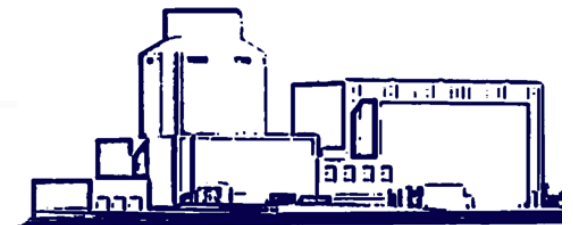


21世纪中国核电人力资源需求的 挑战和对策

**The Challenge and Countermeasure of Human
Resources on Nuclear Power for China
in the 21st Century**

Dr. Zheng mg
October 2009, Vienna



1. 核电发展人力资源挑战来自何处？二次严重事故、巨大需求

Where Challenges of HR resulting from? Three aspects

1.1 Impacts of two severe accidents and GCR

1.2 Great plan and demands for nuclear power development(NPD)

1.3 Natural laws for human resources development

2. 核电发展人力资源对策与举措？

How to confront HR problems for NPD?

3. SNPTC/SNERDI 简述

Brief about SNPTC/SNERDI

4. 结论与思考

Conclusion and thinking beyond HR



The first Challenge is from:

- The consequences of two SA and stagnation of development
- And Great culture revolution

The accident of TMI in 1979 and Chernobyl NPP in 1986 had cast a shadow over the world, especially the Chernobyl accident caused an environmental disaster.

Impacts of two severe accidents were:

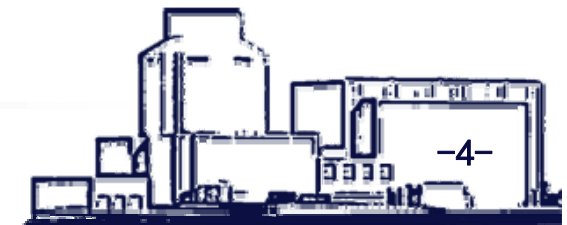
Directly resulting into Questions on nuclear safety and more safety review requirements imposed, Licensing uncertainties increased, nuclear power economy degraded, low public confidence obtained.



SA Indirectly resulting into:

- 1、 The cancellation of a lot of nuclear power project contracts lead directly to slow down the world's nuclear power development from 1980 to 2004.
- 2、 The stagnation of the development of nuclear power, influenced the whole nuclear industry including the buildup and training of scientists and engineers.

The nuclear power policy in China before 2004 was adequate or moderate not active as present, i.e. low speed development.

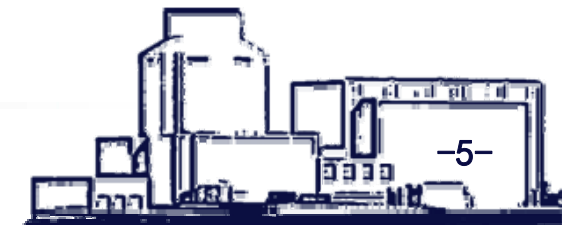


3、 Many nuclear departments, teachers and relevant courses in the various universities had been changed or closed. Only four universities in China kept the nuclear power engineering technology specialty but with no students in some years.

4、 Lot of engineers and scientists left from nuclear related industries and entered other industries.

Lots of engineers joined, trained and left from SNERDI from 1998 to 2004 due to the low development of NP.

5、 Undergraduates and Graduates from university are directly switched or attracted to IT and commercial industries.



1.1 文化大革命的影响 additional impacts from GCR

Challenge also from great culture revolution(GCR):

There was **a gap of over 10 years** without normal student graduation. Many nuclear power experts and engineers graduated from 1950 to 1970 were retired. The normal university education was resumed in 1978.

This gap had also greatly contributed to the temporary shortage of manpower in nuclear power industry.

These major problems combined were resulting into the less Manpower supply for nuclear power industry as well as education, and created the present challenges or critical situation in various nuclear power fields. **As HR required for all the nuclear fields to maintain the sustainable system operation.**



□ 第二个挑战来自于核电建设的热潮

The **second challenge** is from high demand of NP development:
With the efforts of nuclear industry and safety administration as well as technical innovation to demonstrate the nuclear power is:

安全、经济、高效、清洁、可持续的

The safe, economical, clean and sustainable energy supply.

核能对气候变化、节能减排非常重要

The importance of nuclear power for energy-saving and emission reduction of CO₂.

具有更大的发展空间---先进核电技术与燃料循环技术的发展以及安全与保障体系

And more benefits from the development of advanced NPP and fuel cycle technology as well as the enhancements of security

and safeguards.

2009年10月26日星期一



□ 上世纪70年代起步，1983年确定压水堆技术路线
Chinese NPP was started in 70s, PWR determined in 1983.

□ 中国大陆第一座核电厂----自主开发的秦山核电厂1991年并网发电

The 1st commercial operation NPP indigenously developed by SNERDI--- Qinshan NPP was connected to grid in 1991

□ 目前 Current situation

投入运行机组11台，约910万千瓦

11 units in operation, generate approximate 9.10 GW

在建24台核电机组，约2540万千瓦

24 units under construction, generate approximate 25.40 GW



□ **2007年10月 《核电中长期发展规划(2005-2020)》**

Chinese nuclear energy medium and long term development plan for 2005-2020 was issued in October, 2007.

- **容量目标：到2020年，建成4000万千瓦，占全国电力装机容量4%左右；2020年末在建1800万千瓦**

Capacity Target: to complete 40 GW in operation representing 4% of the total national power grid capacity; 18 GW under construction by the end of 2020.



可能性:

2020年，建成~7000万千瓦，占电力总装机5%以上；在建3000万千瓦，到2030更多。

Great Possibility:

To complete ~70 GW in operation representing 5% of the total national grid power capacity, and 30 GW under construction by 2020. Positive estimation in 2030 could be up to 200 units and with big unit size.

Newly possible target set for clean energy 15% from news of G20 meeting.



□ **核电能力发展目标:**

Capability Target of development by 2020:

● **形成比较完整的自主化核电发展工业体系**

Establishment of a more complete nuclear power industrial system for self-research and development, design, manufacture, construction and operation including the guides and standards for the development of Nuclear Power.

● **培育与国际先进水平接轨的核电建设和运营管理模式**

Building of the construction and operation management system for NPP based on the internationally advanced modes.



- 核电发展将作为国家调整能源结构、保护环境、应对气候变化的重要措施之一，加大核电中长期建设规模

Development of Nuclear Power is national key policy and measures to restructure the energy supply, to confront the problem resulting into environmental and climate changes.

Present actions:

- 建设一批二代改进型压水堆核电机组

A batch of improved G-II PWR is being built currently.

- 抓紧三代核电自主化依托项目建设

To promote the G-III self-reliance supportive project for Sanmen and Haiyang, including the follow-up projects.



□ **2009年5个新的核电项目开工**

**5 NPP projects are supposed to perform FCD in 2009:
San Men (AP1000), Hai Yang (AP1000), Tai Shan (EPR),
Chang Jiang (CNP600) and Rong Cheng (HTGR).**

□ **AP1000机组批量化建设并向内陆省份推广**

**Construction of standardized AP1000 proposed in inland of
China.**

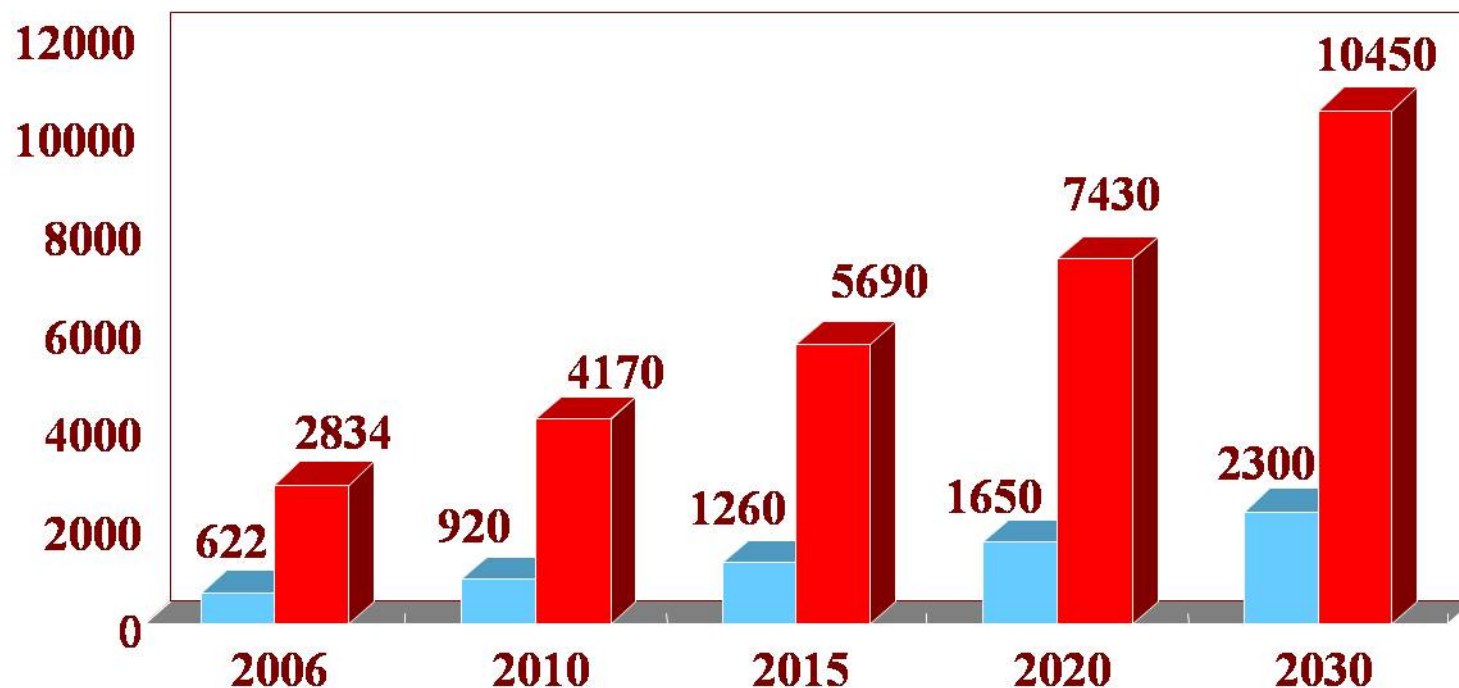
□ **国家重大科技专项“大型先进压水堆及高温气冷堆核电站”**
**National key research project ‘Large Passive Nuclear Power
Plant and High Temperature Gas Cooled Reactor’.**

● **加快速堆技术研发和示范堆建设**

**To speed up the research of the technology for Sodium-cooled Fast Reactor
and promote the construction of demonstrating NPP.**

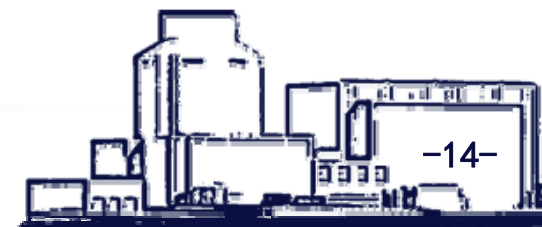


1.2 中国核电规划及核能需求 Great Plan and Demand of NP

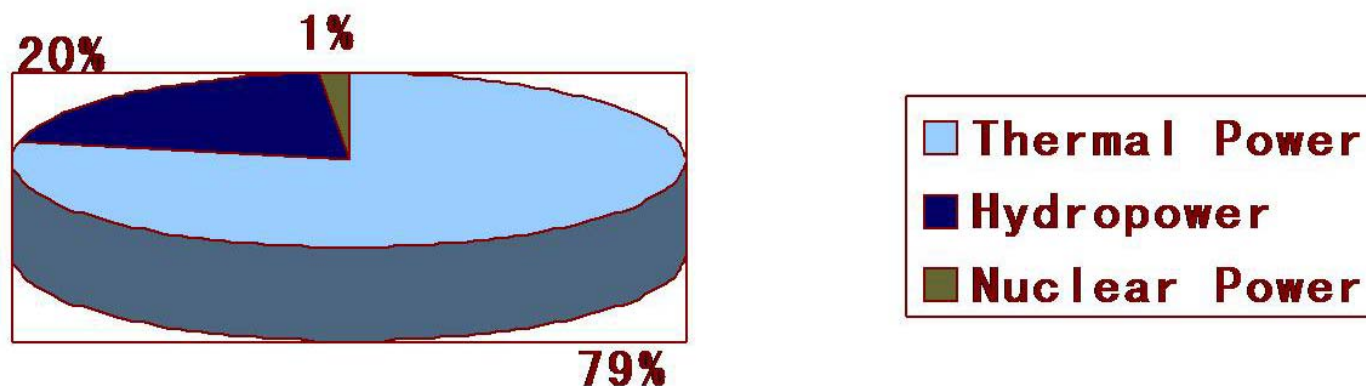


■ Total Installed capacity (GW) ■ Total Generation Capacity (billion KWH)

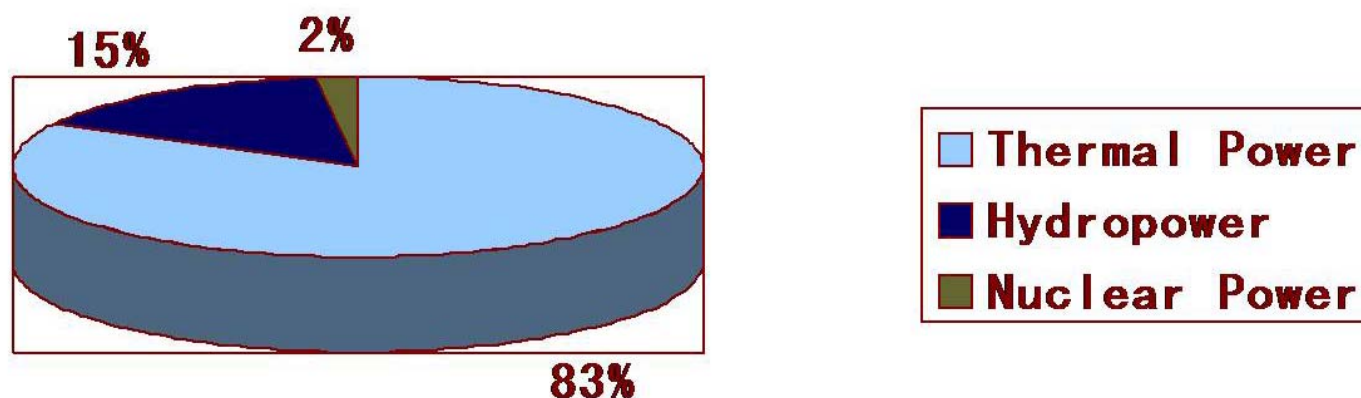
Data from “Estimation of Nation’s Power Demand from 2005 to 2030 and the strategy analysis” by Expert Committee of China Development Bank



1.2 中国核电规划及核能需求 Great Plan and Demand of NP



Proportion of Installed Capacity

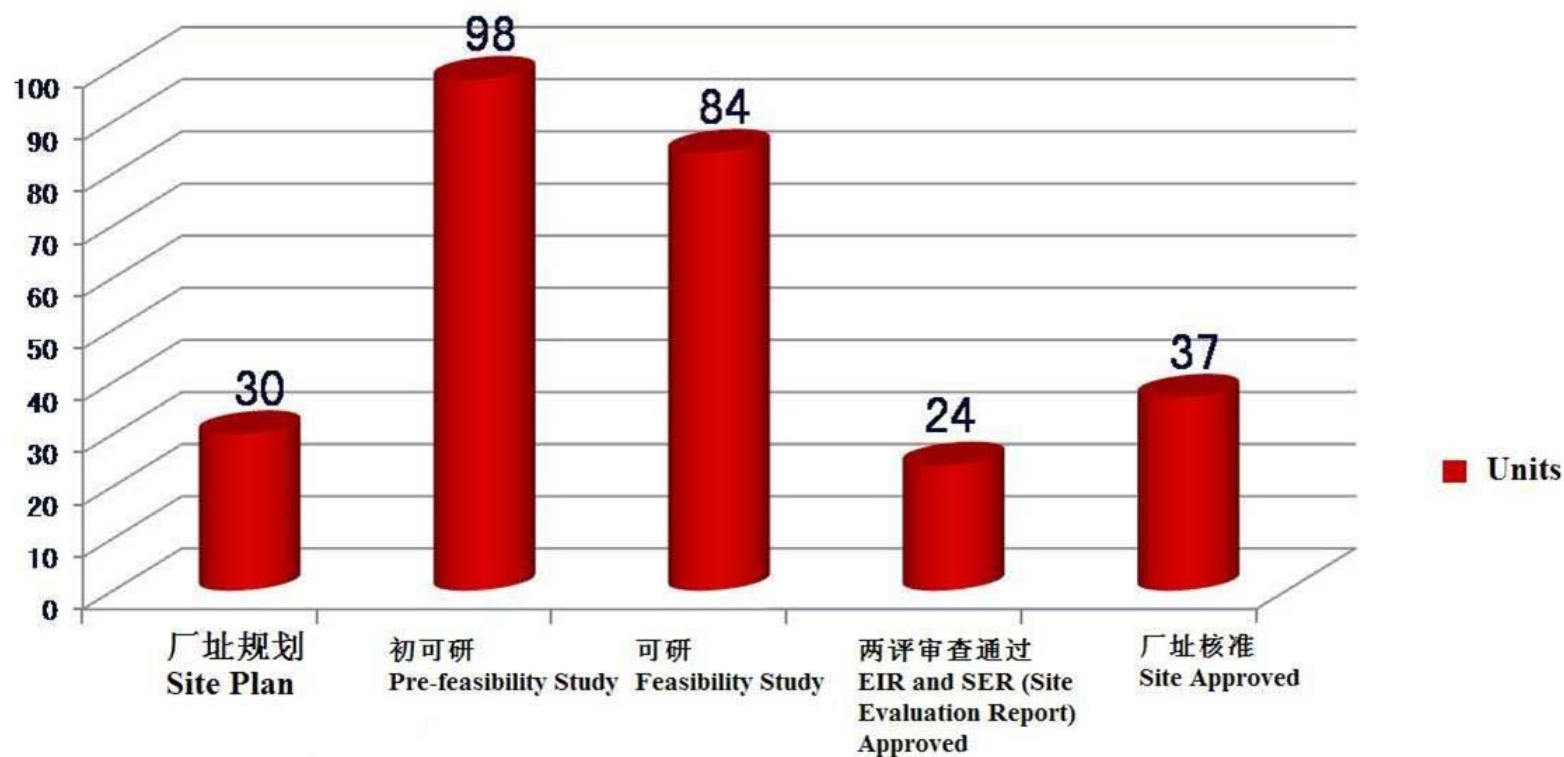


Proportion of Generation Capacity



1.2 中国核电规划及核能需求 Great Plan and Demand of NP

Chinese Nucleae Power Plan (As of August 2009)



Challenge is enormous as so large amount of HR is required in such short time for all nuclear industries to meet the highly demands of quick nuclear power development .

and Only can professional and technical personnel promote the sustainable development of nuclear power.

It' s also a great motivation and chance for youngsters . We have human resources but how to educate and train them? Still a challenge!





1.3 人力资源培养有自然规律 Natural laws for HR development

The **third challenge** is from the natural law for HR development:

It Depends mostly on the domestic overall scientific, educational, technical level and industrial systems capabilities including various Infrastructures and qualified Teachers. AS:

- Time period required for engineers to cover education, training, practice. Rome is not built in one day.

Example: A control room operator needs 8-10 years with strict training of 3000 hours of practical training, 8 hours of test. Qualification and Certificate to be awarded by National Nuclear Security Agency.

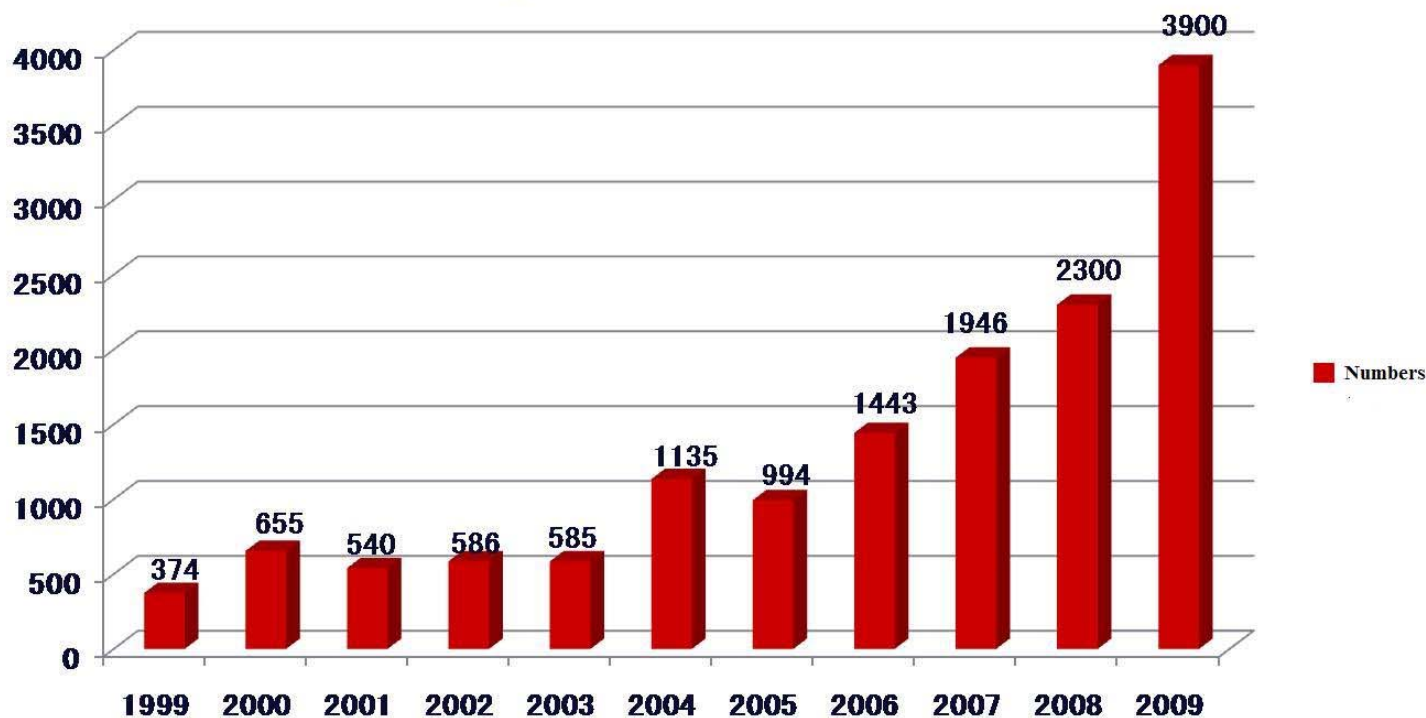
- Time period required for infrastructure establishment.



1.3 人力资源培养有自然规律

Natural laws for HR development

年度本科核专业招生人数 (1999-2009)
Undergraduate Enrollment in China

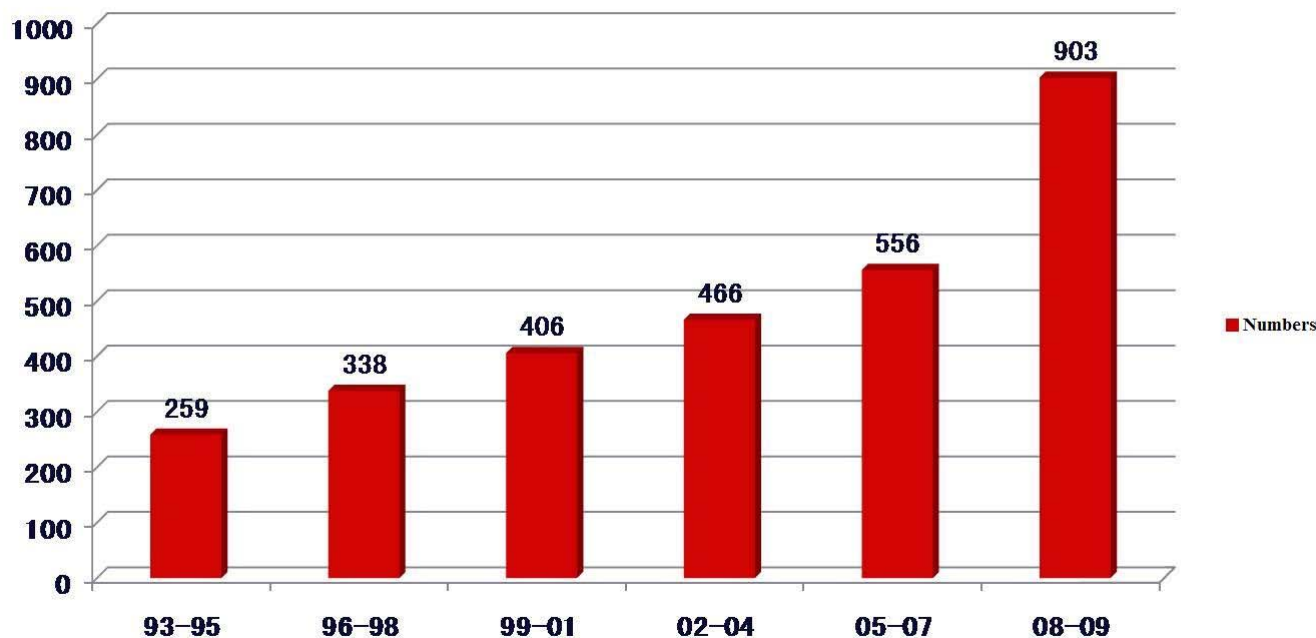


中国高校年度年度招生人数
Number of undergraduates enrolled in Nuclear Engineering – China
(1999-2009)



1.3 人力资源培养有自然规律 Natural laws for HR development

本科核专业毕业人数(1996-2009)
Degree Number of Undergraduate



中国高校核专业年度毕业人数
Number of graduates major in Nuclear Engineering – China
(1996-2009)





1.3 人力资源培养有自然规律

Natural laws for HR development

2020年前核专业人才需求情况调查(不完全统计)
Nuclear Talent Demand Survey before 2020

Specialty	Total				Year 2010			Year 2011-2015			Year 2016-2020		
	All degree	Ph. D	Master	Bachelor	Ph. D	Master	Bachelor	Ph. D	Master	Bachelor	Ph. D	Master	Bachelor
	20130	2826	5154	12150	366	702	1713	1170	2295	5526	1290	2157	4911
放射性地矿专业 Radioactive Ore	2352	234	573	1545	36	108	183	108	240	672	90	225	690
等离子体物理 Plasma physics	999	510	354	135	36	24	15	210	165	60	264	165	60
粒子物理与原子核物理 Particle physics and nucleonics	1092	363	342	387	48	60	48	147	126	177	168	156	162
反应堆工程 Reactor Engineering	5220	483	1386	3351	99	222	507	189	579	1449	195	585	1395
辐射防护与环境保护 Radiation and environment protection	2397	162	573	1662	18	81	216	63	249	765	81	243	681
核化工与燃料循环 Nuclear chemical and fuel recycle	6054	657	1407	3990	78	153	564	267	690	1977	312	564	1449
核能类其他专业 Other subjects	1884	411	513	960	45	48	120	186	246	426	180	219	414

2. 核电发展人力资源对策与举措? How to confront HR for NPD?

为满足中国核电发展，需从几个方面加强核电人力资源建设

Therefore, several countermeasures and ways should be adapted to enhance the nuclear power HR development to meet the demands of nuclear power development in China.

与高校建立联动，改变学科设置，加大毕业生培养力度。

1.Coordination with the universities to set up and change the subject, and set force the training of graduates with more nuclear knowledge before their leaving university.

2.More universities to have nuclear research, development and engineering departments





2. 中国核电发展人力资源对策与举措? How to confront HR for Chinese NPD?

改变学科设置，目标要培养能满足核电发展的各类人才
To change the subject to foster the development of nuclear power and to meet the requirements for all kinds of talents.

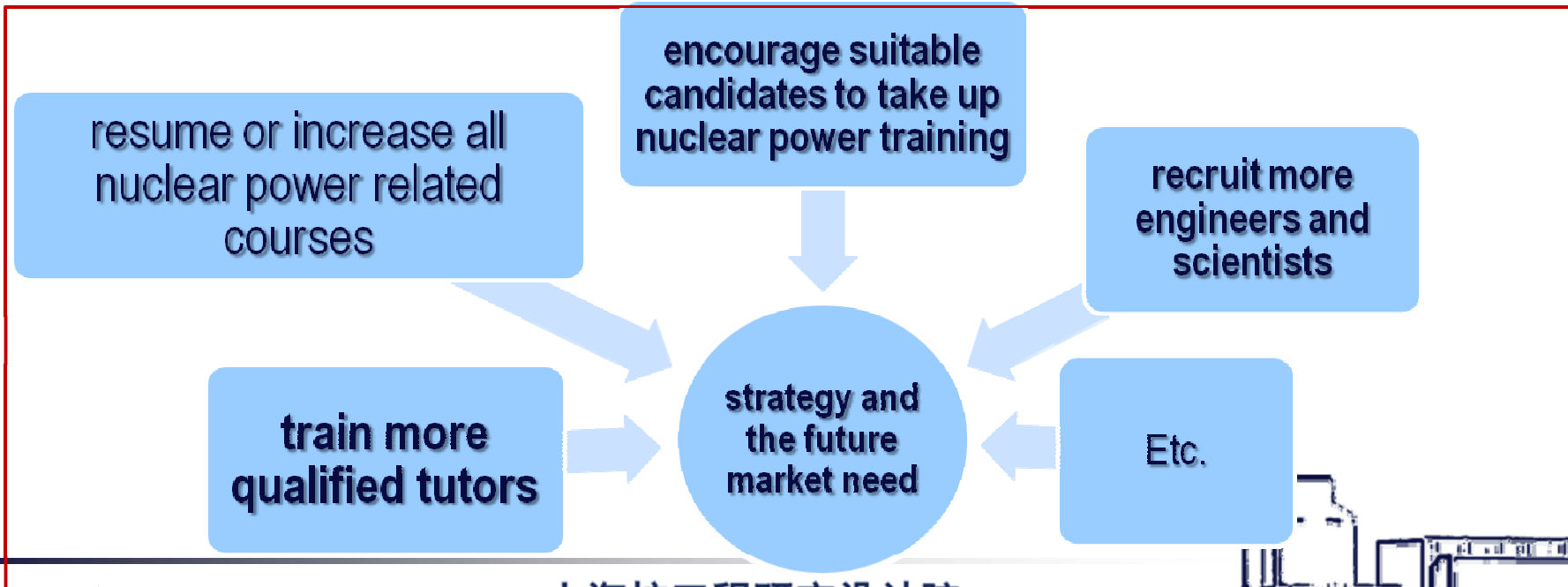
Nuclear Science and Technology		
1950	1986	1998
Reactor Engineering	Uranium Mine Geology	Nuclear Energy Science and Engineering
Isotope Separation	Isotope Separation	
Nuclear Material	Nuclear Material	Nuclear Fuel Cycle and Materials
Nuclear Physics	Nuclear Reactor Engineering	
Nuclear Chemical	Nuclear-Powered Installation	Nuclear Technology and Applications
Nuclear Geology	Accelerator	
	Nuclear Electronic	Radiation and Environmental Protection
	Nuclear Technology and Application	



2. 中国核电发展人力资源对策与举措? How to confront HR for Chinese NPD?

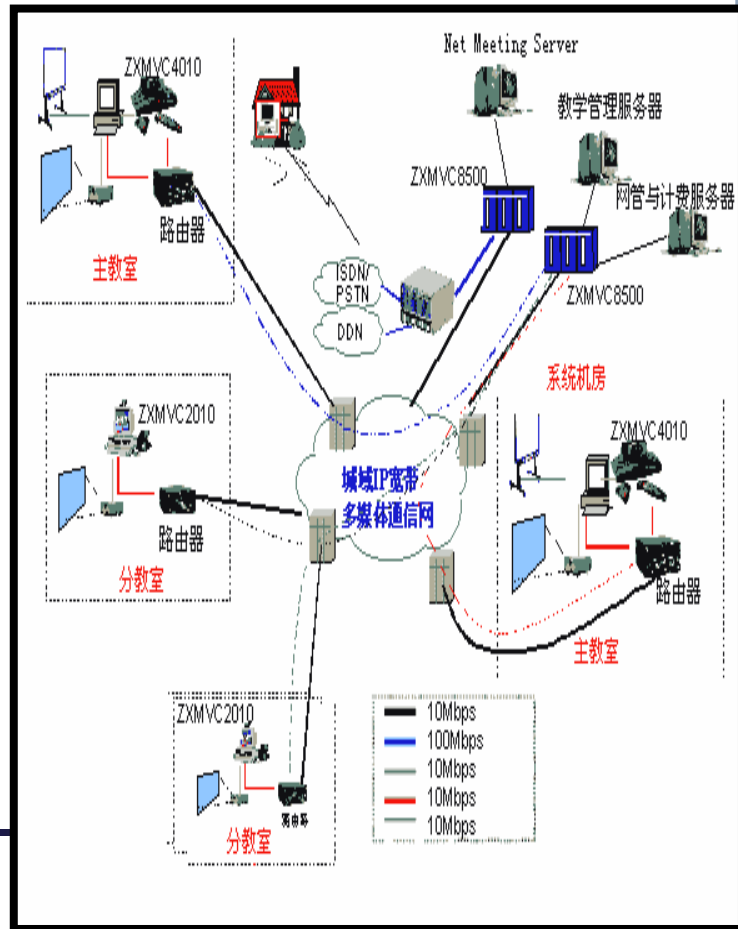
开展需求分析，确定人力资源战略规划及配套发展措施。

3. Demand analysis of HR which fit for China's nuclear power development plan should be made, and to form the human resources strategic development plan and supporting development initiatives.



2. 中国核电发展人力资源对策与举措? How to confront HR for Chinese NPD?

建立核电教育网站，以方便核电专业连续再教育和远程再教育。
4. Establish educational website to facilitate nuclear power professional Continuous re-education and distant self learning.



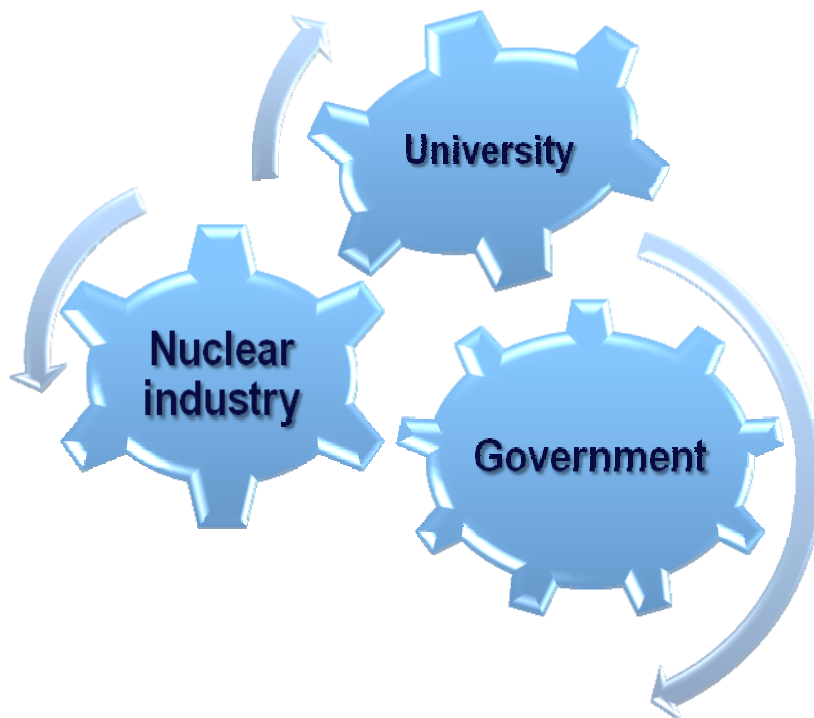
Establish global or regional Nuclear Technology internet website providing distant learning with various nuclear power educational information and act as an intercommunication centre for nuclear power researchers, lecturers and students. Establish corporate nuclear power University to provide new education system to train more middle and senior management staff and fulfill the life long learning need. Corporate NE university will offset the short fall in the conventional university. Corporate U emphasize more on practically and pertinent need. Provide systematic training and solution for each different position designated.

加快团队与组织的能力建设显得尤其重要。如果有限的人力资源尚不能形成有效的组织与团队，不能形成一个比较完整的体系，没有办法满足核电发展的需要。

5. Under the existing conditions of Human resources the team and organizational capability buildings are particularly important Such as:

- **Fully using of the limited human resources to form an effective organization and team in all nuclear power fields including education, R&D, engineering, project management and etc.**
- **Effective evaluation and supervision system of performance**

6. Strengthen the exchange, interaction and feedback among the Government, the nuclear industry and university to improve human resource development of effectiveness.



Firstly, the role of Chinese government had been changed from “control all” to “limited control”

Secondly, systematic approach or coordination is required for all partners in the fields. Proper guides for students are important to attract them.

Lastly, nuclear power industry should financially support university to have more education facilities including teachers, meanwhile, the most important thing is to establish the feedback features.

引入更加科学的人才规划、引进、培养、培训、配置、薪酬、激励体系，吸引各类人才加入核电行业。

7. The professional human resources management should be introduced into nuclear industry, including the introduction of more scientific HR planning, introduction, training, configuration, remuneration, incentive system, to attract various talents to join the nuclear power industry.

加强国际合作。

8. Promotion of HR international cooperation by using international expert database which needs urgently to be established. Actively introduction of international nuclear talents is important to enrich China's nuclear power development in manpower demand.



3. SNPTC/SNERDI 简述

Brief about SNPTC/SNERDI

SNPTC was found in May 2007:

- 1. SNPTC authorized by State Council, is the signee and transferee of G-III nuclear power technology**
- 2. SNPTC are the major carrier and R&D platform of the introduction, localization, self engineering, construction and development.**
- 3. SNPTC is the main organization and body to develop the large advanced pressurized water reactor CAP1400 or CAP1700.**



3. SNPTC/SNERDI 简述

Brief about SNPTC/SNERDI

SNERDI was found on 8th of Feb, 1970. The work scopes cover the design of followings:

---CNP300 self developed by SNERDI

---CPR1000 based on M310

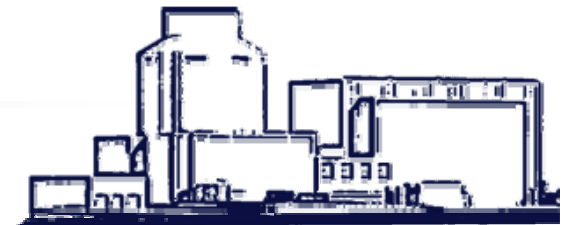
---AP1000 self reliance supportive and follow up projects

---CAP1400

---CAP1700

And technical support and service for operating NPP

As well as pre-projects of sites SER and EAR and etc.



Same situation is faced by Shanghai Nuclear Engineering Research and Design Institute (SNERDI).

We have lots of projects with the limited human resources and with the conditions of:

✓ **专业技术人员相对年轻，缺乏工程经验**

Younger staff, and the lack of engineering experience.

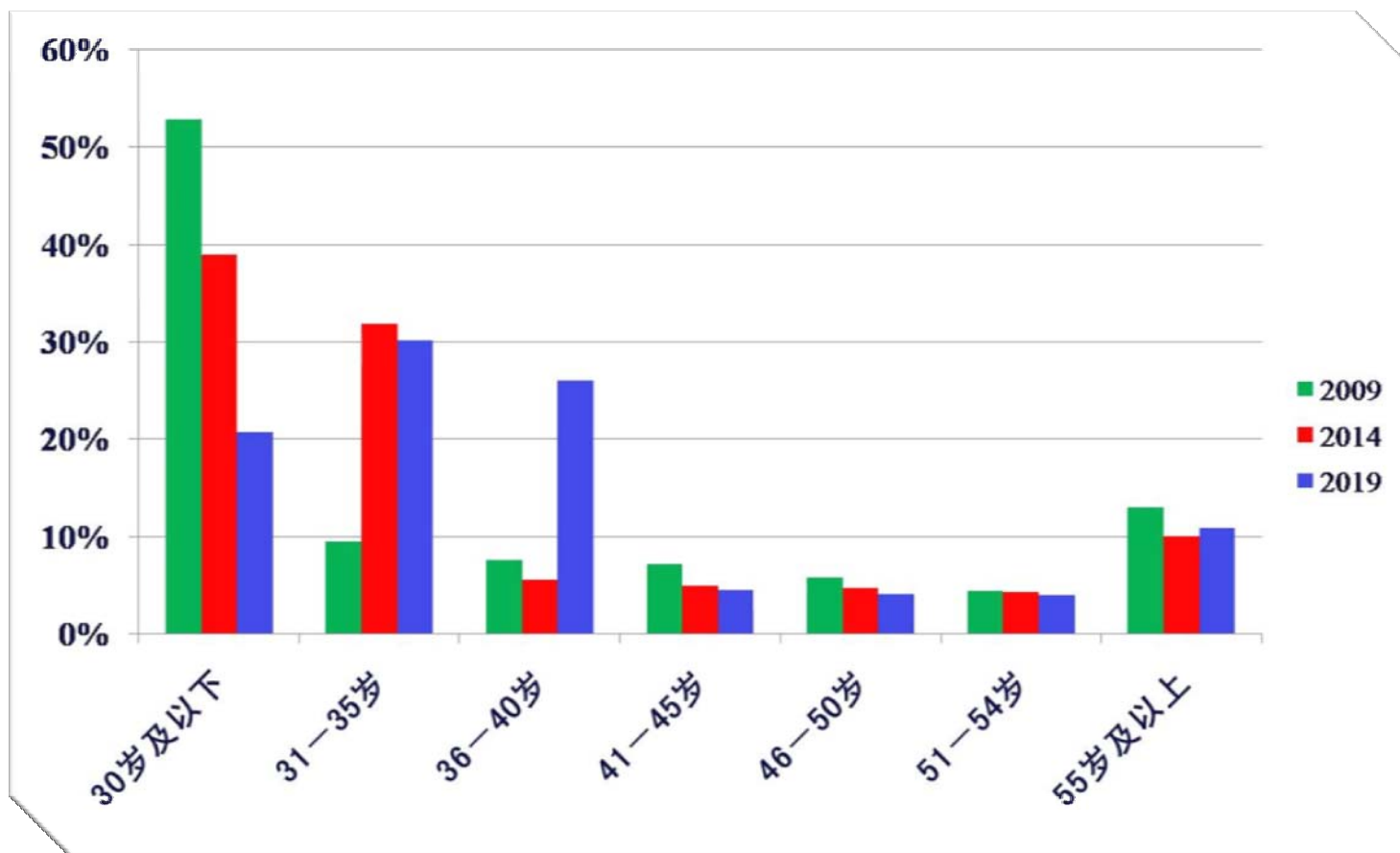
✓ **大量有经验的专家和工程师退休**

Retirement of the experienced experts and engineers.



3. SNPTC/SNERDI 简述

Brief about SNPTC/SNERDI

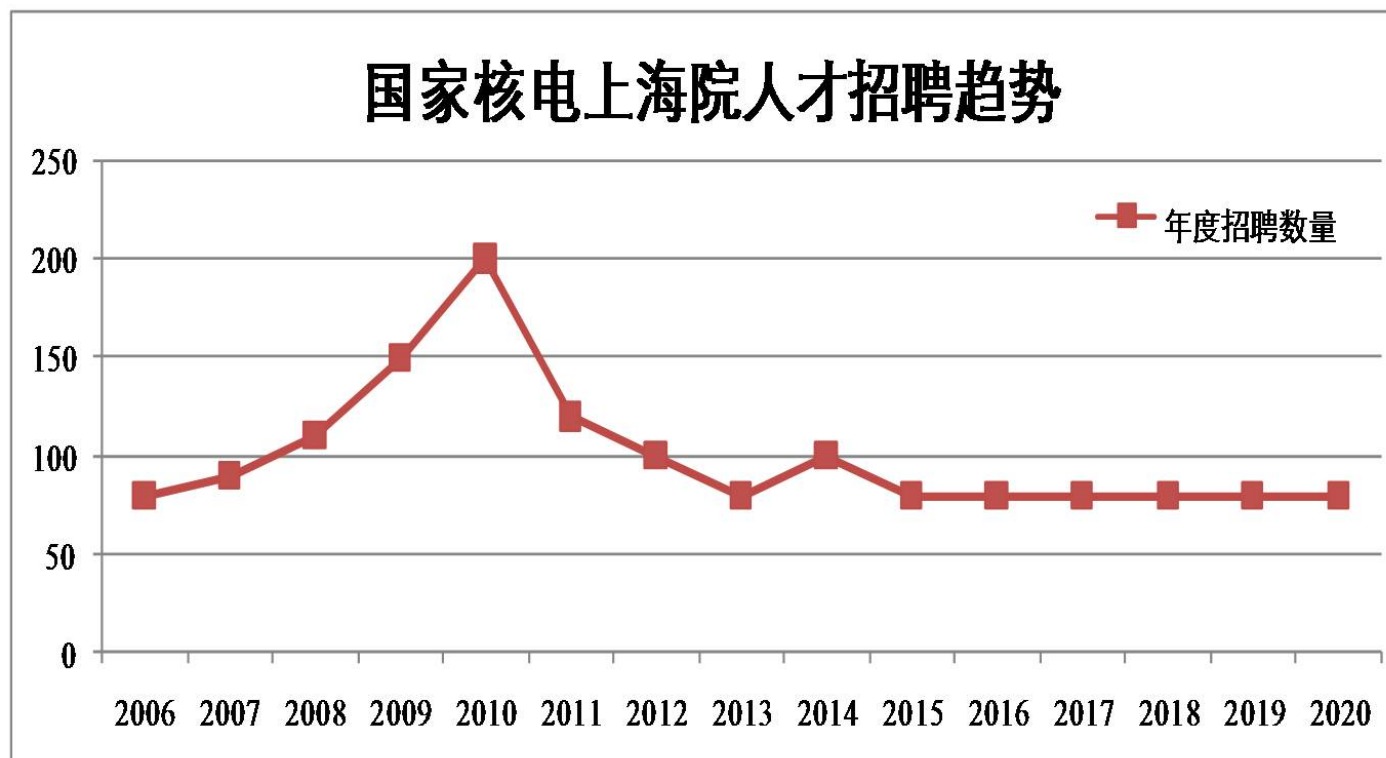


SNERDI 员工年龄分析
SNERDI Staff Aging Analysis

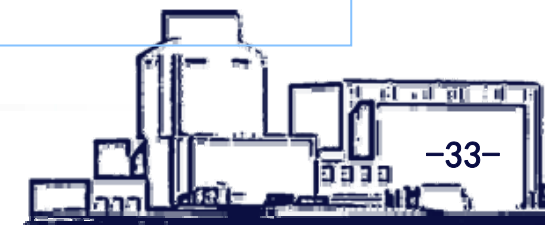


3. SNPTC/SNERDI 简述

Brief about SNPTC/SNERDI



SNERDI年度招聘分析
SNERDI Staff Yearly Recruitment Trend
(2006-2020)



The certain countermeasures have been established by SNPTC and SNERDI to enhance the development of HR except those measures mentioned in chapter 2:

1. HR development plan 2008-2020 has been compiled based on institute development strategy.
2. Increase the introduction of senior professionals from domestic and overseas.
3. Proper planning for new recruitment of undergraduates and graduates. The means are used to attract the better students by running twin program with school on NE courses, providing scholarship, practical training after high school and enhancing communication for better understanding.



4. Education, training system

- master and apprentice system: provide guide in the work and clearly define the responsibility of deliverable.
- seniors and juniors team system: Job training and Job learning
- follow up education for experienced engineers
- post Ph. D students education and R&D
- Net work education system after or between works
- enrollment of the students from grade 3 and last year to learn nuclear engineering courses.
- training in construction site and operation NPP for technical service.

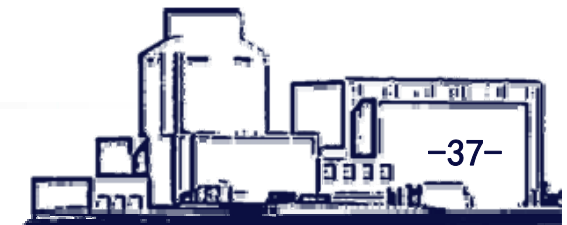




1. Last 70's oil crisis resulting into first quick nuclear power development and then slowed down by two SAs. Ups and Downs are normal for all industries including nuclear industry.
2. The once more oil high prices and environment protection requirements push forward the big tides of nuclear power development. It's the best nuclear power time for all of us and
3. How to seize such a good opportunity and to prevent another downs? It is the responsibility of us.



4. The development of diversification, balance and sustainability is indispensable to prevent the great downwards tendency of nuclear power industry thus to avoid great demand of HR suddenly or lay them off unwillingly.
5. The safety and economy of nuclear power is a topic forever. The safer, more economical, and advanced nuclear power is needed to be developed.
6. International cooperation including technical, philosophical and engineer exchange is strongly proposed.



Confront the challenge of HR together!!

謝謝！



2009年10月26日星期一

上海核工程研究设计院
SHANGHAI NUCLEAR ENGINEERING RESEARCH & DESIGN INSTITUTE

