

WiN-Global 2006

Country Report for:

The People's Republic of China

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About nuclear in the People's Republic of China



- Number of reactors in service: 10 units
- Percent of electricity from nuclear: 2.3% of the country's total power generation
- 7800 MWe

About nuclear in the People's Republic of China



- Reactor types:
 - Pressurized water reactors and Heavy water reactors

About nuclear in the People's Republic of China



- Introduction to Reactors in Service



About nuclear in the People's Republic of China



1. Qinshan Nuclear Power Station is the first nuclear power station with a 300MW pressurized water reactor which has been designed, constructed, operated and managed by China it's own. It was connected to the grid on Dec. 15th, 1991.



About nuclear in the People's Republic of China



2. Phase II of Qinshan Nuclear Power Project

The two commercial 600MW pressurized water reactors have been designed, constructed, operated and managed by China it's own. They are of Phase II of Qinshan Nuclear Power Project started on Jun. 2nd, 1996..



About nuclear in the People's Republic of China



- Unit 1 of the two units was connected to the grid on Feb. 6th. 2002, and was put into commercial operation 47 days earlier. Unit 2 was put into commercial operation on May 3rd 2004

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3. Qinshan Nuclear Power Phase III Project is China's first commercial nuclear power station with two heavy water reactors. It is by far the largest project cooperated by China and Canada. The total capacity installed is 2x728MWe.



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The project was launched on Jun. 8th, 1998. It's Unit 1 was connected to the grid on Nov. 19th, 2002, and was put into commercial operation on Dec. 31st, 2002. The Unit 2 came into commercial operation on July 24th, 2003, 112 days earlier than regulated in the main contract signed by China and Canada, which was the shortest period of its kind in the world

About nuclear in the People's Republic of China



4. Daya Bay NPP is the first large commercial 2x900 MW PWR NPP in the mainland of China. The Unit 1 and Unit 2 were put into commercial operation in February 1, 1994 and May 6, 1994 respectively.



About nuclear in the People's Republic of China



5. Ling Ao NPP is the second large commercial 2x1000 MW PWR NPP in Guangdong following the successful operation of Daya Bay NPP. The Unit 1 and Unit 2 were separately put into commercial operation on May 28, 2002 and January 8, 2003.



About nuclear in the People's Republic of China



- Tianwan NPP
- The construction of four 1000MW units is schemed in two phase. In the first phase, two Russian AES-91 type units are adopted, which started with the first concrete on October 20, 1999, and will be completed and put into commercial operation by the end of 2005.

About nuclear in the People's
Republic of China



Future of nuclear power in the People's Republic of China

About nuclear in the People's Republic of China



- **Government Position**
- “Standing on our own feet and breaking new ground for resplendence” is the guiding principle of the current and future development of China’s nuclear power industry.

About nuclear in the People's Republic of China



In light of the government's strategic on positively developing nuclear for benefiting the nation and people, contributing to the peaceful development, the nuclear industry in China enters a new stage and crucial period of development.

About nuclear in the People's Republic of China



- In the new era of the development, the Chinese government has drawn up the 2020 Strategic Plan. The target of the plan is that a six-fold increase in the nuclear electricity capacity is to be realized by the year 2020 and the installed capacity of nuclear power in China should reach 40 000MW.

About nuclear in the People's Republic of China



- 3 new nuclear power plants is built under way with all together 15 units
- Type: Heavy water & VVER
- Introduction to the new nuclear power plants

About nuclear in the People's Republic of China



1. Tianwan NPP

TNPP is a large scale cooperation project in the nuclear energy in accordance with an inter-government agreement concluded between China and Russia in December 1992. The plant is located in Tianwan, Gaogongdao, Lianyung District, Lianyungang City, Jiangsu Province. The construction of four 1000MW units is schemed in two phase.

About nuclear in the People's Republic of China



In the first phase, two Russian AES-91 type units are adopted, which started with the first concrete on October 20, 1999, and will be completed and put into commercial operation by the end of 2005. TNPP installed capacity is 2×1060 MW and design life 40 years, the annual average load factor is no less than 80% and annual generated electricity 14 billion kWh.

About nuclear in the People's Republic of China



2. Zhejiang Sanmen NPP

The first phase of Sanmen nuclear power project was started on July 21, 2003. It will be composed of 6x1000MW nuclear power units, two units of phase one with introduce into the international advanced technology of third generation of PWR through inviting international bidding.

About nuclear in the People's Republic of China



According to the planning, Sanmen nuclear power project will start construction in 2007, and the first unit will put into operation in 2011.

WIN

About nuclear in the People's Republic of China



3. Yangjiang NPP

Six units of 1000 MW or larger capacity are planned to be constructed for Yangjiang NPP (located in Guangdong Province) in two or three phases.

About nuclear in the People's Republic of China



For nuclear phase out policy

- The principle of “safety first” and “giving priority to prevention” has been consistently carried out, and a sound nuclear safety system has been established in China’s nuclear power industry.

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- Number of WiN members: 17 (granted by WIN Global) 158 (granted by WIN-China)



Sharing Best Practice



Education

A WiN –China achievement

- Introduction of Academic Program Relating Nuclear and Radiation Engineering in China
- There are many disciplines in engineering fields. The nuclear science and technology is one of the 1st level disciplines in engineering fields. It included four 2nd level disciplines:
 - Nuclear energy science and engineering
 - Nuclear fuel cycle and material
 - Nuclear technology and applications
 - Radiation shielding and environmental protection

Sharing Best Practice



- Different universities and departments have different emphases.
- Nuclear and Radiation Engineering as the emphasis: Tsinghua, Xi'an Jiaotong, Shanghai Jiaotong, and Harbin Engineering
- Nuclear Technology and physics as the emphasis: Tsinghua, Beijing University, Chengdu Technology University, Lanzhou University, Sichuan University, Nanjing University, Chongqing University, Jilin University, Nanhua University,...

Sharing Best Practice



- Undergraduate students for bachelor degree(4 years)
- Graduate students for Master(2-3 years) and Doctor Degree(3 or 5 years)
- Students for the second Bachelor Degree(2 years)
- Students for Engineering Master Degree(2-5 years)
- Students aimed at some specified institutions or enterprises (different levels) by contracts
- Students for some short training program (a few months)

Sharing Best Practice



- The undergraduate courses are designed and arranged to make students to have strong basis of basic science including mathematics and physics, etc, and to master foreign language and computer skills well while they study the related engineering and specialized courses.

Sharing Best Practice



- The specialized courses related to nuclear and radiation engineering are as follows:
- Required: Principles of nuclear engineering, Experiments of reactor physics and radiation detection; Radiation protection and health physics, Radiation physics and detection, Nuclear instruments.
- Recommended: Reactor thermal-hydraulics, Systems of nuclear power plant, Nuclear safety, ...
- Electives: Nuclear design, (Nuclear) materials, Nuclear fusion, ...

Radioprotection

- **1. Radioprotector research**
- The main works which played important roles in the mechanism in the pathogenesis and development of body deficiency induced by radiation were studied, and the changes which happened on animal model were investigated from whole animal, tissue, cell and molecule levels. The evaluate standard of body deficient animal model were established.

About our achievement



- The therapeutic mechanism of natural products was observed, the approach and mechanism on enriching blood of it was systematically analyzed, materially foundation and active constituents of herbs were discovered by activity directed separation. In the results of genomic and proteomics of it, the injury could be alleviated by regulating hematopoietic factors level. The compatible principle, action mechanism and active constituents were elucidated detailed and rationally using modern technique.
- Based above, the evaluation on radio-sickness of new drugs were investigated.

About our achievement



- **2. Biological dose estimation for the victims exposed to nuclear and radiation accidents:**
- Including over-high dose ^{60}Co source irradiation accident, protracted irradiation accidents and over-exposure accident.
- **3. Study on radiation biological dosimetry:**
- On the base of chromosome bio-dosimeter, the curve of 6-22Gy doses and chromosome aberrations was established in order to estimate biological dose for over-high dose exposure.

About our achievement



- Chromosome aberration frequencies between low and high dose rates were compared, different dose rates and response curves were prepared.
- Relationships of dose-effect and time-effect was studied with the method of single cell gel electrophoresis (SCGE or comet) in order to explore feasibility of rapid dose estimation.

About our achievement



- **4. Assessment of radiation late effect and follow-up observation:**
- Chromosome aberration follow-up observation and cancer risk assessment for five victims of Shanghai “6.25” ^{60}Co source accident have been in progress from 1990-2004.

Safety of nuclear power plant

For a nuclear power plant, the safety is one of the most important aspects. The reliability and safety must be considered both during the design stage and the duration of operation. As a nuclear power plant ages, its reliability and safety margins provided by the design tend to decrease and its operations and maintenance costs are likely to increase unless an awareness of the need to manage age related to degradation is imparted to and acted upon by the plant's operations and maintenance personnel.

About our achievement



The ageing of nuclear power plant system, structures and components (SSCs) important to safety must be effectively managed to ensure that the required safety functions are available throughout the service life of the plant, including its extended life. Naturally, the ageing of the other SSCs must also be properly managed to properly managed to provide for reliable and economic plant operation.

About our achievement



- The history of nuclear power in mainland of China started in 1991 and it is still younger than western countries. But the safety of operational NPPs has already draw considerable attention both of nuclear safety regulatory organizations, owners and technical supporters in China. From the viewpoint of sustainable development, improving economic benefit of nuclear power while assuring its safety by implementing effective ageing and life management is of importance to showing the advantage of nuclear energy over other energy source. According to the requirements of NNSA, to every operational NPP,

About our achievement



- a periodic safety review (PSR) should be carried out every 10 years. Ageing management is one of the safety factors for PSR. Main components such as reactor pressure vessel (RPV), steam generator (SG) and reactor internals (RI) are the most important objects for ageing management review (AMR).

About our achievement



- As the member of the nuclear field, the staff of institute, the professional women, I made many efforts on the material design, nuclear coating design, material performance research, corrosion and protection research, Assessment and management of ageing for major nuclear power plant components important to safety, Lifetime management and lifetime prediction of materials in PWR environments,

About our achievement



- Failure analysis and safety evaluation for components etc. for the new and operational NPPs. For example, we have complete the PSR (the first ten year) for Qinshan 1 a few years ago and just now, we are undertaking ageing management for Qinshan 3.

Thanks!

