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Fostering of Personnel for Nuclear Science and Engineering according to China's NPP Prospects

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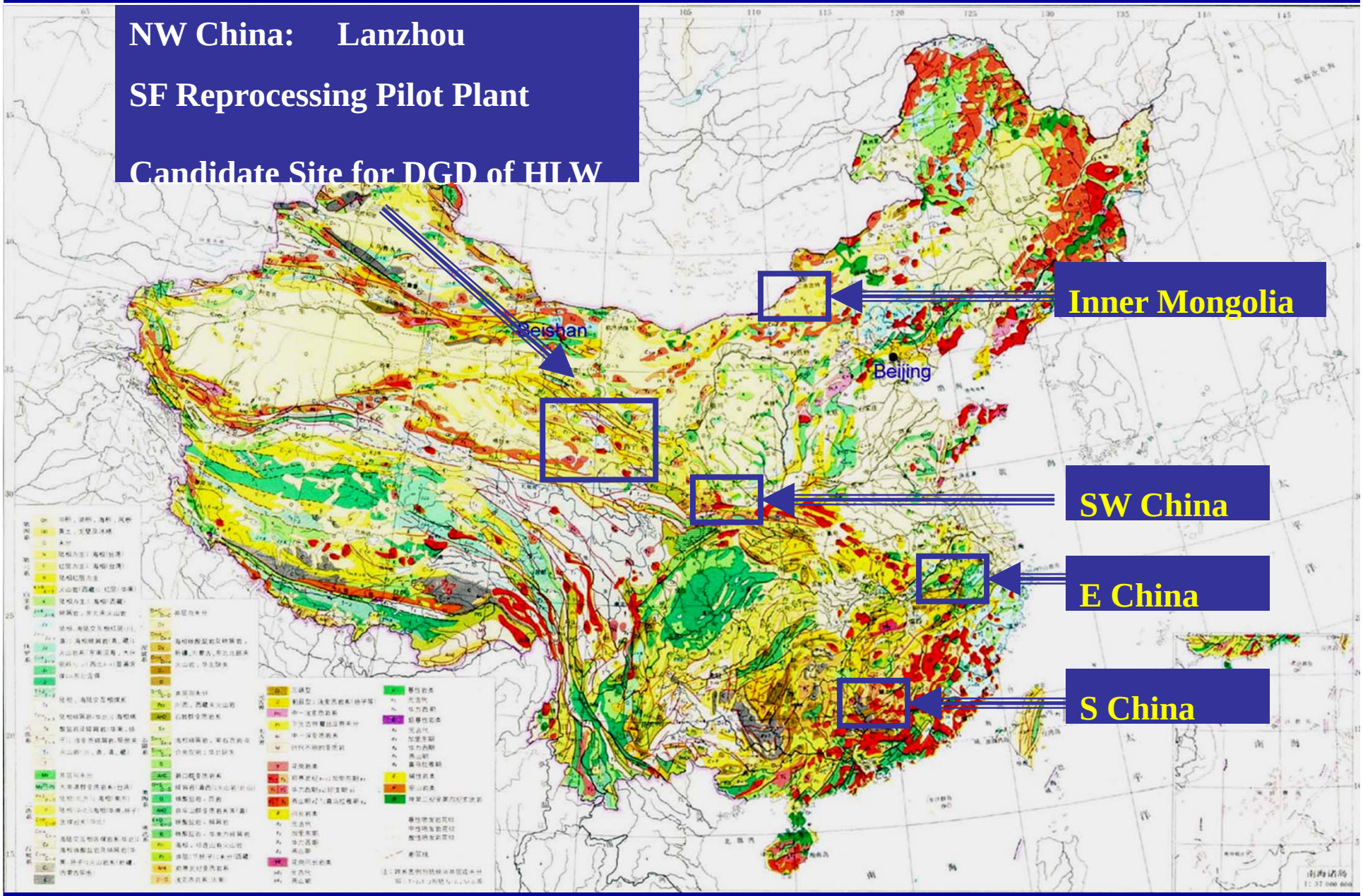
中国核能行业协会
CHINA NUCLEAR ENERGY ASSOCIATION

我国核电厂分布图
NPPs Distribution in China

Major activities: Site selection and site characterization



5 pre-selected regions for China's HLW repository

OUTLINE OF THE TALK

Part Ⅰ China's NPPs Prospects after Fukushima Daiichi Accident

Part Ⅱ Fostering of Personnel for Nuclear Science and Engineering

Part I

China's Nuclear Power Prospects

- **NPPs in Operation – 11 units, 0.9GW**
- **NPPs under Construction – 24 units, 22GW**
- **NPPs About to Be Approved and Constructed - 9 units, 10GW**
- **NPPs May or May Not Be Constructed - Inland**
- **China's Nuclear Power Prospects**

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我国核电厂分布图
NPPs Distribution in China

Nuclear Power Units in Operation

NPP Name	Location	Electrical Capacity (MW)	Reactor Type	Completed & operation date
Qinshan NPP	Zhejiang Haiyan	310	PWR	1991.4
Daya Bay NPP	Guangdong Shenzhen	984*2	M310 PWR	1994.5
Qinshan Phase II	Zhejiang Haiyan	650*2	PWR	2004.5
Ling'ao NPP	Guangdong Shenzhen	990*2	M310 PWR	2003.1
Qinshan Phase III	Zhejiang Haiyan	700*2	HWR	2003.7
Tianwan NPP	Jiangsu Lianyungang	1060*2	VVER PWR	2006.8

NPPs under Construction in China

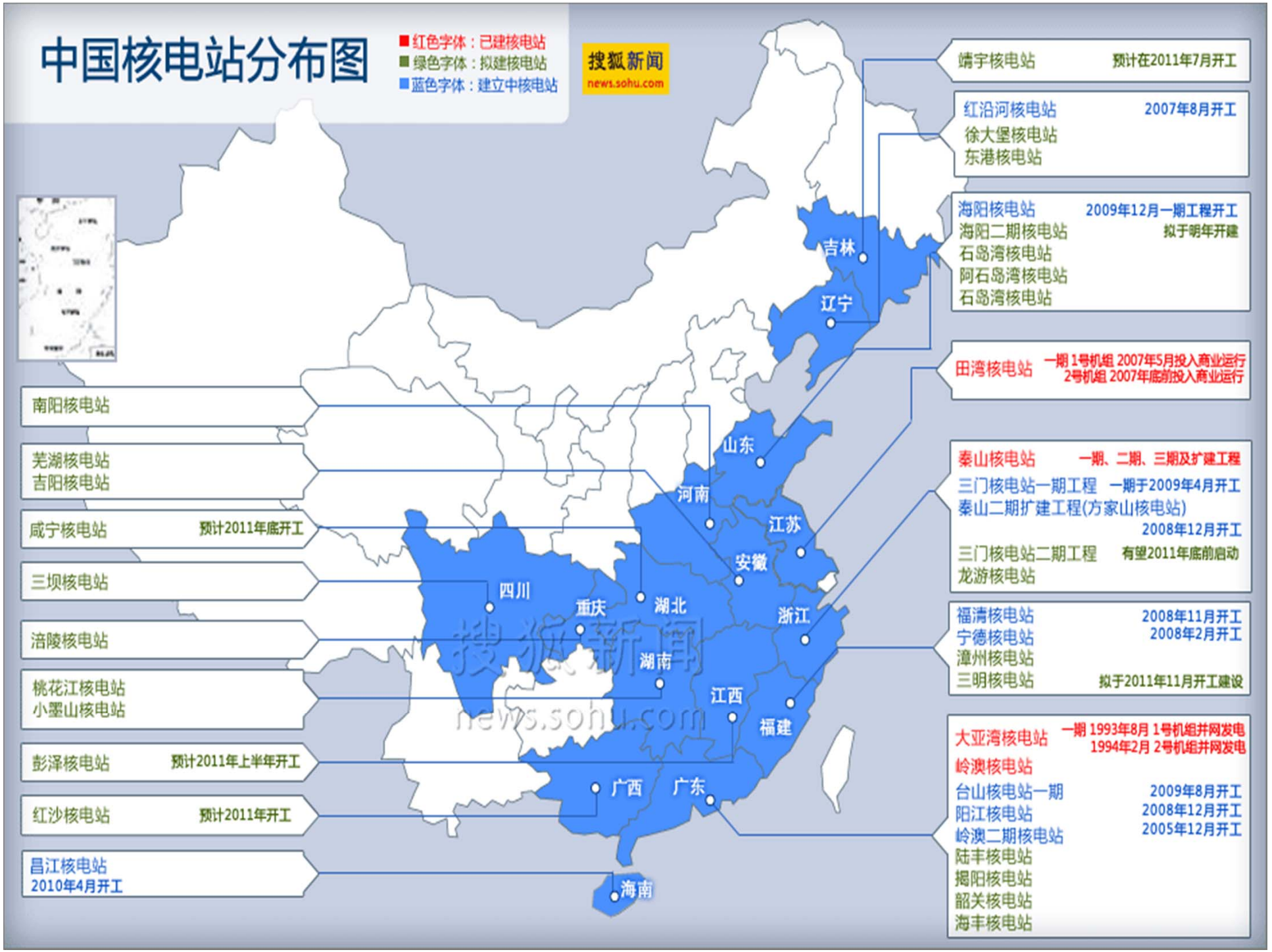
NPP Name	Location	Elec. Power Capacity (MW)	Reactor Type	Start Building Date
Lingdong NPP	Guangdong Shenzhen	1080*2	CPR 1000	2005.12
Qinshan Phase II Expansion	Zhejiang Haiyan	650*2	CNP 600	2006.4
Hongyanhe NPP	Liaoning Dalian	1080*4	CPR 1000	2007.8
Ningde NPP	Fujian Ningde	1080*4	AP 1000	2008.2
Fuqing NPP	Fujian Fuqing	1080*2	CNP 1000	2008.11
Fangjiashan NPP	Zhejiang Haiyan	1080*2	CNP 1000	2008.12
Yangjiang NPP	Guangdong Yangjiang	1080*6	CPR 1000	2008.12
Sanmen NPP	Zhejiang Sanmen	1250*2	AP 1000	2009.4

NPPs About to Be Approved and Constructed

NPP Name	Location	Elec. Power (MW)	Reactor Type
Haiyang NPP	Shandong Haiyang	1250*2	AP 1000
Taishan NPP	Guangdong Taishan	1600*2	压水堆EPR
Changjiang NPP	Hainan Changjiang	650*2	压水堆CNP 600
Shidaowan NPP	Shandong Yantai	200*1	高温气冷堆HTR
Fangchengang NPP	Guangxi Fangchengang	1080*2	压水堆CPR 1000

NPPs May or May Not Be Constructed --inland NPPs

Before Fukushima Daiichi Accident, The nuclear power construction is no longer limited to the coastal region, the first match of inland NPPs will be built in Hunan, Hubei and Jiangxi etc.. Many provinces are actively preparing to build or expand NPPs, including Jilin, Chongqing, Anhui, Sichuan, Henan, Hubei as well as Guangdong, Zhejiang, Liaoning and Shandong where NPPs have existed.


中国核电站分布图
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■绿色字体：拟建核电站
■蓝色字体：建立中核电站
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靖宇核电站 预计在2011年7月开工
红沿河核电站 2007年8月开工
徐大堡核电站
东港核电站
海阳核电站 2009年12月一期工程开工
海阳二期核电站 拟于明年开建
石岛湾核电站
阿石岛湾核电站
石岛湾核电站
田湾核电站 一期1号机组2007年5月投入商业运行
2号机组2007年底前投入商业运行
南阳核电站
芜湖核电站
吉阳核电站
咸宁核电站 预计2011年底开工
三坝核电站
涪陵核电站
桃花江核电站
小墨山核电站
彭泽核电站 预计2011年上半年开工
红沙核电站 预计2011年开工
昌江核电站
2010年4月开工
秦山核电站 一期、二期、三期及扩建工程
三门核电站一期工程 一期于2009年4月开工
秦山二期扩建工程(方家山核电站)
2008年12月开工
三门核电站二期工程 有望2011年底前启动
龙游核电站
福清核电站 2008年11月开工
宁德核电站 2008年2月开工
漳州核电站
三明核电站 拟于2011年11月开工建设
大亚湾核电站 一期1993年8月1号机组并网发电
1994年2月2号机组并网发电
岭澳核电站
台山核电站一期 2009年8月开工
阳江核电站 2008年12月开工
岭澳二期核电站 2005年12月开工
陆丰核电站
揭阳核电站
韶关核电站
海丰核电站
吉林
辽宁
山东
河南
江苏
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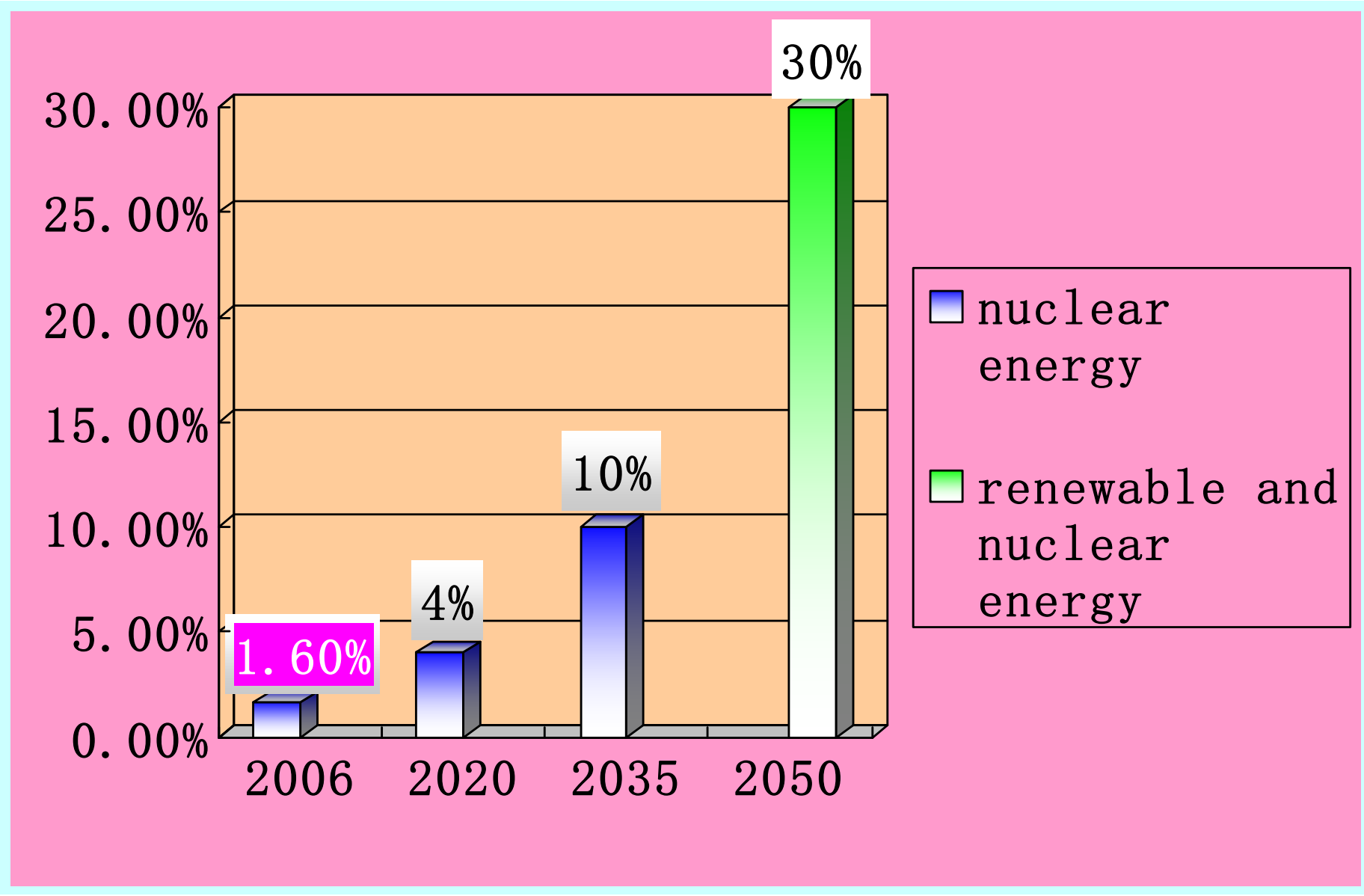
Steps and Goals for Nuclear Energy Share



Reasons for NPP Developed rapidly in China

- China's energy structure focusing on coal must be adjusted
- The contradiction between rapid economic growth and environmental improvement
- Acute fluctuation of regular energy price risking the investor
- Increasingly intensified constraints from other energy environment and resources.
- Nuclear Power Construction Promoting the Equipment Manufacturing Advance in China
- China's Nuclear Power Owner and Engineering Corporation

Challenges for Global Nuclear Power Development

- Safety
- Economics
- Wastes Management
- Non-proliferation
- Reprocessing
- ……

Challenges for China's Nuclear Power Fast Growth

Some special issues resulting from fast growth

- Nuclear fuel supply and uranium resource security
- Capacities of nuclear equipment manufacturing and localization
- Self-innovation of nuclear power technology
- Special issues of inland NPP construction
- Fostering of Personnel

Nuclear Talent Demand Survey before 2020

discipline	total	2006--2010																		2011-2020							
		小计				2006年			2007年			2008年			2009年			2010年			2011-2015年				2016-2020年			
		小计	博士	硕士	本科	博士	硕士	本科	博士	硕士	本科	博士	硕士	本科	博士	硕士	本科	博士	硕士	本科	小计	博士	硕士	本科	小计	博士	硕士	本科
	10404	4621	560	1157	2904	115	251	614	104	227	578	110	224	599	109	221	542	122	234	571	2997	390	765	1842	2786	430	719	1637
radiogeology	1343	668	67	156	445	13	33	122	12	25	92	15	29	80	15	31	70	12	38	81	340	36	80	224	335	30	75	230
Plasma phys.	434	126	54	47	25	9	11	5	10	11	5	11	9	5	12	8	5	12	8	5	145	70	55	20	163	88	55	20
Nuclear physics	541	229	67	87	75	13	16	15	14	12	15	12	21	14	12	18	15	16	20	16	150	49	42	59	162	56	52	54
Reactor engineering	2894	1410	156	370	884	33	71	158	26	80	182	32	74	200	32	71	175	33	74	169	739	63	193	483	745	65	195	485
Radiation protection	1182	488	27	128	333	6	21	71	4	27	56	6	24	72	5	29	62	6	27	72	359	21	83	255	335	27	81	227
Nuclear chemical engineering	3095	1342	124	268	950	30	75	212	26	48	189	21	47	186	19	47	175	28	51	188	978	89	230	659	775	104	188	483
Other energy	915	358	65	101	192	11	24	31	12	24	39	13	20	42	14	17	40	15	16	40	286	62	82	142	271	60	73	138

Challenge for China's Nuclear Power Development—Talents

- **The talents demand for nuclear engineering and the related specialty is rising significantly as the result of industrial advance in NPP design, construction, operation and nuclear fuel cycle;**
- **The talents demands of nuclear majors based on nuclear power development plan, namely, about 6,600 for nuclear engineering as well as about 5,000 for elementary science and nuclear technology application.**

Part Ⅱ

Fostering of Personnel for Nuclear Science and Engineering

- Nuclear Scientific E & T in China– The History
- Nuclear Scientific E&T in China
  -Current Status
- Talents Demand for NPP Development in China
- Other Demands Apart From NPPs
- Problems
- Suggestions

Nuclear Education and Training in China – The History

- Early Stages (1930s-1950s)
- Golden Season (1955-1970s)
- The Declining Stage (1986-2000)
- Renaissance (new millennium)
- After Fukushima Daiichi Accident


爆心

The Declining Stage (1986-2000)

- However, it entered the declining stage in the 1980s and 1990s, the same as other countries in the world.
- Only 6 or 7 universities have BS students of Nuclear S&T in China
- Less than 300 students in these Univ.

Renaissance (new millennium)

- Gladly, Nuclear E&T is at renaissance after the beginning of the new millennium. In China it is called the **Second Spring** for nuclear science and Engineering.
- 25 universities
- Near 1200 undergraduate and 300 graduate students each year

Nuclear Scientific E&T in China
--Current Status

For meeting the talents demand of nuclear industry progress, many universities are making new education plans for some related subjects, such as nuclear technology, nuclear physics, nuclear medicine, etc., which include

Nuclear Scientific E&T in China
--Current Status

Peking University, Nanjing University,

Lanzhou University, Wuhan University,

Tianjin University, Jilin University,

Sichuan University,

Chengdu University of Technology,

University of South China, Suzhou University,

East China Institute of Technology, etc..

Nuclear Engineering E&T in China
--Current Status

Tsinghua University,

Shanghai Jiao Tong University

Harbin Engineering University

Xi'an Jiaotong University,

North China Electric Power University,

in order to strengthen the cultivation for undergraduates, masters and doctors.

Nuclear Science and Engineering E&T in China--Current Status

SOME INSTITUES (only graduates)

- China Institute of Atomic Energy
- Shanghai Institute of Applied Physics
- Institute of High Energy Physics
- Institute of Modern Physics
- Institute of Plasma Physics
- Other Institutes

Talents Demand for Nuclear Power Development in China

Based on the current trend of fast growth of nuclear power, the demands by NPP operator MAY BE doubled, the talents need for nuclear industry chain will also be increased greatly, the educated talents amount will reach 25,000 or so in about 2020.

Talents Demand for Nuclear Power Development in China

- **The talents demand is comparatively urgent before 2015, because enlarged development brings strong talents need in the context of slow development in the past.**
- **After 2015, along with talents growth during practical work, it will come into a saturation period, this kind of demand will become stable gradually.**

Talents Demand for Nuclear Power Development in China

As the calculation, about 1200 nuclear students should be educated annually before 2015, including:

- **330 in reactor engineering;**
- **350 in nuclear fuel chemical engineering**
- **130 in radiation protection and environmental protection;**
- **90 in basic sciences, such as nuclear physics, etc.;**
- **140 in nuclear geology and uranium mining and metallurgy.**

Talents Demand for Nuclear Power Development in China

- **The above-mentioned forecast is expected before (March 11th, 2011), actually the positions change very fast recently, the cultivation channel and means for special personnel show diversified trends;**
- **We need the talents specialized in not only reactor engineering, nuclear chemical industry, nuclear fuel engineering, radiation protection, etc., but also finance, laws, environmental protection.**

Talents Demand for Nuclear Power Development in China

- **Nuclear power development has provided both broad space and grim challenge for special nuclear talents cultivation;**

- **Overcoming the difficulty and facing the challenges to ensure the most important talents for nuclear power span in China.**

PROBLEMS

- Contradiction Between Demands and Supply
- Experienced Teachers Are Urgently Needed
- Labs. In Univ. Are Outdated and ill-equipped
- Lack of Attraction to High School Students

especially after Fukushima Daiichi Accident

A High-level Solution is Required

- **Until our political leaders and decision makers firmly commit to nuclear science and technology, all lower level efforts are bandages to this urgent national problem**
- **The decision to truly improve nuclear S&T education has to come from Congress with a commitment to (long-range) funding.**

- **Our government has made a decision to still develop NPPs, so …good news in China.**
- **Some Chinese experts in nuclear field have discussed several times to improve education and training after Fukushima Daiichi Accident.**

SUGGESTIONS

- **To the Government—— Sustainable Financial Support to nuclear Education and Training**
- **To the Companies——Cooperate and Share Facilities with Universities**
- **To the Universities——Renew Apparatus and Facilities, Teacher's Training, International Cooperation, …..**


谢　谢！
Thanks for Your Attention!
Ling’ao NPP