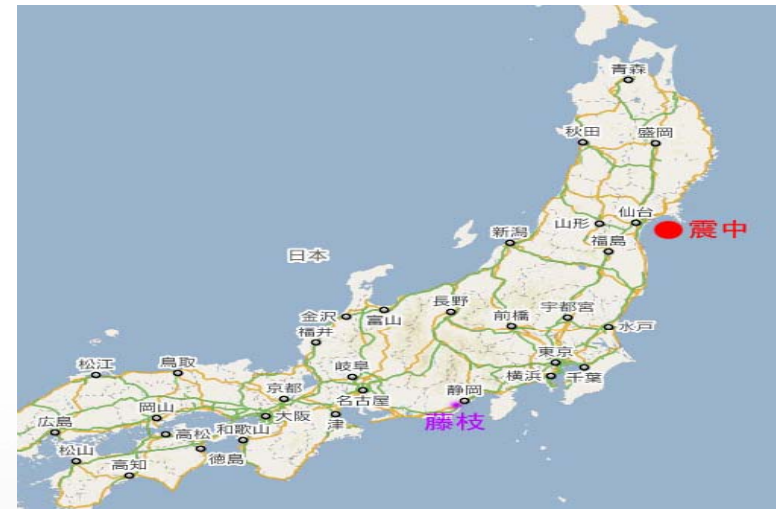
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Background



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■ *11 March 2011, TEPCO Fukushima Daiichi NPP Accident*



■ *The accident has a broad and profound impact on the global nuclear energy industry*

Background



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■ *NNSA's response actions:*

Emergency Response and Emergency Monitoring

Nuclear Safety Examination (CSE)

Requirements on Safety Improvement

General Technical Requirements for Improvement Action of NPPs

Safety Margin Evaluation on Important External Events of NPPs in Operation

Nuclear Safety Planning



Comprehensive Safety Examination (CSE)



Process

Times: March to December, 2011

Scopes: NPPs, research reactors, nuclear fuel cycle facilities

Objectives: To find out potential safety weaknesses



Comprehensive Safety Examination (CSE)

■ 3 levels for benchmarking of CSE:

- the current nuclear safety regulations
- the latest IAEA standards
- lessons learned from Fukushima nuclear accident

■ Contents of CSE:

11 factors: such as the appropriateness of external events assessed, the flood prevention planning and flood control capacity, and the measures for prevention and mitigation of severe accidents



Comprehensive Safety Examination (CSE)

■ Methods of CSE:

1. Self-Examination by licensees

2. Technical Assessment by NNSA/NSC

3. Site Inspection: 13 sites

4. Issue-specific Research on the potential influence of tsunami triggered by remote earthquake with very conservative assumption whose epicenter locates in Manila Trench or Ryukyu Trench, performed by NNSA-CEA-China State Oceanic Administration

5. Technical Dialogue between licensees and regulators

6. Interaction with Industry

7. Expert Consultation



Comprehensive Safety Examination (CSE)

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Conclusions

The existing NPPs in China basically meet the requirements of current nuclear safety regulations and the latest IAEA safety standards. They possess certain capability of preventing and mitigating the accident, the safety risk is under control and the safety is guaranteed.



Comprehensive Safety Examination (CSE)



Issues

- Flood Issue of Qinshan NPP: the plant's flood prevention capacity is not content the latest regulation requirements
- Partial NPPs have not established and conducted SAMGs
- Deepen evaluation on the effects of the tsunami induced by earthquake to individual plants



Comprehensive Safety Examination (CSE)

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Regulatory Requirements

- According to the Comprehensive Safety Examination results, NNSA put forward requirements to all the Nuclear Utilities, but the requirements are not necessarily the same to all the plants because of the different reactor types and different site conditions.
- The following requirements are common to all NPPs, and are grouped into technical and managerial.



◆ Common technical requirements include:

- ① Enhance **water-proof measures** regarding related doors/windows, air-vent, cable or pipe penetrations.
- ② Increase **mobile power sources and pumps** against SBO.
- ③ Improve **the capability against flooding** of Qinshan NPP by heighten the dike, increase wave wall and enhance anti-flooding and dewatering measures for safety related building.
- ④ Strengthen the **earthquake monitoring**, maintenance and management of seismic instrumentation, and site-specific operator action after earthquake.



◆ Common managerial requirements include:

- ① Improve **SAMGs**.
- ② Improve **Emergency Plans**; enhance the capacity of environmental monitoring especially in case of sever accident; optimize the function of emergency control centre; establish the multi-units emergency plan;
- ③ Establish **the information and communication procedures**
- ④ Deepen the research on the risk induced by earthquake and tsunami.
- ⑤ Perform **the PSA on external events** including seismic PSA or SMA (seismic margin assessment).



General Requirement for the Improvement of NPPs

- It put forth technical requirements on eight common improvement items, namely ;

•**Flooding-Prevention** capability

•**Emergency Water-Injection** and Related Equipment

•**Mobile Power Supply** and Setup

•**Spent Fuel Pool Monitoring**

•**Hydrogen Monitoring** and Controlling Systems

•**Habitability** and Functions of Emergency Control Center

•**Radioactive Environment Monitoring** and Emergency Improvement

•**Response to External Disasters**



Illustrate on the General Requirements

- Flooding-Prevention Capability Improvement for NPPs

■ **Functional requirements**

- review and confirm the validity of the original design basis flood level;
- under the appropriate beyond design-basis flood scenes (such as the design basis flood condition accompany with a millennium retain period rainfall), assessed the drainage capacity of the site and the accumulating water depth in the site;
- during the above flooding scenes and before the emergency complement water supply is available, at least one residual heat removal safety sequence is available;
- some potential risk caused by the implementation of flood defense measures should be assessed.

■ **Current Status**

all plants have completed



Illustrate on the General Requirements

- Emergency Water-Injection and power supply

■ Functional requirements

- the flow rate of emergency water injection: should be able to meet the need of removing the core residual heat **in 6 hours after shutdown**;
- the flow rate of emergency water injection of spent fuel pool: should be considered for the water boiling loss corresponding to **the maximum design basis heat load**;
- the load at least should cover the power for monitoring and control of the safety; besides, **a low-pressure safety injection pump or a auxiliary feed-water pump** are also included;
- Storage requirements: can cope with the flooding that is **5 meters above the design basis flood; 100 meters** beyond the safety significant building; and considering the seismic requirements;
- at least **two sets of equipment** should be established in the **multi-reactor site**.

■ Current Status

all plants have completed



◆ **Aims of the *General Technical Requirements* :**

- To harmonize as much as possible the intensiveness and extensiveness of safety improvement approaches adopted by every NPP.
- To resolve the possible differences in understanding between the regulatory body and utilities.
- To provide substantial guidance for China's NPPs to carry out post-Fukushima improvement measures.

◆ **The *General Technical Requirements* will be amended and improved considering the international research and studies on the Fukushima accident.**



Pictures of modification (water-proof sealing)



2011 12 29

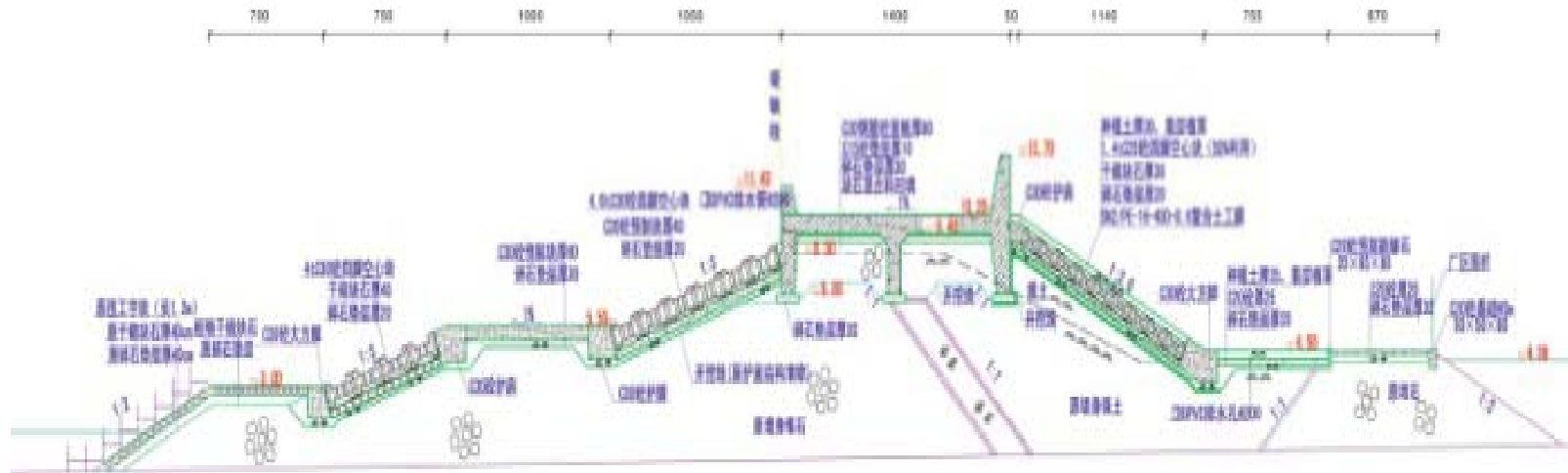


Pictures of modification (emergency water and power supply)





Heighten the sea dike of Qinshan NPP



旧海堤拆除



改造进展



External Safety Margin Evaluation

- Objectives: assessing the safety margin taking into account the **BDBEs**
- External events to be selected:
 - Seismic
 - flooding
 - SBO
- Methods: the baselines have been established on the **deterministic viewpoints**



■ Evaluation methodologies:

- **Seismic margin evaluation:** using **the EPRI Seismic margin assessment(SMA)** to find out all the systems and components used for mitigating accidents, on the basis of that , searching for success routes to shut down the reactor steadily
- **Flooding margin evaluation:** finding out the routes according to the data of SSCs, assuming that **the systems will come to failure gradually** because of the increasing flooding level
- **SBO:** before recovery of the off-site power sources and EDGs, **accumulators are the only power supplies** used for monitoring the main parameters of reactors and controlling the status of reactors



■ Conclusions:

July 2012, all plants submitted their Primary Assessment Reports to NNSA. China Nuclear Energy Association carried out the peer review on these assessments, and the conclusion were:

- All NPPs meet the SL-2 anti-seismic requirements of no less than 0.15g.
- All NPPs have the safety margin coping to the beyond design basis flooding, except Qinshan NPP.
- The accumulators of all NPPs have the capacity no less than 8h after SBO.



Nuclear power safety planning

Considering the experiences of Fukushima accident and the latest nuclear safety researches, the higher safety requirements were put forth for new nuclear power plants, mainly in two documents, one is **the “12th Five-year Plan and 2020 long-term goal for nuclear safety and radioactive pollution prevention and control” (the nuclear safety planning)**.



Nuclear power safety planning

➤ Safety Objectives:

✓ New nuclear power units shall have fairly complete provisions to prevent and mitigate severe accidents, the core damage frequency (CDF) per reactor-year shall be lower than 10^{-5} and the large scale radioactive substance release frequency (LRF) per reactor-year shall be lower than 10^{-6} .”

✓“For nuclear power units built in 13th Five-year Plan period (after 2015), efforts shall be made to actually eliminate the possibility of large scale radioactive substance release in design”.

➤ Important requirements set in the nuclear power safety planning include

✓“adopting the highest nuclear safety requirements in the world”, “newly built nuclear power units must comply with the third generation safety standards”



Nuclear power safety planning

■ research work

The research work is now still in progress, the NNSA has prepared the draft of “*Safety requirements for newly built nuclear power plants during ‘12th Five-year Plan’ period*” (Safety requirements), to ask for comments extensively in the nuclear industry.



- The NNSA will be concerned to strengthen the research on the Safety Goals, and on the basis of the *Nuclear power safety planning*, ensuring that all improvement measures are fully implemented.



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Thank you!

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