



生态环境部核与辐射安全中心
Nuclear And Radiation Safety Center



**Regional Workshop on the Development of National Strategies
and Regulatory Requirements for Spent Fuel Management**

Spent Fuel Management in China

2023.9.11-15, Beijing



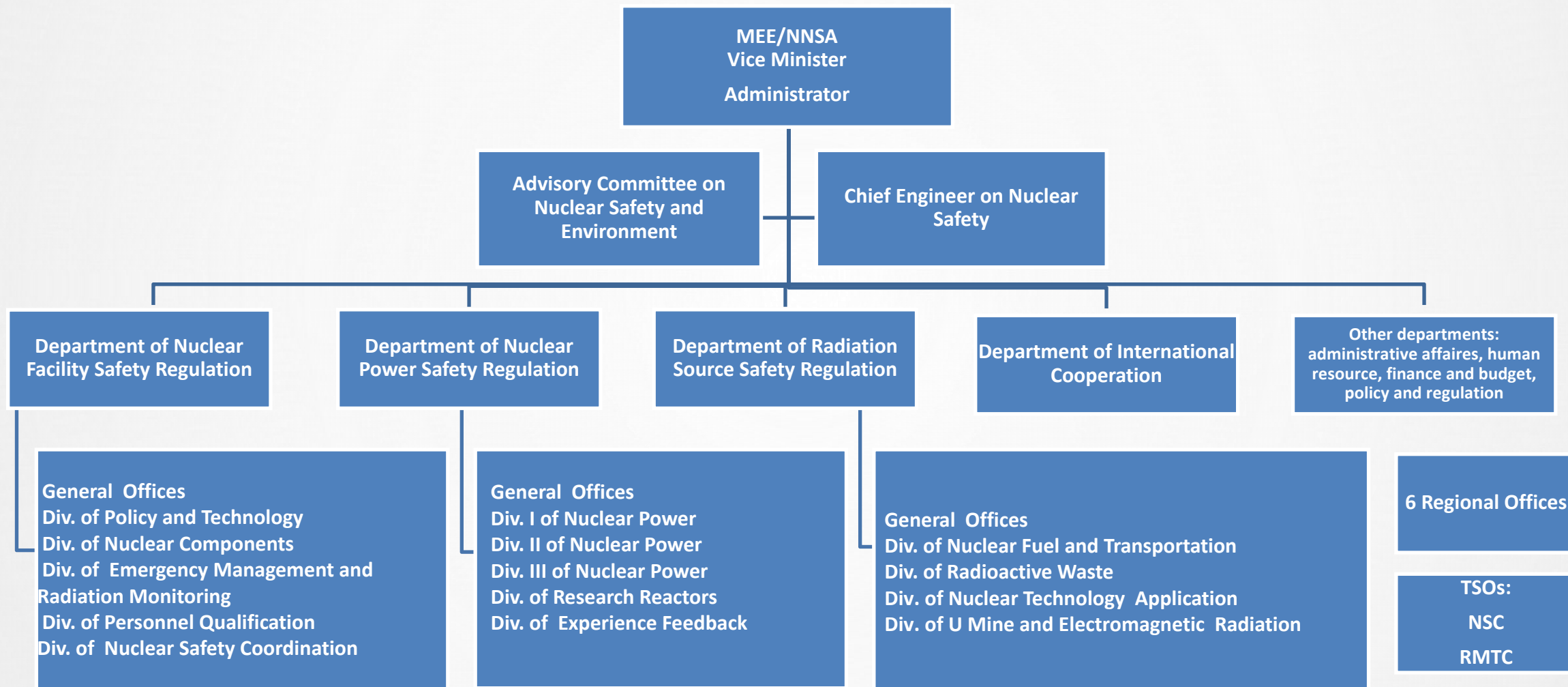


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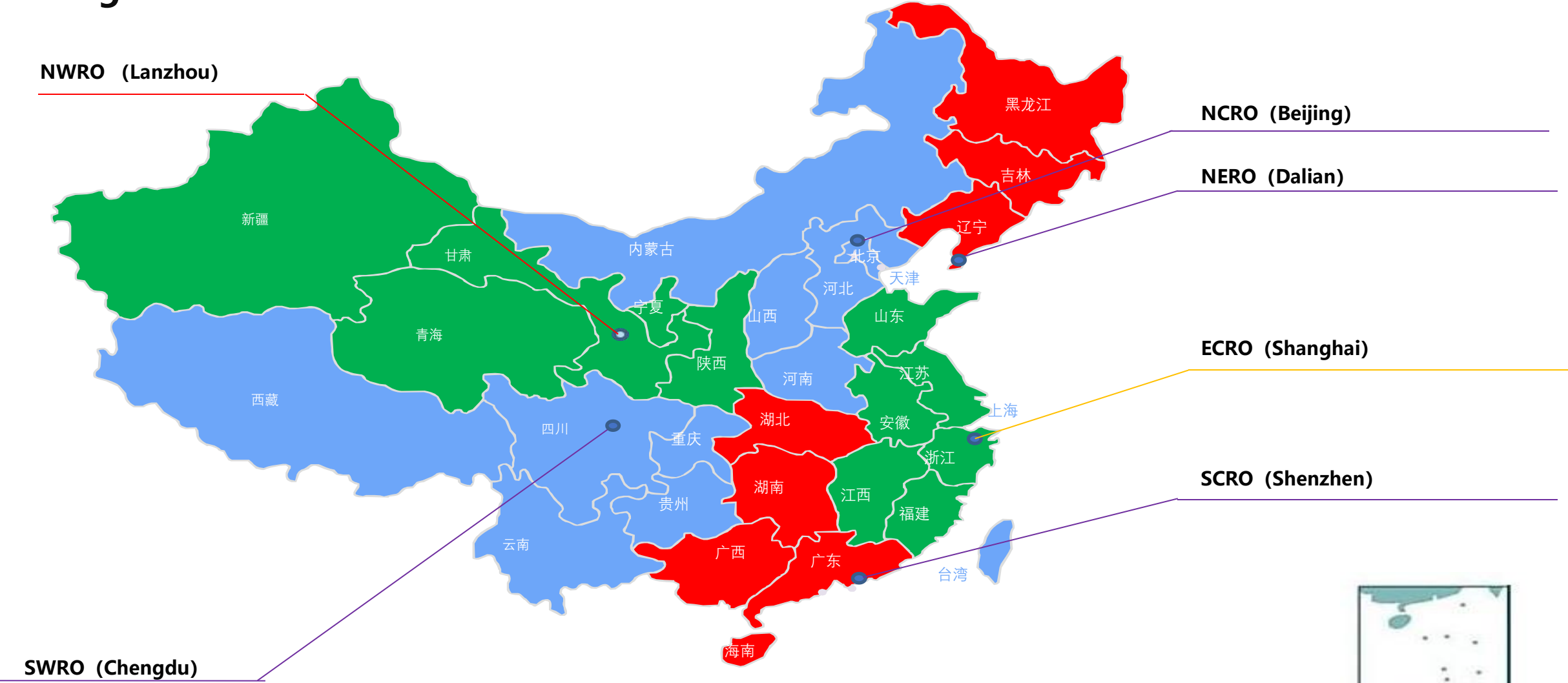
- 1. Regulatory Framework**
- 2. Spent Fuel Management Policy**
- 3. Spent Fuel Management Practices**

1. Regulatory Framework

➤ Organization of MEE(NNSA)



Regional offices in China Mainland



The inspection on nuclear safety components is allocated to North China RO.



1. Regulatory Framework

➤ Organization of MEE(NNSA)

Current Human Resources of NNSA

Headquarter of NNSA/MEE (100 staff)

- 3 Nuclear Safety Regulatory Departments

6 Regional Offices of NNSA/MEE (300 staff)

Technical Supporting Organizations

- NSC: Nuclear and Radiation Safety Center of MEE(600 staff)
- RMTC: Radiation Environmental Monitoring Technical Center (100 staff)
- Other contractors as TSO

Advisory Committee on Nuclear Safety and Environment

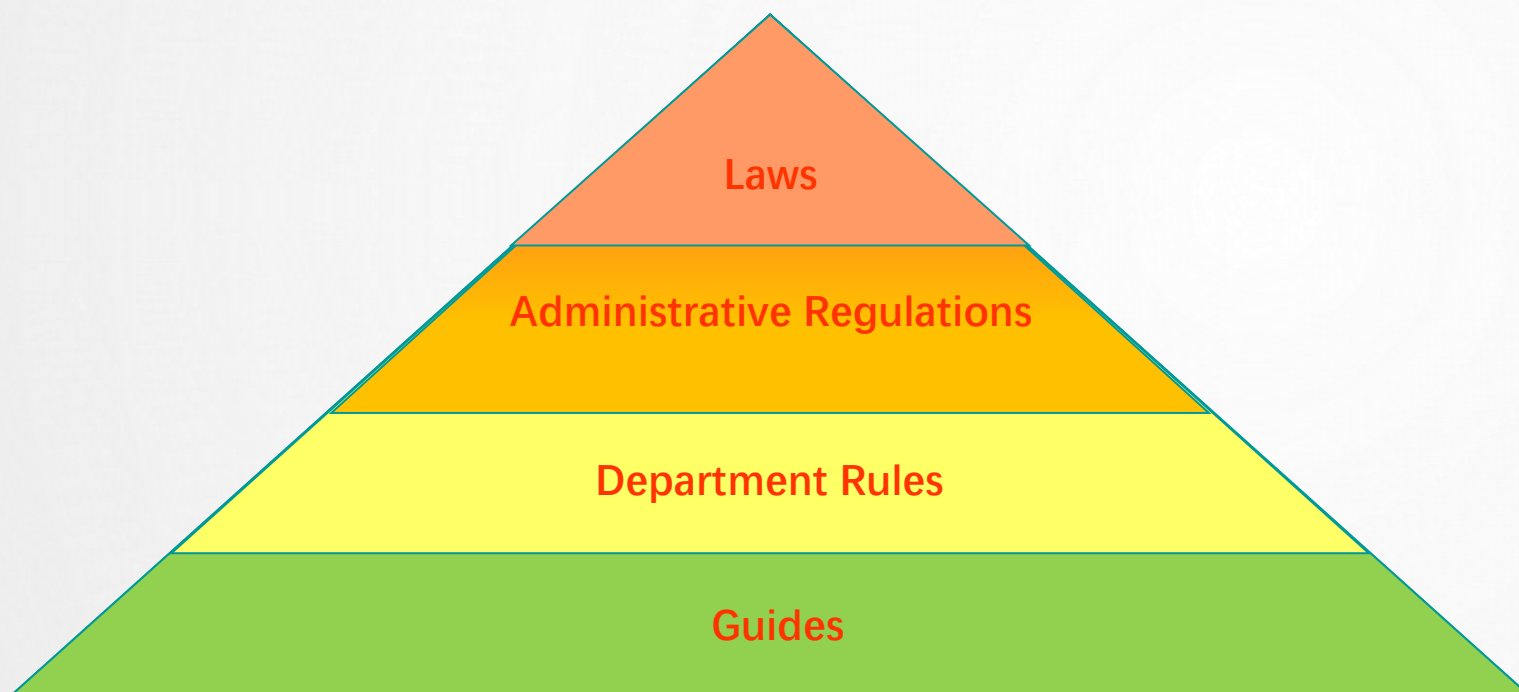
- 5 groups: system, construction and commissioning, equipment, radioprotection, sitting

1. Regulatory Framework

➤ Legislation Framework

Structure

The Hierarchy of Nuclear Safety Regulations



- Four-Level Hierarchy
 - Laws and Acts
 - Administrative regulations of the State Council
 - Departmental rules
 - Guiding documents
- Scope
 - 0: General
 - 1: NPPs
 - 2: Research reactors
 - 3: Fuel cycle facilities
 - 4: Radioactive waste
 - 5: Nuclear Material Control
 - 6: Nuclear safety components
 - 7: Nuclear Material Transportation
 - 8: Nuclear Technology Application
 - 9: Radiation Environment

1. Regulatory Framework

➤ China develops nuclear safety regulations which are based on IAEA nuclear safety standards and combine with the national condition and regulatory practice. The safety principles, safety objectives and requirements are consistent with the international safety standards.

1. Regulatory Framework

- **Laws (2)**— issued by the Congress (**Mandatory**).
- **Regulations (7)**— issued by the State Council (**Mandatory**).
- **Departmental rules (29)** issued by MEE(NNSA) (**Mandatory**).
- **Safety guides (94)**
- **Technical documents : more than 180**

1. Regulatory Framework

Laws — Issued by the Congress (**Mandatory**)

- Law on Prevention and Control of Radioactive Pollution, 2003
- Nuclear Safety Law, 2018

These two laws constitute the main legal basis for nuclear safety regulation and environmental protection management of nuclear installations (including nuclear fuel cycle facilities).

1. Regulatory Framework

- **Regulations(7)**— Issued by the State Council (Mandatory).
- Regulation on Surveillance of Civilian Nuclear Installations, 1986
 - Regulation on Nuclear Materials Control, 1987
 - Regulation on Nuclear Accident Emergency Management in NPPs, 1993
 - Regulation on Safety and Protection of Radioisotope and Radioactive Ray-Emitting Devices, 2005
 - Regulation on Surveillance of Civilian Nuclear Safety Equipment, 2007
 - Regulation on Surveillance of Radioactive Substance Transportation, 2009
 - Regulation on Surveillance of Radioactive waste

1. Regulatory Framework

➤ Regulation on Surveillance of Civilian Nuclear Installations, basis of License management

The regulations stipulate the responsibilities, licensing system and supervision and inspection in nuclear safety management:

- ❑ Nuclear safety licensing system for nuclear facilities during construction and operation, and approval system for siting, loading and decommissioning.
- ❑ The nuclear facility operator license system
the nuclear fuel cycle facility have not been implemented. The next step is to include the reprocessing operator license in the scope of the license

1. Regulatory Framework

➤ Departmental rules (29)

— Department rules are issued by MEE(NNSA)

- Code on the Safety of Nuclear Power Plant Siting (1991)
 - Code on the Safety of Nuclear Power Plant: Design (2004)
 - Code on the Safety of Nuclear Power Plant: Operation (2004)
 - Code on the Safety of Nuclear Power Plant Quality Assurance (1991)
 - Code on the Safety of Civilian Nuclear Fuel Cycle Installations(1993)
 - Management Rules on Safety and Protection for Radioactive Isotopes and Irradiation Devices (2006)
- ...etc.

1. Regulatory Framework

Main standards

- Mandatory standards on nuclear safety and radiation protection are issued jointly by MEE and China Commission of Standards
For example, in the aspect of radiation protection : Basic Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources (GB18871-2002) is equivalent to IBSS.
- There are series of standards in the aspects of nuclear criticality safety, radiation protection, safety design, radioactive waste ,effluent discharge.
For example, in the aspect of Nuclear Criticality Safety :
GB15146 series "Nuclear criticality safety of fissile materials outside the reactor", equivalent to ANSI/ANS8.1
- In addition : the seismic design of front–end facilities follows relevant civilian construction standards. The reprocessing facility uses relevant standards for NPP in seismic design.

1. Regulatory Framework

➤ Safety guides : 94

- Operation Limits, Conditions and Procedures of Nuclear Power Plant (2004)
- Safety Important System Software of Nuclear Power Plant based on Computer (2005)
- Safety Assessment and Verification of Nuclear Power Plant (2006)
- Periodic Safety Review of Nuclear Power Plants (2006)
- Organization and Safety Operation Management of Nuclear Power Plant Operating Organization (2006)
- Design of fuel handling and storage system of nuclear power plant (2007)
- ...

1. Regulatory Framework

➤ License system

China establishes a license system for nuclear facilities.

The operating organization of nuclear facility shall apply for permission MEE(NNSA) for activities such as site selection, construction, operation and decommissioning of nuclear facilities.

- ✓ **Nuclear facility license system**

Cover siting, construction, commissioning, operation and decommissioning stages

- ✓ **Nuclear safety equipment license system**

Related to design, manufacture, installation, non-destructive test organizations

- ✓ **Personnel qualification**

Reactor operator (RO/SRO), welding operator, registered nuclear safety engineer, NDE staff

1. Regulatory Framework

Nuclear facility license system

License Types	
1	Siting Approval
2	Construction License
3	Operation License
4	Decommissioning Approval
5	Ratification of Environmental impact Report (per stage)

1. Regulatory Framework

□Approval of Siting :

to review the Site Safety Assessment Report, to approve review opinions of siting

Documents submitted for Siting Approval	
1	Nuclear Power Plant Site Safety Analysis Report
2	Environment Impact Report in stage of siting

Usually, the validity period of approved site is 5 years.

1. Regulatory Framework

□ Construction License

Documents submitted for Construction Permit (6 months before FCD)	
1	Application for construction
2	Preliminary Safety Analysis Report (PSAR)
3	Environment Impact Report
4	Quality Assurance Program (for stage of design and construction)
5	Other documents stipulated in laws and regulations

Usually, the validity period of construction license shall not more than ten years

1. Regulatory Framework

□ Operation license

Documents submitted for operation license (6 months before first loading)	
1	Application for operation
2	Final Safety Analysis Report (FSAR)
3	Quality Assurance Program (for stage of operation)
4	Emergency plan
5	Environment impact Report (for stage of operation)
6	Commissioning Program
7	Report on Commissioning before Fuel Loading
8	License of Nuclear Materials

□ Operation license

If operating organization need to change the following contents, it should apply for approval of NNSA in advance:

- SSCs significant to safety
- Limits and conditions stipulated in license
- Other procedure or documents, which are related to nuclear safety, have been approved by NNSA

1. Regulatory Framework

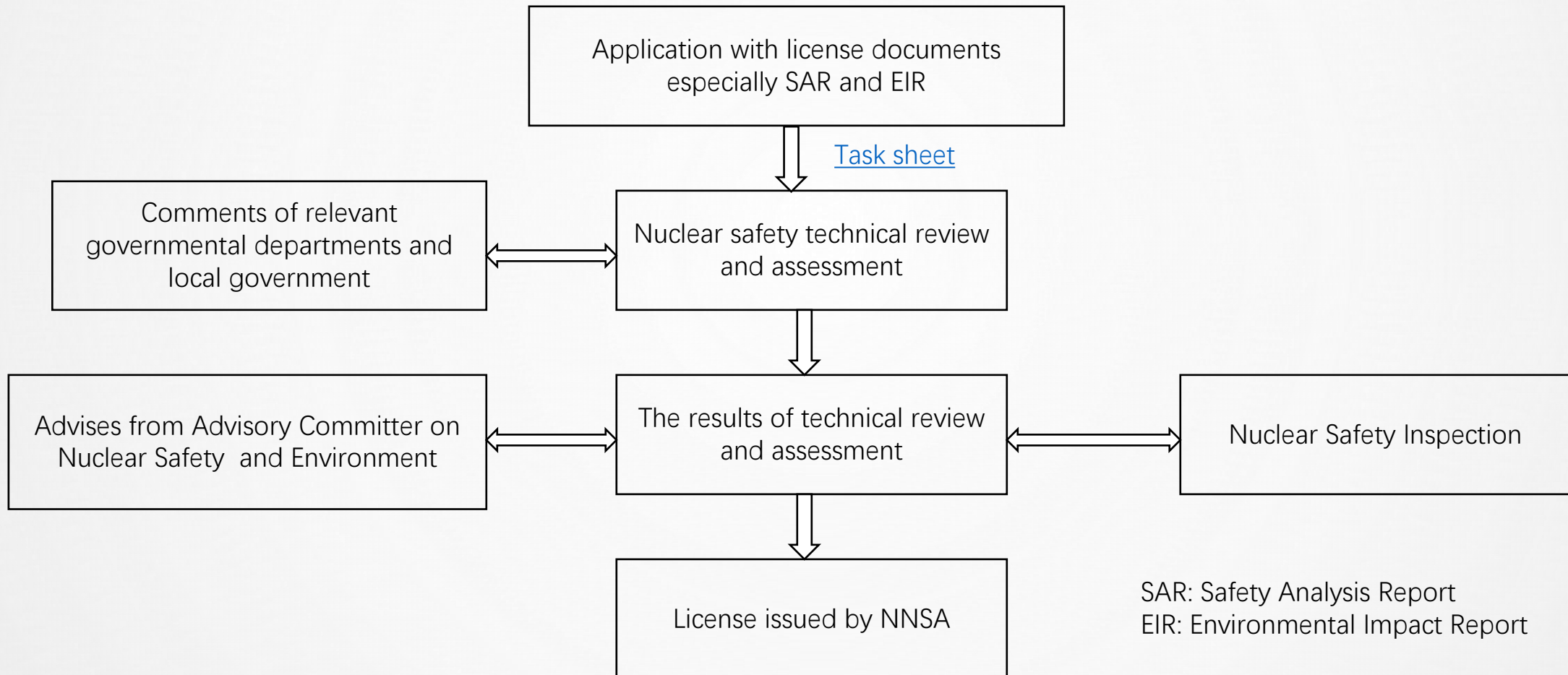
□ Approval of Decommissioning

Documents submitted for approval of decommissioning	
1	Application for decommissioning
2	Safety Analysis Report (SAR)
3	Environment Impact Report
4	Quality Assurance Program (for stage of decommissioning)
5	Other documents stipulated in laws and regulations

1. Regulatory Framework

Safety review process

IN GENERAL



1. Regulatory Framework

□ Supervision

➤ Nuclear safety inspection mode: daily, routine and non-routine.

- ✓ Daily inspections are conducted by regional inspection offices, important site set resident inspector
- ✓ Routine inspections are organized before approval and issuing license
- ✓ Non-Routine Inspection conducted for events or accidents, Others: for example, comprehensive safety examination after Fukushima Daiichi NPP Accident

➤ Nuclear safety inspection methods:

document inspection, on-site observation, survey and interviews, witness, measurements or tests.

➤ General inspection procedures

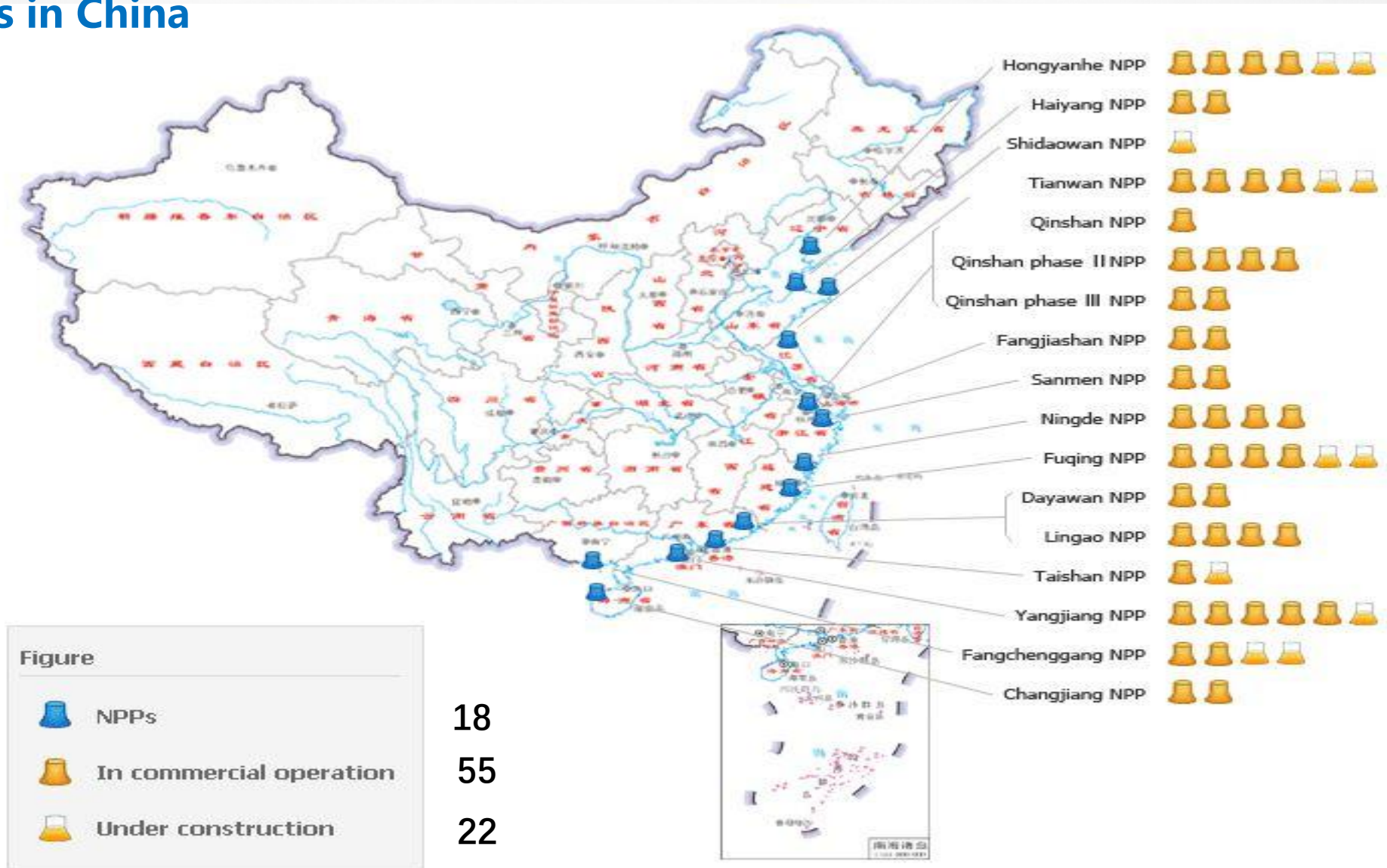
preparation work, pre-inspection meetings, implementation, post-inspection meetings, inspection reports, follow-up actions.

1. Regulatory Framework

- China establish a complete regulatory framework, it can cover the regulation of all stages(siting, design, construction, operation, decommissioning) for spent fuel management facility.
 - A series of standards can ensure the functions, such as appropriate confinement of the radionuclides involved, maintaining subcriticality, heat removal, radiation shielding and retrievability of the spent fuel or spent fuel packages.
 - All these above can ensure safety management of spent fuel.
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2. Spent Fuel Management Policy

Current NPPs in China (up to July, 2023)

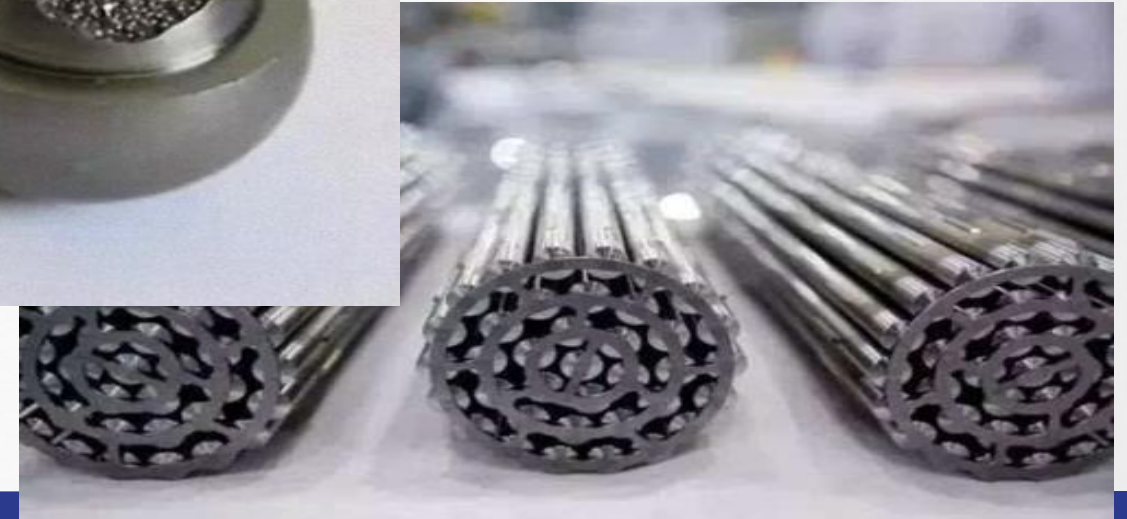


Type of reactor

- PWR: CNP300, CNP650, M310, CPR1000, VVER, AP1000, EPR, HUALONG-1, CAP1400, SMR
- HWR: CANDU-6
- HTGR
- Research reactor

2. Spent Fuel Management Policy

Fuel Assembly



Inventory of spent fuel

- As to July 2023, China's NPPs have produced a total of 8988 tHM of spent fuel(PWR) held in pool storage at-reactor, 206 tHM of spent fuel held in dry storage facility
- 3961 tHM of spent fuel(CANDU), 2661tHM of spent fuel held in dry storage facility.
- The spent fuel associated with research reactors are stored in the at-reactor pool(very small amount).
- As to July 2023, there is not any spent fuel disposal activity occurred in China.

2. Spent Fuel Management Policy

□ China's spent fuel management policy is to implement the reprocessing of spent fuel and to extract and recover uranium and plutonium materials, so as to achieve maximum use of resources, reduce the generation of high level radioactive wastes (HLW) and to ensure the safety of spent fuel management and the public safety, and to lower the risks to the future generations.

□ On the basis of the demands of nuclear power expansion in the near and long-term future, China is making efforts to develop overall planning for spent fuel management capability building, encourage enterprises to participate in capability building and scientific research, improve the regulatory system, and train high quality talent team, so as to ensure the smooth implementation of the spent fuel management policy.

3. Spent Fuel Management Practices

□ At present, the spent fuels generated from NPPs and research reactors are stored at reactors. The operators of NPPs and research reactors shall have the overall responsibility over the safety of management of the spent fuels generated by them.

□ The construction plan on storage system of spent fuel generated from NPPs has been developed by CAEA. With the demands of the transportation and storage of spent fuel withdrawn from NPPs, this plan has defined the planning and support policy in building spent transportation and storage ability, and put forward spent fuel management principle compatible with its nuclear power expansion.

2. Spent Fuel Management Policy

- The spent fuel storage facilities (based on spent fuel storage pool and complemented by dry storage facilities) have been established to variable extent at NPPs to accommodate the spent fuel arising from NPPs within a certain period of time and ensure storage safety. The dry storage facility at Tianwan NPP and Daya Bay NPP have been completed and put into operation, and the dry storage facility is under construction at Qinshan NPP(PWR).
- An away-from reactor storage dry facility of spent fuel has been erected at QNPP III site, consisting mainly of spent fuel preparation zone, transport zone, and dry storage zone. The first two modules were put into operation in September 2009; the second two began in operation since the end of 2013; and the third two was put into operation in April 2018.

3. Spent Fuel Management Practices

Off site SF Storage Facilities

- Temporary Dry Storage Facility for Spent Fuel of Qinshan NPP, Phase III(CANDU), design capacity 8251 tHM, Nuclear Power Operation and Management Co., Ltd CNNC

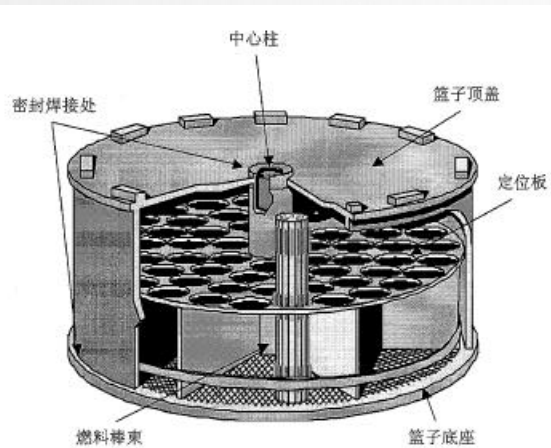
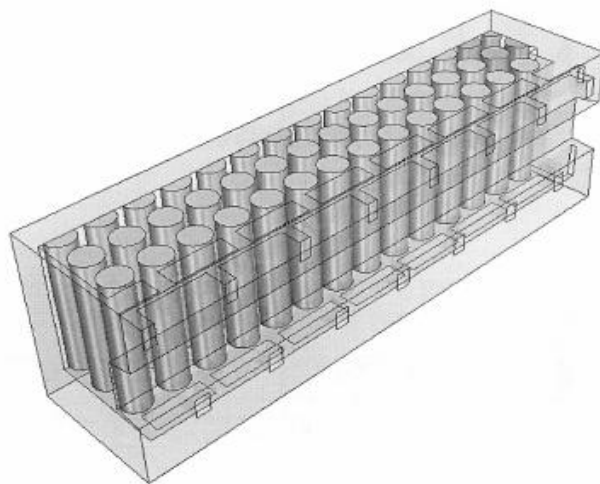


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3. Spent Fuel Management Practices

In site SF Storage Facilities

Temporary Dry Storage Facility for Spent Fuel, as BOP

- Tianwan NPP
- Daya Bay NPP
- Qinshan NPP: under construction



3. Spent Fuel Management Practices

The fund for SF Management

- The fund for treatment and disposal of spent fuel from NPPs has been set up in China and can be available for the transport, storage and reprocessing of spent fuel and the disposal of HLW. In 2010, Interim Measures for Collection and Use of the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants were issued by Ministry of Finance, National Development and Reform Commission and Ministry of Industry and Information Technology. In 2014, CAEA issued Projects Management Methods of the Fund for Treatment and Disposal of Spent Fuel from Nuclear Power Plants (PMMFTDSFNPP) governing the management of the funded-projects, so as to improve the efficient use of the funds.
- To meet the demands of nuclear power expansion, China makes effort, based on an overall planning, to construct the facilities for storage, transportation and reprocessing of spent fuel. The ongoing efforts involve the extension of the research and development of spent fuel dry-storage and reprocessing technologies, the promotion of large commercial reprocessing plant project. The capacity of the storage and reprocessing of spent fuel continued to be constantly improved as needed.

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Thank You!

