Introduction of Nation-wide Inspection and Reassessment to Chinese Research Reactors after Fukushima Accident

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CONTENTS

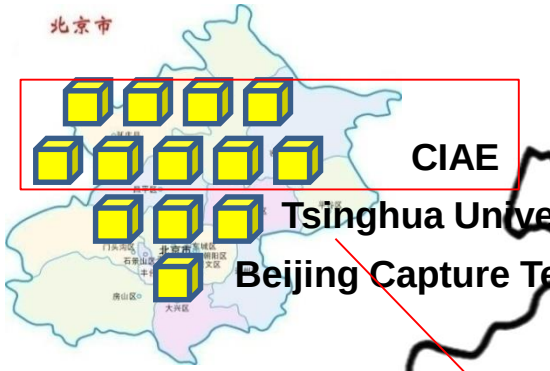
1. Chinese nuclear power plants

There are 56 unit NPPs in China now, among which 38 units are operating and 18 unit are under construction. All of these 56 units are located in 13 coastal sites, operating NPPs lists in table 1.

2. Chinese civil research reactors and critical installations

There are 19 civilian-use research reactors and the critical devices under supervision of National Nuclear Safety Administration (NNSA), the major reactors are listed in table 2.

NPPs and Research Reactors in China



CIAE

Tsinghua University

Beijing Capture Tech

56 NPPs in China

38 Units in operation

18 Units under construction

19 Civil research reactors

Hongyanhe

Haiyang

Shidaowan

Tianwan

Qinshan Phase I

Fangjiashan

Qinshan Phase II

Qinshan Phase III

Sanmen

Ningde, Fuqing

Daya Bay, LingAo

Yangjiang

Taishan

Shenzhen University

Changjiang

Fangchenggang

NPIC

Units in operation

Units under construction

Civil research reactors

Name of NPP		Unit No	Reactor type	Power (MWe)	First fuel-loading
Qinshan NPP	Unit 1	CN-01	PWR	310	1991.08.02
Qinshan Phase II NPP	Unit 1	CN-04	PWR	650	2001.10.09
	Unit 2	CN-05		650	2004.01.29
	Unit 3	CN-14		650	2010.05.30
	Unit 4	CN-15		650	2011.10.21
Qinshan Phase III NPP	Unit 1	CN-08	PHWR (CANDU)	720	2002.07.18
	Unit 2	CN-09		720	2003.03.16
Daya Bay NPP	Unit 1	CN-02	PWR	984	1993.06.01
	Unit 2	CN-03		984	1993.11.26
LingAo NPP	Unit 1	CN-06	PWR	990	2001.12.08
	Unit 2	CN-07		990	2002.07.15
	Unit 3	CN-12		1080	2010.04.21
	Unit 4	CN-13		1080	2011.01.05
Tianwan NPP	Unit 1	CN-10	PWR	1060	2005.10.18
	Unit 2	CN-11		1060	2007.03.16
	Unit 3	CN-45		1060	2017.08.23
Ningde NPP	Unit 1	CN-18	PWR	1080	2012.09.29
	Unit 2	CN-19		1080	2013.11.08
	Unit 3	CN-34		1080	2015.01.29
	Unit 4	CN-35		1080	2016.01.03
Hongyanhe NPP	Unit 1	CN-16	PWR	1080	2012.11.26
	Unit 2	CN-17		1080	2013.09.03
	Unit 3	CN-26		1080	2014.09.18
	Unit 4	CN-27		1080	2016.01.18
Yangjiang NPP	Unit 1	CN-22	PWR	1080	2013.10.25
	Unit 2	CN-23		1080	2015.01.25
	Unit 3	CN-40		1080	2015.10.11
	Unit 4	CN-41		1080	2016.11.19
Fuqing NPP	Unit 1	CN-20	PWR	1080	2014.06.05
	Unit 2	CN-21		1080	2015.05.15
	Unit 3	CN-42		1080	2016.04.04
	Unit 4	CN-43		1080	2017.06.15
Fangjiashan NPP	Unit 1	CN-24	PWR	1080	2014.10.22
	Unit 2	CN-25		1080	2014.12.03
Fangchenggang NPP	Unit 1	CN-38	PWR	1080	2015.09.06
	Unit 2	CN-39		1080	2016.05.25
Changjiang NPP	Unit 1	CN-36	PWR	650	2015.08.28
	Unit 2	CN-37		650	2016.05.12

Reactor Operator	Reactor type
China Institute of Atomic Energy	heavy water reactor
	swimming pool reactor
	prototype micro-reactor
	China experimental fast breed reactor
China Nuclear Power Research and Design Institute	high-flux engineering test reactor
	Chinese pulse reactor
	Minjiang test reactor
Tsinghua University	shielding test reactor
	low temperature nuclear heating reactor
	high temperature gas-cooled reactor
Shenzhen University	micro-reactor

3. Nuclear regulatory body

Ministry of Environmental Protection (National Nuclear Safety Administration (NNSA) is the national nuclear safety regulatory body, which carries out unified supervision on safety of Chinese civilian-use nuclear facilities and exercises the right of supervising nuclear safety independently.

NNSA has 6 regional offices in six areas of the country, one TSO (Nuclear and Radiation Safety Center) in Beijing.

Implement of nation-wide nuclear safety inspection

- From March to December 2011, just after Fukushima accident, NNSA conducted a comprehensive safety inspection on Chinese civil nuclear facilities including NPPs in operation and construction, research reactors and nuclear fuel cycle.
- It was carried out in six stages including scheme determination, operators or owners self-inspection, safety reevaluation, field inspection and verification, expert review and improvement measures submission.

INSPECTION AREAS

1. Resistance to extreme external events
2. Prevention and mitigation of severe accidents
3. Radiation monitoring and emergency preparedness and response, specifically including the appropriateness of external events assessed.
4. Flood prevention planning and flood control capacity
5. Anti-seismic planning and anti-seismic capability
6. Effectiveness of quality assurance system
7. Firefighting and protection system
8. Prevention and mitigation of overlying of muti-natural events
9. Analysis and evaluation on station-black-out (SBO) accident
10. Measures for prevention and mitigation of severe accidents and their reliability evaluation, the public communication and information release.
11. Effectiveness of environment monitoring system and emergency system

INSPECTION CONCLUSIONS

1. China's nuclear safety regulations fully adopted IAEA safety standards and the system of nuclear safety regulations and standards reached the international level.

2. During siting, NPPs conducted a thorough argumentation on earthquake, flood and other external events, and confirmed that the possibility of occurrence of extreme natural events similar to Fukushima accident is extremely small. NPPs took full account of the prevention and mitigation of severe accidents and conducted effective management in all stages including design, manufacturing, construction, commissioning and operation, thus the overall quality was under control.

INSPECTION CONCLUSIONS

3. Chinese research reactors have been under NNSA effective supervision and meet current nuclear safety regulations. Although some old reactors and critical installations built prior to the establishment of NNSA, they have been conducted a retroactive safety review and periodic safety reviews. According to the review results, great efforts were paid and corrective actions have been already implemented, the safety level of old research reactors and the critical installations are guaranteed completely.

The measures for engineering and technology improvement:

1. Accomplish modification of flood control capacity against tsunami and mountain torrent of some NPPs and research reactors respectively, via building wave walls, and taking other flood prevention and drainage measures. Investigate and complete waterproof sealing for doors and windows, air vents, cable penetration, process pipeline penetration, etc.
2. Install more mobile power supply, moving pumps, etc. to meet the safety requirements in case of station blackout (SBO).
3. Strengthen the maintenance and management of instruments and meters for seismic monitoring and recording to ensure the effectiveness. Improve the post-earthquake actions of corresponding operators in combination with field conditions to improve the seismic response capacity.

The measures for management improvement :

1. Perfect the emergency plan and improve nuclear accident emergency response capacity. Increase the environment monitoring capacity in severe accident condition, perfect the functions of emergency control center, formulate multi-unit emergency planning, establish and improve a sound external emergency support capability.

2. Formulate and perfect information release procedures to reassure the public timely and effectively.

3. Accelerate the outward transport of the spent fuel and treatment and processing of radioactive waste.

Additional requirements for several research reactors

1. In the site of China Nuclear Power Research and Design Institute

This site should be equipped with more equipment to improve the emergency rescue capacity to deal with mountain landslides, road congestion and other natural disasters; Built the second emergency road of the site to improve the emergency state of road transportation capacity; Improve the emergency control center, strengthen the emergency environmental monitoring capabilities.

2. High-flux engineering test reactor

High-flux engineering test reactor was built in the 1970s, adopting low standards of seismic design. Since seismic check and modification have been carried out several times under the requirements of retroactive safety review and periodic safety review, the seismic capacity has been improved. However, due to the intensity of earthquake was increased in this area, seismic reassessment and reinforcements are necessary to perform in some safety structures to meet its safety margin.

Besides, necessary reliable uninterrupted battery power, mobile EDG power, fire-fighting vehicle, emergent water source, mobile pumps and post-accident monitoring equipment are required to install.

3. In the site of China Institute of Atomic Energy

The history of tornado disaster situation in the site should be verified to assess the impact on plant structures. Fulfill preparatory work of decommissioning or long-term closure for several reactors. Study multiple reactors of one site entering into the emergency response at the same time. Speed up spent fuel outward transportation and radioactive waste disposal work in the China Atomic Energy Research Institute, China Nuclear Power Research and Design Institute and Tsinghua University.

Thanks for your attention!