

The Study of the Construction Requirements for CPI Nuclear Emergency Technical Support Center

Song Minghai¹, Zhou Pingyuan¹, Liu Zhenling², Zhong Chongjun², Fu Xiaohua¹, Li Haicheng¹, Ning Shasha¹

¹Nuclear Power Institute, China Power Investment Corporation (CNPI), Beijing, China

²Nuclear Power Department, China Power Investment Corporation (CPIN), Beijing, China

E-mail contact of main author: songminghai@cpicorp.com.cn

1. Introduction

CPI Nuclear Power Institute (CNPI) as the nuclear Technical Support Organization (TSO) of China Power Investment Corporation (CPI) is working on the construction of CPI Nuclear Emergency Technical Support Center. The paper discusses the construction requirements for CPI Nuclear Emergency Technical Support Center.

CPI was founded in Dec. 2002 and it is a comprehensive energy group engaged in power, coal, aluminum, railway, port, coal chemical and environment protection industries. Among the five State-owned electric power groups in China, CPI is the only one of companies which have all the assets of hydro power, fossil power, nuclear power and new energy. CPI is one of the three qualified nuclear power constructors/operators in China (together with CNNC and CGN, etc.) and become the Fortune 500 Companies since 2011. By the End of 2013, CPI has a total electricity installed capacity of 89.67 GW, coal production capacity of 74.1 million tons, aluminum production capacity of 2.89 million tons, total asset of 617.4 billion RMB, revenue of 190.2 billion RMB, and 126,000 employees.



Adhering to the concept of "providing green energy, serving the public", CPI has adjusted its power mix and industrial structure, and has made remarkable progress in pursuing green and low-carbon development. CPI has developed the installed Capacity of Clean Energy Plan to develop nuclear power from 2% (2010) to 10-15% (2020) (Fig.1).

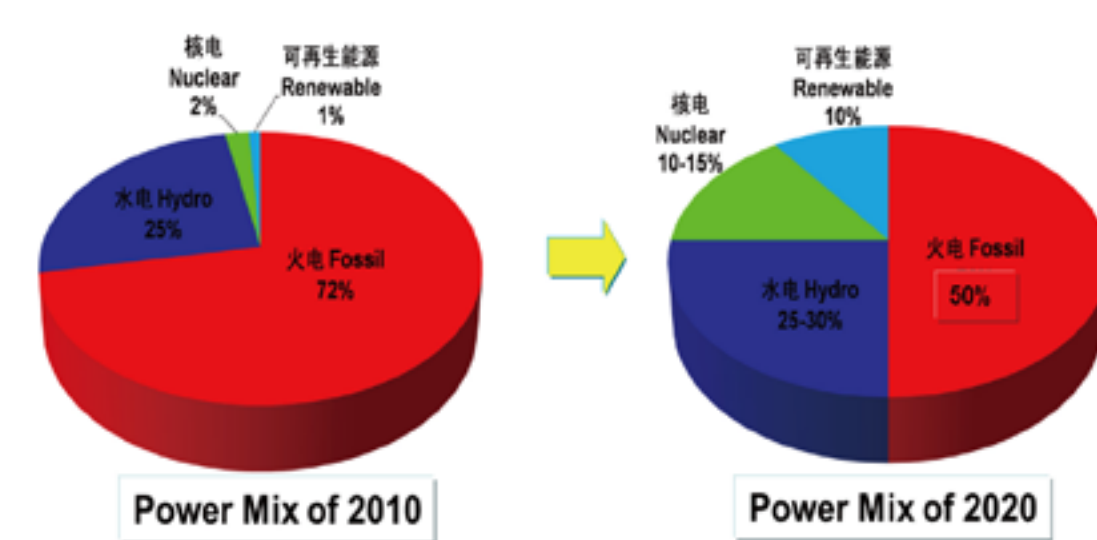


FIG. 1 Installed Capacity of Clean Energy Plan of CPI

By 2020, CPI plans to achieve 14 GW operational nuclear capacities and 10 GW constructional capacities (FIG. 2). At current stage, Phase 1 of Hong Yanhe NPP (2 units of CPR1000 PWR, equivalent stake sharing with CGN) in Liao Ning province is in operation and Phase 1 of Hai Yang NPP (AP1000) in Shan Dong province is under construction. All the new build projects (except Phase 2 of Hong Yanhe NPP) are planned to adopt the 3rd generation technology, represented by AP1000.

Nuclear power department of CPI and CPI Nuclear Power Company Ltd. (CPIN) are combined in one team for nuclear power business management and reported to CPI management (FIG.3). As the CPIN's subsidiary and CPI's professional R&D subsidiary of nuclear technologies, CNPI is taking the responsibilities to promote the preparation and implementation of CPI's strategies on nuclear power R&D and technical services.

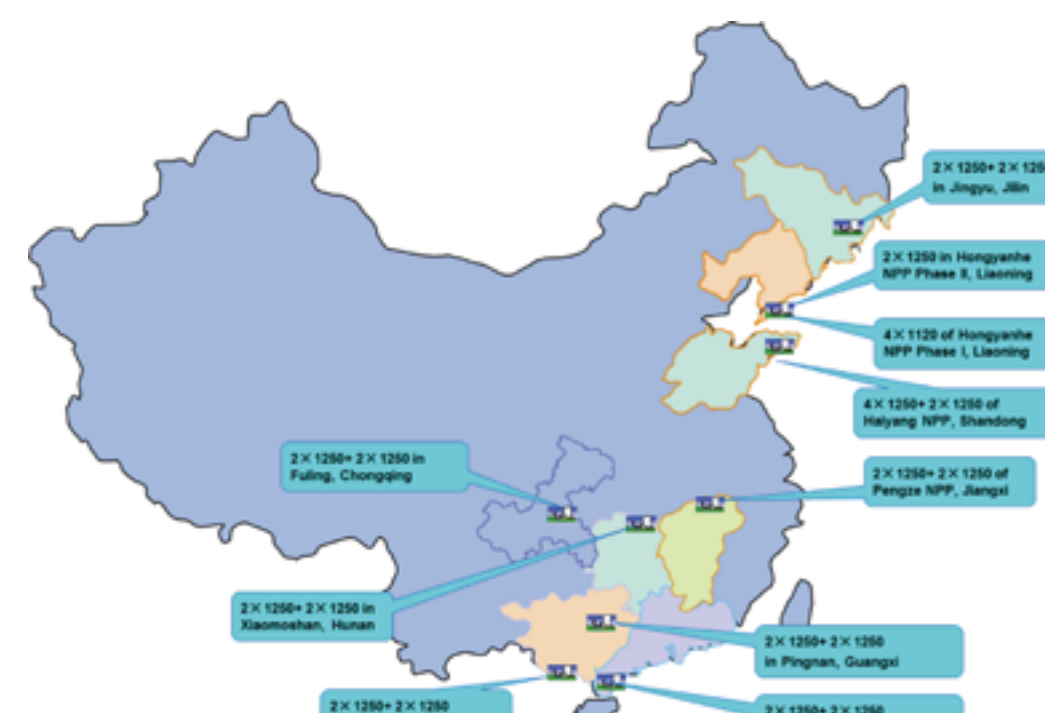


FIG. 2 Nuclear Power Project of CPI

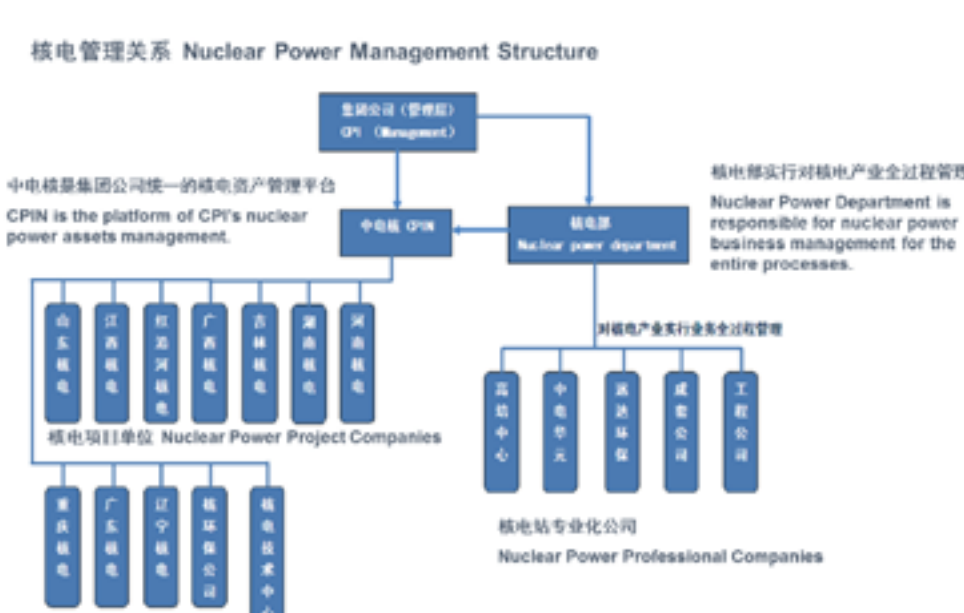


FIG. 3 Nuclear Power Management Structure of CPI

2. Nuclear Emergency Organization of CPI and the Role of CNPI

After Fukushima Daiichi Accident, the nuclear corporations' role in nuclear emergency preparedness and response was recognized well and Chinese government(regulator) are requiring all nuclear corporations in China to enhance their nuclear emergency preparedness and response capabilities.

The nuclear emergency management of Hong Yanhe NPP is leading by CGN (equivalent stake holder), and the nuclear emergency management of Hai Yang NPP is leading by CPI. As Hai Yang NPP (unit 1 of Phase 1) will take into commercial operation in 2016 and before unit 1 of Hai Yang's first fuel loading, CPI is requested by Chinese government(regulator) to build CPI headquarter's emergency preparedness and response capabilities. Base on the requirements, CPI has built up the nuclear emergency organization and CNPI was involved in the nuclear emergency organization to be one part of the technical support system.

2.1. Nuclear Emergency Organization of CPI

The CPI headquarter's emergency organization is consisted by Nuclear Accident Emergency Commission, Nuclear Accident Emergency Office and Nuclear Accident Emergency Consulting Group. The corresponding nuclear emergency organization of CPI has been built up as FIG. 4.

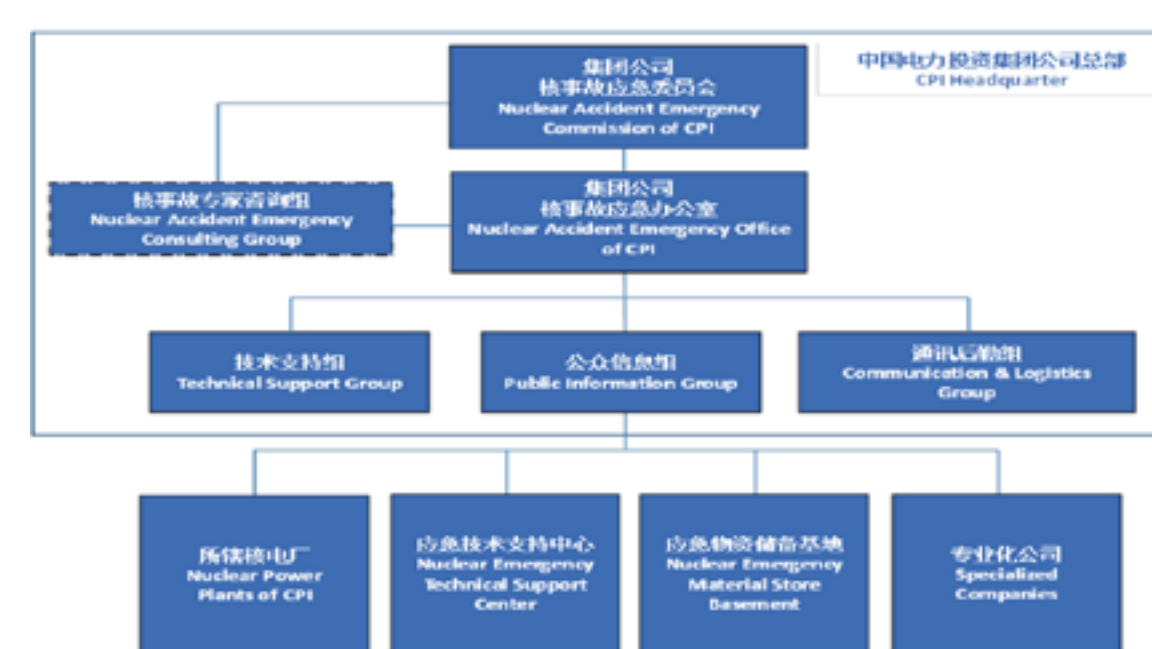


FIG. 4 Nuclear Emergency Organization of CPI

The Nuclear Emergency Technical Support Center which is under construction by CNPI (the nuclear emergency facilities are located in Beijing) and Shan Dong Nuclear Power Company (the operator of Haiyang NPP, the nuclear emergency facilities are located in Hai Yang city and Yan Tai city of Shan Dong province) will provide technical support to CPI headquarter and CPI's NPPs. The Nuclear Emergency Material Store Basement of CPI is located in Yan Tai city of Shan Dong province and will provide emergency material support to NPPs (FIG. 5). According to Chinese regulator's requirement, the CPI Nuclear Emergency Technical Support Center (Shandong Part) and Nuclear Emergency Material Store Basement will be combined together to be the CPI NPPs Nuclear Accident Emergency in Site Fast Rescue Basement and CPI NPPs Nuclear Accident Emergency in Site Fast Rescue Team will work there.



FIG. 5 Nuclear Emergency Material Store Basement of CPI in Yan Tai

2.2. CNPI's Role for Nuclear Accident Emergency Technical Support

As the CPIN's subsidiary and CPI's professional R&D subsidiary of nuclear technologies, CNPI is taking the responsibilities as the one part of CPI Nuclear Emergency Technical Support Center to provide nuclear emergency technical support to CPI Nuclear Accident Emergency Commission and Nuclear Accident Emergency Office. The major role of CNPI is to provide the expert advice on the following aspect, e.g. management and maintain of the CPI headquarter's emergency support computer system, plant data and process parameter explanation, plant state assessment, cord damage assessment, radiation source assessment and accident consequence assessment, etc. Based on the above role, the suggested organization structure of CPI Nuclear Emergency Technical Support Center (Beijing Part) is shown in FIG. 6.

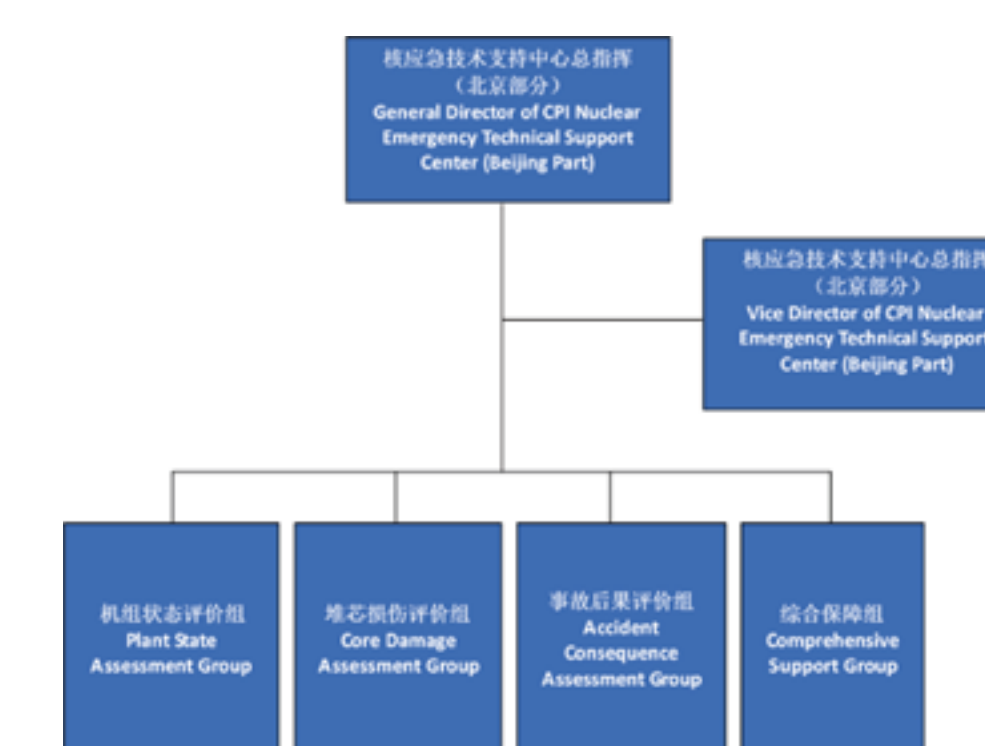


FIG. 6 The Suggested Organization Structure of CPI Nuclear Emergency Technical Support Center (Beijing Part)

Under the leading of general director of CPI Nuclear Emergency Technical Support Center (Beijing Part), it is suggested to arrange four specialty groups, as the plant state assessment group, cord damage assessment group (including radiation source assessment function), and accident consequence assessment group. The CPI Nuclear Emergency Technical Support Center (Hai Yang or Yan Tai Part) can arrange the similar function with the Beijing part.

3. Construction Requirements for CPI Nuclear Emergency Technical Support Center

For the purpose to maintain the technical capability to provide sufficient nuclear emergency technical support, the Nuclear Emergency Technical Support Center of CPI should be construed from management and technical aspects.

3.1. Management Requirement

The main responsibilities for CPI Nuclear Emergency Technical Support Center are as follows:

- 1) Nuclear technology research, nuclear emergency preparedness;
- 2) Provide technical support for the nuclear emergency system construction of CPI and nuclear power plants operated by CPI;
- 3) Provide technical support for CPI Nuclear Emergency Response and Assistance Center during an accident;
- 4) Take charge of the analysis of the situation, development trend of the accident and its possible consequences, and propose appropriate mitigation measures.

According to the responsibilities of the Nuclear Emergency Technical Support Center, the management requirement is to establish an emergency organization which have reasonable staffing, running efficient, and with a perfect emergency program system.

The management program system includes two aspects, emergency management procedures and technical procedures. The management procedures are used to standardize the daily operation and maintenance work, emergency response and on-call management of the Nuclear Emergency Technical Support Center. The technical procedures are used to guide the analysis and interpretation of the data coming from the power plant which have the accident, and the relevant assessment of the accident.

The management procedures include the Operation and Maintenance Management of the Nuclear Emergency Technical Support Center, the Nuclear Emergency Response Procedure of the Nuclear Emergency Technical Support Center, and the Nuclear Emergency On-call duty Management of the Nuclear Emergency Technical Support Center. The technical procedures include the use of the reactor core damage assessment software and technical support, the use of the radiation source assessment software and technical support, the use of the accident consequence assessment software and technical support, and the plant state assessment and technical support.

3.2. Technical requirement

The technical requirement of Nuclear Emergency Technical Support Center of CPI should be as follows:

- 1) Plant State Assessment: the status of plant systems and components should be well assessed in order to mitigate accident consequence and take correct actions. The parameters required for emergency evaluation, emergency report and emergency decision support, such as reactor vessel water level, pressure, temperature and other significant parameters, should be transferred to Nuclear Emergency Technical Support Center for review in real time.
- 2) Core Damage Assessment: during accident, the status of core should be well assessed. Core damage is assessed through containment dose rate, core exit thermocouple temperature, reactor vessel lever, etc. The emergency staff of Nuclear Emergency Technical Support Center should be well trained to assess core damage by emergency support systems, which is used to determine the core damage status, e.g. core integrity, fuel clad fracture, core overheat, core melt, sever accident of loss of the SG integrity in qualitative and quantitative analysis.
- 3) Source Term Assessment: source term released to environment during an accident is the basic input of the off-site dose prediction, Operational Intervention Levels (OIL) calculation, the precondition to determine the area of the emergency planning zone, and the primary basis to get recommendations of public protection action. Source term released to environment during an accident is related to the design of the unit. AP1000 is a new type nuclear reactor, and its idea and characteristic is very different from the former units. It is necessary to study the source term released to environment of AP1000 severe accident. Nuclear Emergency Technical Support Center of CPI should have the capability to perform source term assessment of AP1000 plant, and be able to determine the source term of one unit as well as the source term of more than one unit.
- 4) Dose Assessment: radiological dose assessment calculates the amount of radiation energy that might be absorbed by a potentially exposed individual as a result of specific exposure. External dose will occur when the body is exposed to radioactive material outside the body. This is a primary concern for gamma radiation during accident release. Nuclear Emergency Technical Support Center should have the capability to perform dose assessment to AP1000 plant.

4. Conclusion

The construction requirement for the nuclear emergency technical support center of Nuclear Power Corporation is a new topic in China. Its functions, organizational structure, staffing, management requirement and technical requirement need to be carefully considered. CNPI as the one part of CPI Nuclear Emergency Technical Support Center and the TSO to CPI NPPs, has started to study the construction requirements to Nuclear Emergency Technical Support Center. The work will play a positive role on the construction of the Nuclear Emergency Technical Support Center of CPI.

5. Reference

- [1] INTERNATIONAL ATOMIC ENERGY AGENCY, Generic procedures for assessment and response during a radiological emergency, IAEA-TECDOC-1162, August 2000.
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident [R], IAEA-TECDOC-955, 1997.
- [3] Criteria for emergency planning and preparedness for nuclear power plants-Function and physical characteristics of on-site emergency facilities, GB/T 17680.7-2003.