

# **Nuclear Science & Tech Application in China**

FNCA Symposium, Oct. 28 2005, Tokyo

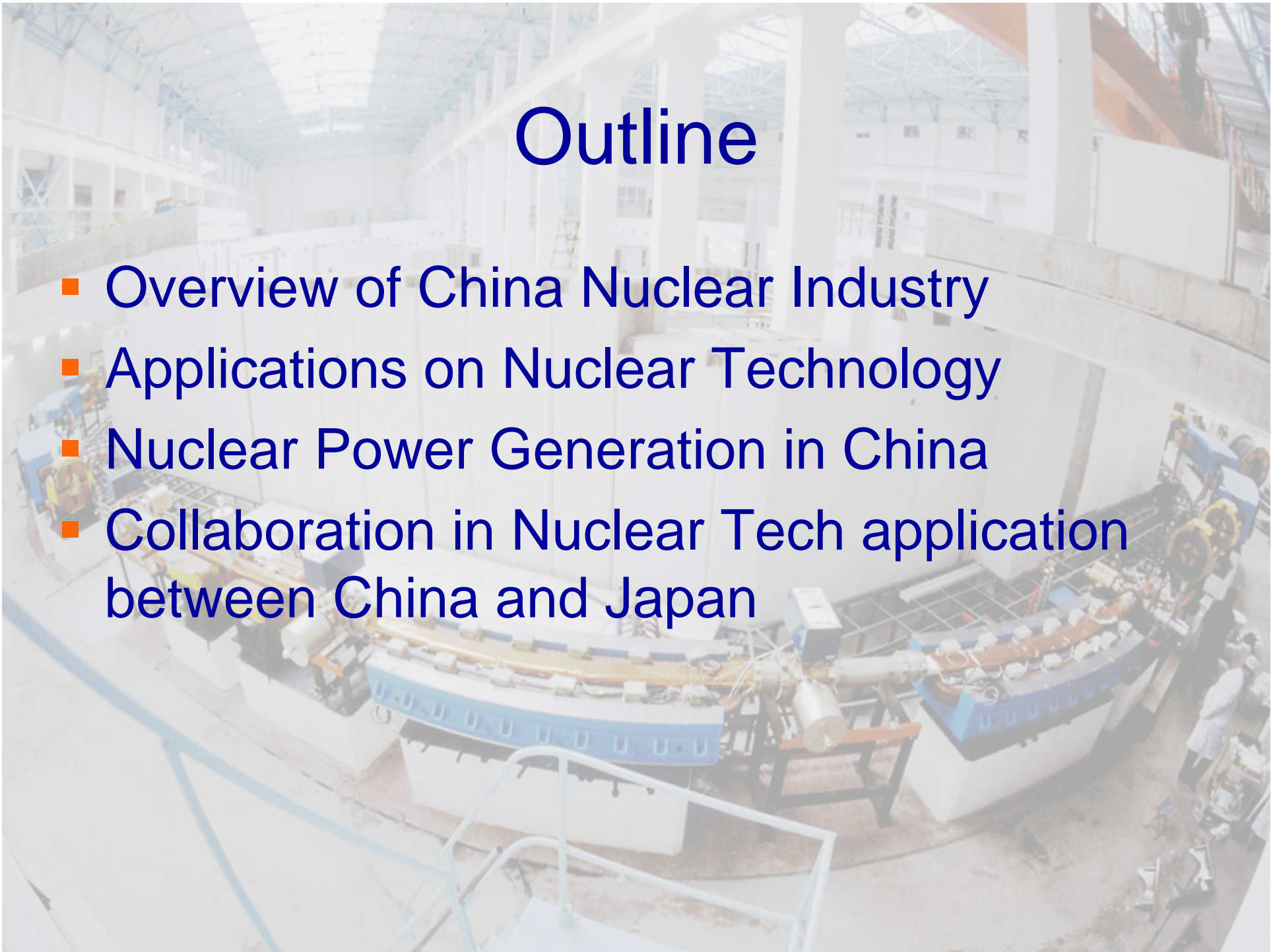
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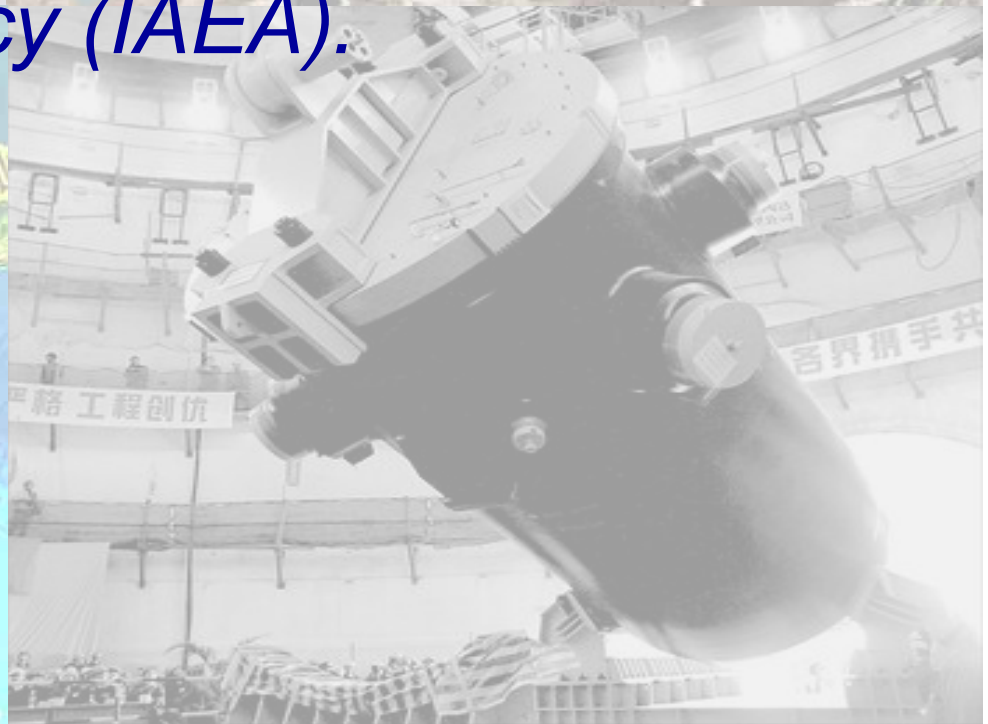
# Outline

- Overview of China Nuclear Industry
- Applications on Nuclear Technology
- Nuclear Power Generation in China
- Collaboration in Nuclear Tech application between China and Japan

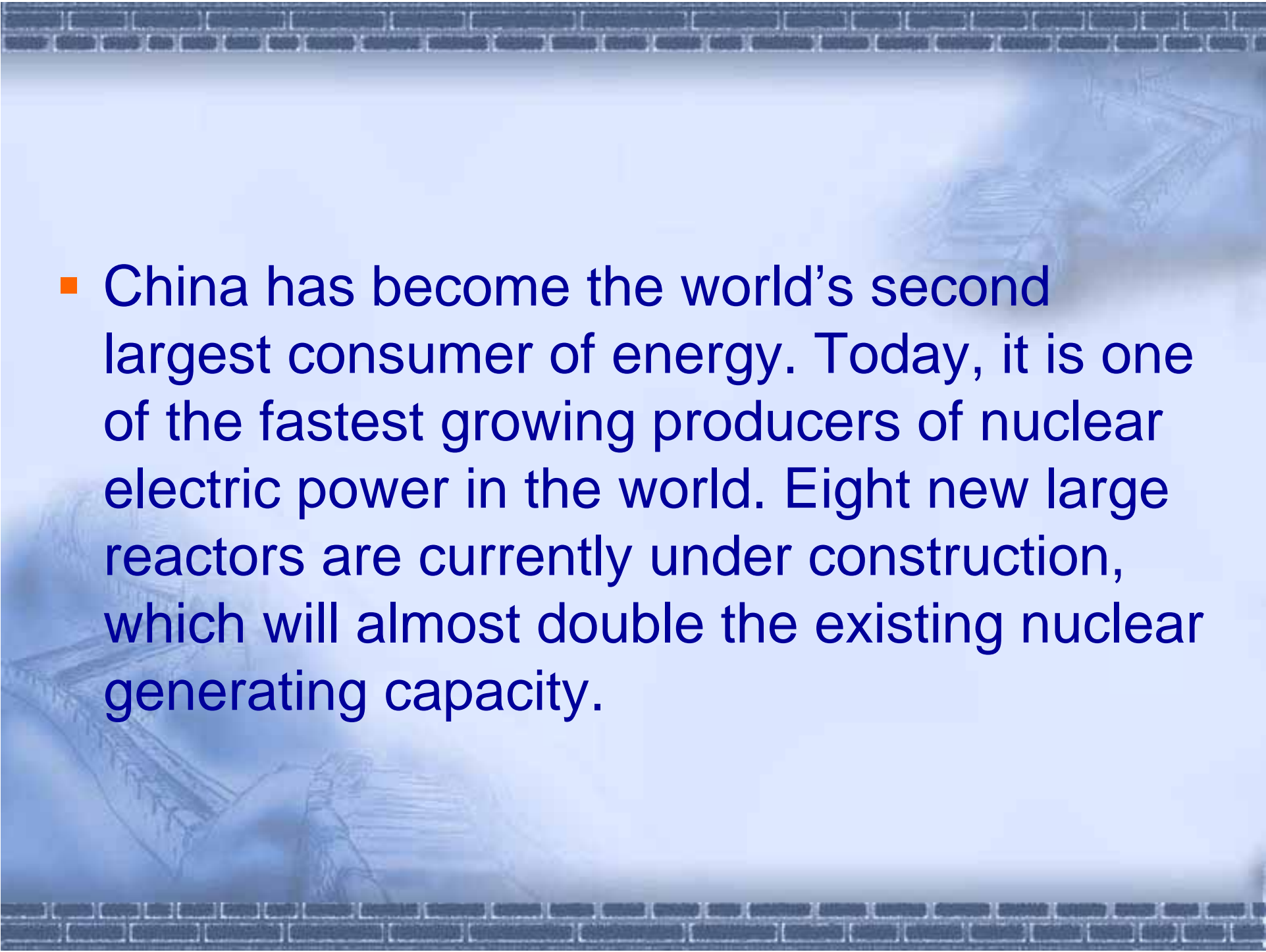


# Overview of China Nuclear Industry


- This year is 50-year anniversary of Chinese nuclear industry establishment, also 20-year anniversary of China joining *International Atomic Energy Agency (IAEA)*.

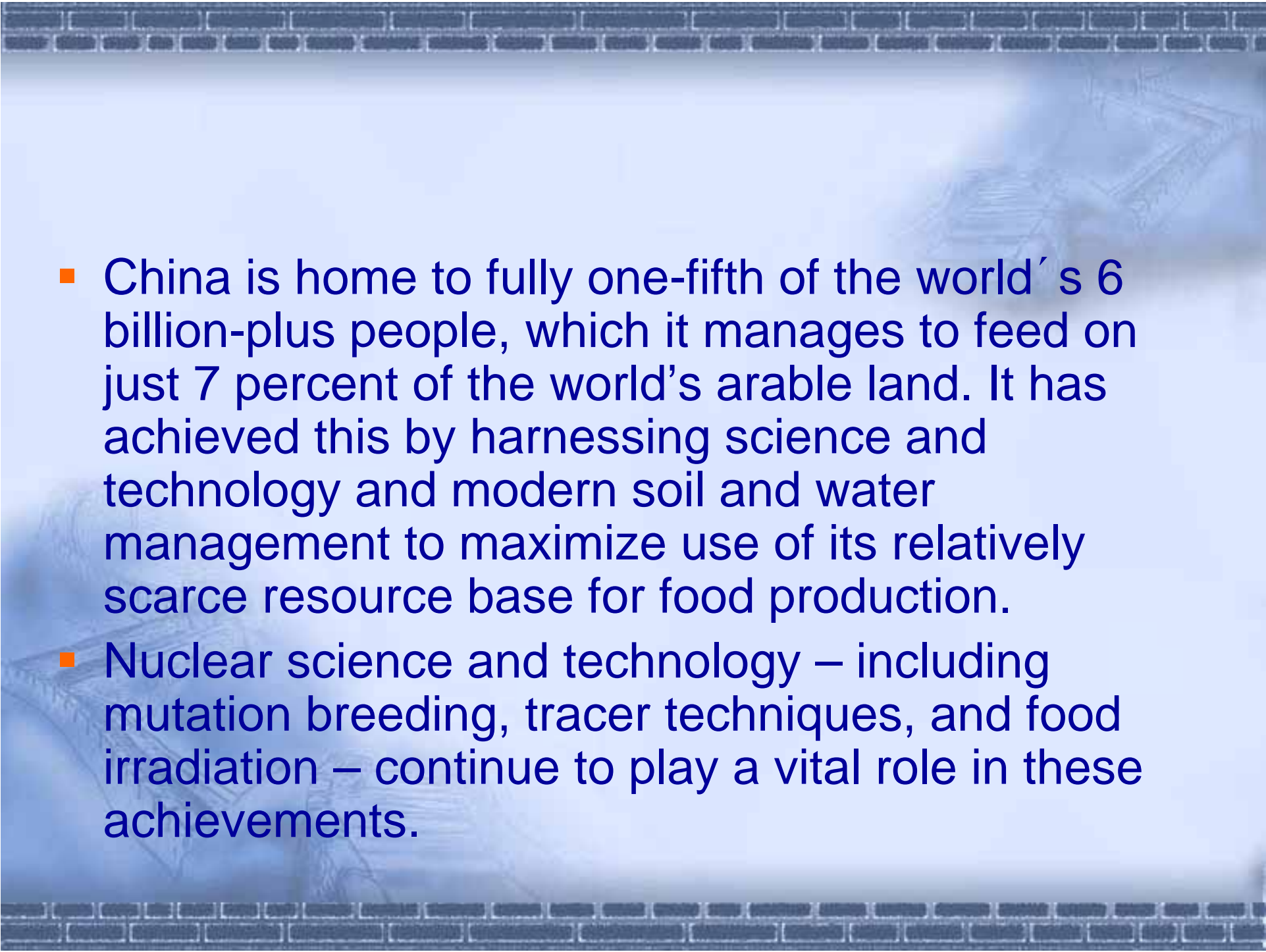




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- China has become the world's second largest consumer of energy. Today, it is one of the fastest growing producers of nuclear electric power in the world. Eight new large reactors are currently under construction, which will almost double the existing nuclear generating capacity.

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- By the end of 2003, more than 300 Chinese enterprises are engaged in the nuclear technology application. The total output value reaches more than **JP ¥ 0.5 trillion**. Under Estimation in 2010, this number will surpass **JP ¥ 1.2 trillion**.

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- Ionizing radiation is increasingly applied in medicine and is firmly established as an essential tool for diagnosis and therapy of major diseases.
  - China now has 43,000 departments of diagnostic radiology in hospitals across the country, with 120,000 radiation technicians. Nuclear medicine has been applied in 2,500 hospitals. To date, China operates 500 linear accelerators, 600 teletherapy and 400 brachytherapy machines for the treatment of cancer.

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- China is home to fully one-fifth of the world's 6 billion-plus people, which it manages to feed on just 7 percent of the world's arable land. It has achieved this by harnessing science and technology and modern soil and water management to maximize use of its relatively scarce resource base for food production.
  - Nuclear science and technology – including mutation breeding, tracer techniques, and food irradiation – continue to play a vital role in these achievements.



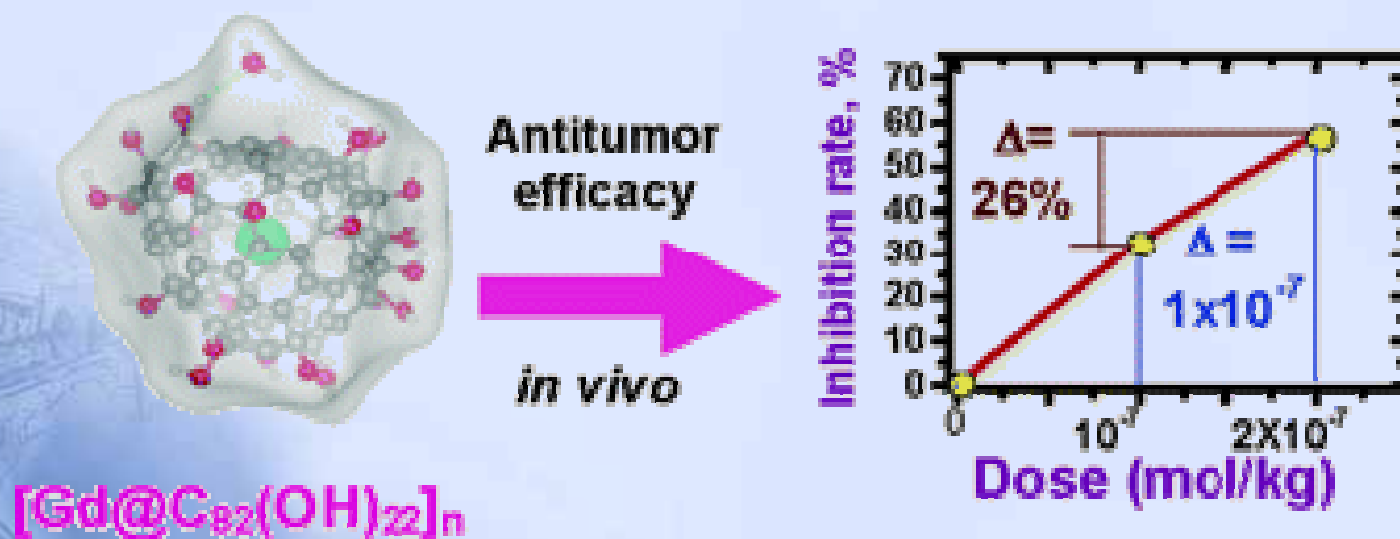
# Applications on Nuclear Technology





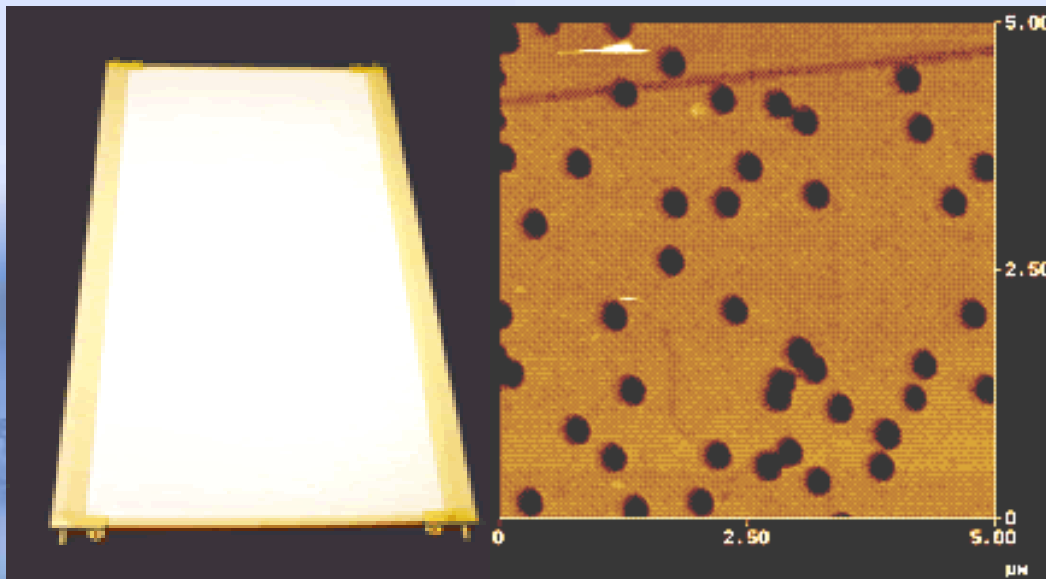
# Radioactive Cancer Therapy

High inhibition rate of tumor cells with low dose chemical modified Carbon-60 nano-particles



Xing GM.(IHEP,CAS) et.al, Nano Letters on Web, Sep.27 2005

# Waste water processing system



Membrane Biological Reactor (MBR)  
with Nuclear pore technology



Waste water processing system  
(Jiading dis., Shanghai, 60 Ton/day )

# XPCI Image System



# Hard X-ray XPCI Image

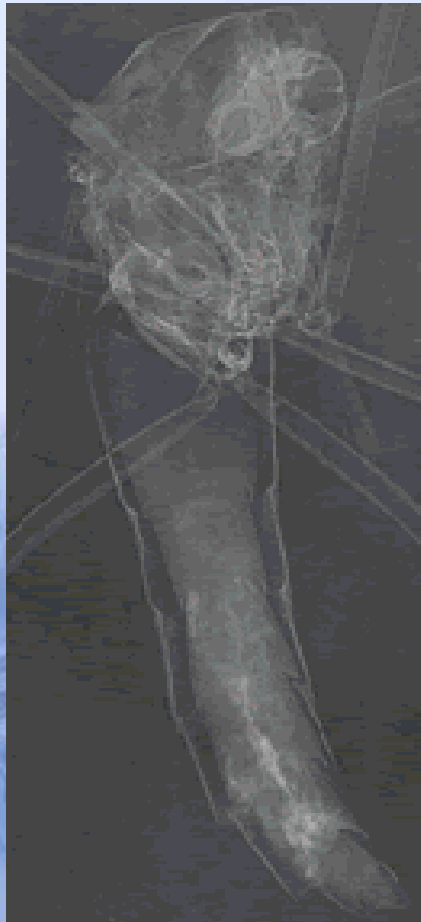
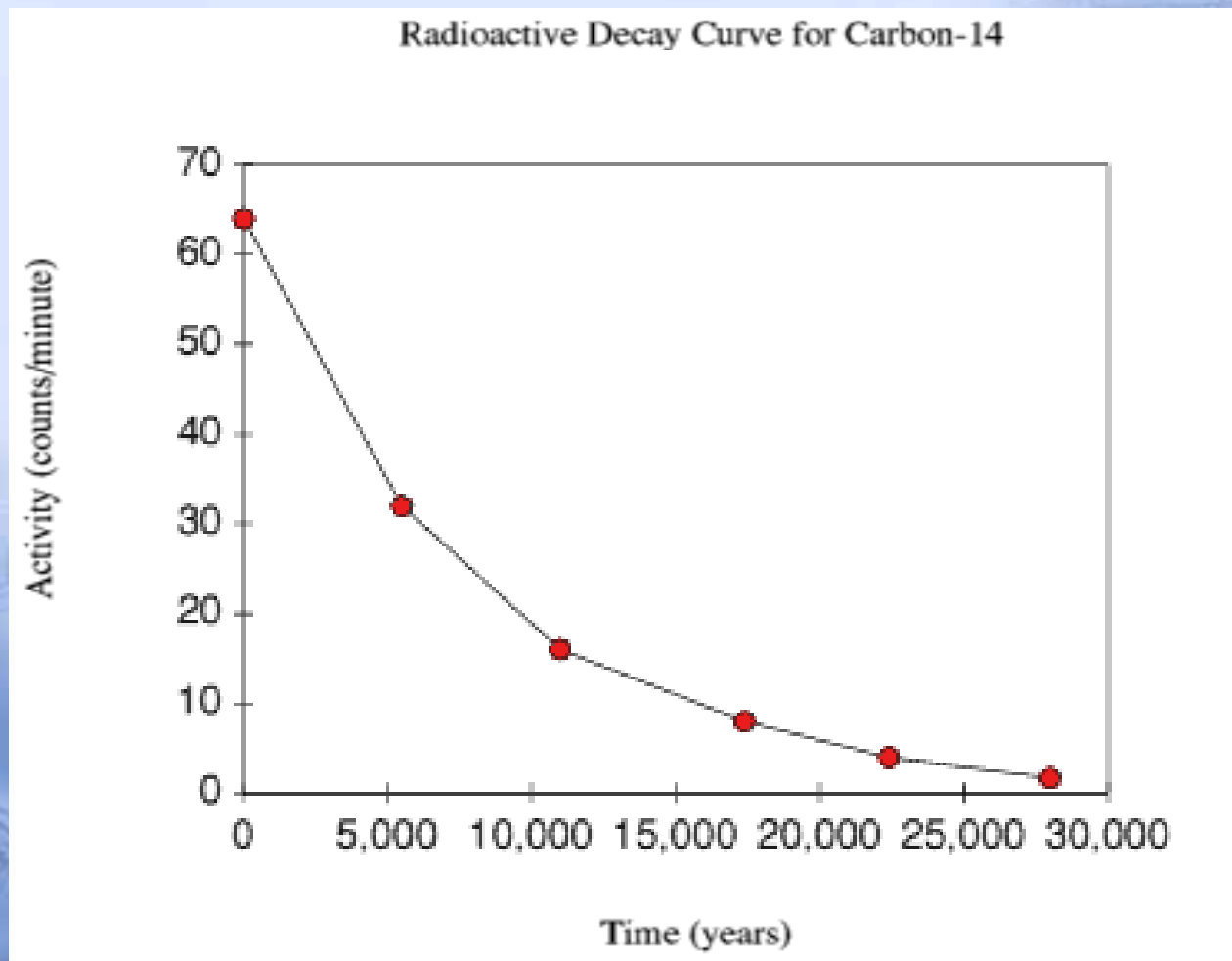


Image of mosquito and its intestine



# $^{14}\text{C}$ Dating Archeology



# XIA SHANG ZHOU three dynasties

## Chronology

Dynasty	King	Period	Dynasty	King	Period
XIA	Yu	2070 B.C. — 1600 B.C.	SHANG	Tang	1600— 1300
	Qi			Tai Ding	
	Tai kong			WaiBing	
	Zhong Kong			ZhongShi	
	Xiang			TaiJia	
	ShaoKong			Wo Ding	
	Yv			Tai Geng	
	Kui			Xiao Jia	
	Mang			Yong Yi	
	Xie			Tai Rong	
	Bu Jiang			Zhong Ding	
	Bian			Wai Ren	
	Lu			He Jia	
	Kong Jia			Zu Yi	
	Gao			Zu Xin	
	Fa			Wo Jia	
	Kui			Zu Ding	
				Nan Geng	

# Radiation Breeding Mutation

- There are over 510 new crop species in about 40 kinds of plants developed by radiation breeding mutation in China, i.e. 1/4 of total mutated species planted in the world.
- The planting area of mutated crops is about 9 million hectares per year, nearly 10% of total planting area in China.
- The production of economic plants increases 3~4 billion kg benefiting from radiation breeding mutation.

# Radiation Breeding Mutation



Original wheat species

Mutated wheat species



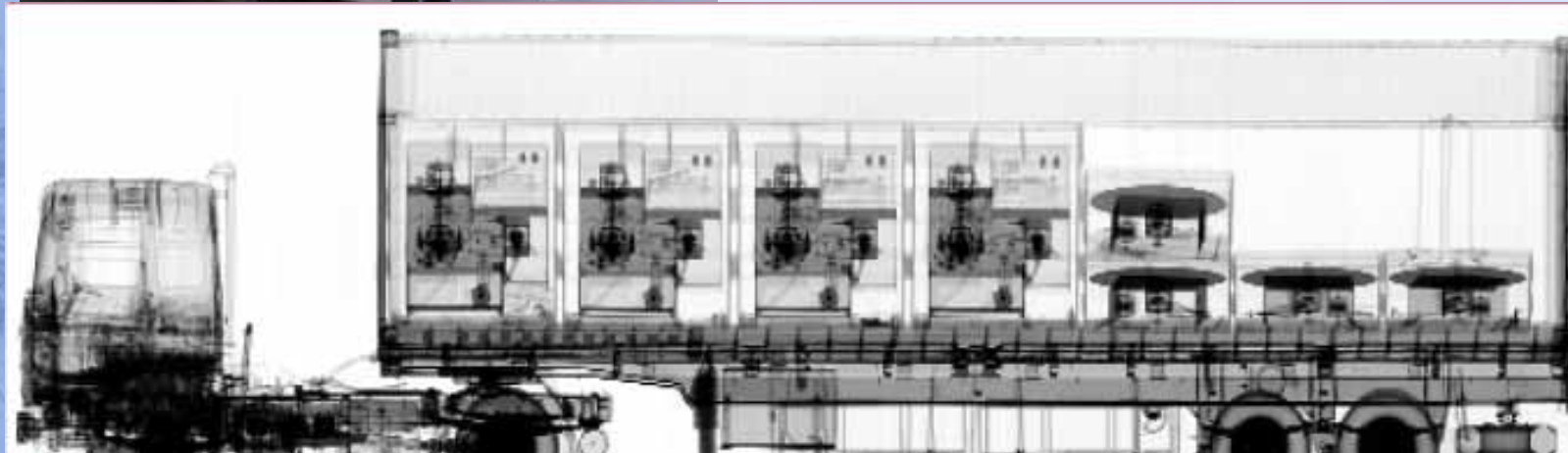
# Radiation Breeding Mutation



# Container Scanning System



Gamma Source	Energy Tested
Cesium-137	662 KeV
Cobalt-60	1.25 MeV
Americium-241	60 KeV
Neutron Source	Type
Americium-241/Be	10 MeV neutrons



Tsinghua THSCAN Container Scanning System

# Nuclear Power Generation in China

中国实验快堆  
2001. 2



# Nuclear Power Production 47,800 GWh(e)

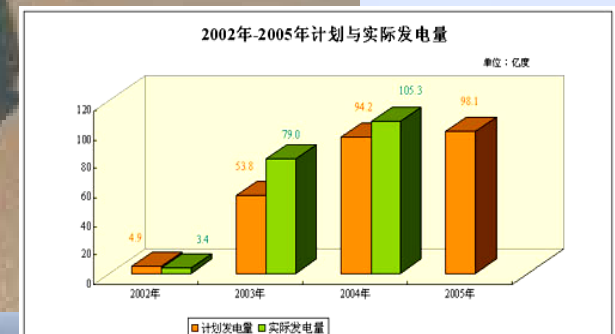
## Proportion in Total power Production 2.2%

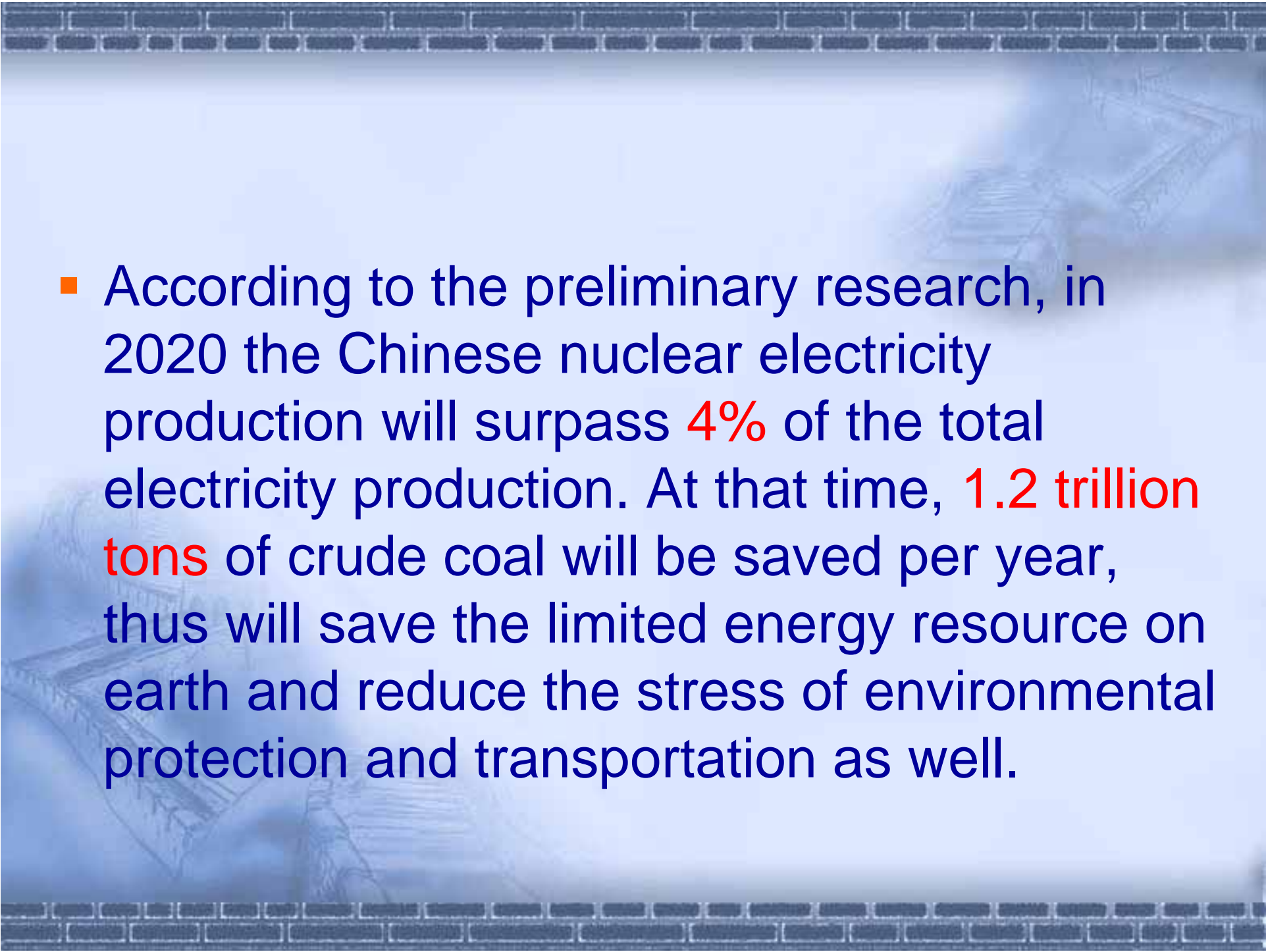
	净功率 (MWe)	堆型	临界和商运日期		反应堆供应商	发电机供应商	建造商
			临界	商运			
中国							
大亚湾1 (Daya Bay)	944	PWR	1993.7	1994.2	Fra	GEC/Alsthom	HCCM/其他
大亚湾2	944	PWR	1994.1	1994.5	Fra	GEC/Alsthom	HCCM/其他
田湾1 (Tianwan)	1000	PWR	2004.4	2004.12	—	—	—
田湾2	1000	PWR	2005.4	2005.12	—	—	—
岭澳1 (Ling Ao)	935	PWR	2002.2	2002.7	Fra	GEC-Alsthom	GEC-Alsthom
岭澳2	935	PWR	2002.10	2003.3	Fra	GEC-Alsthom	GEC-Alsthom
秦山1 (Qinshan)	279	PWR	1991.10	1994.4	CNNC	CNNC	CNNC
秦山2	610	PWR	2001.11	2002.6	CNNC	CNNC	CNNC
秦山3	610	PWR	2002.9	2003.4	CNNC	CNNC	CNNC
秦山4	665	PHWR	2002.10	2003.2	AECL	Hitachi	CNNC
秦山5	665	PHWR	2003.7	2003.11	AECL	Hitachi	CNNC

List of nuclear power plants in China



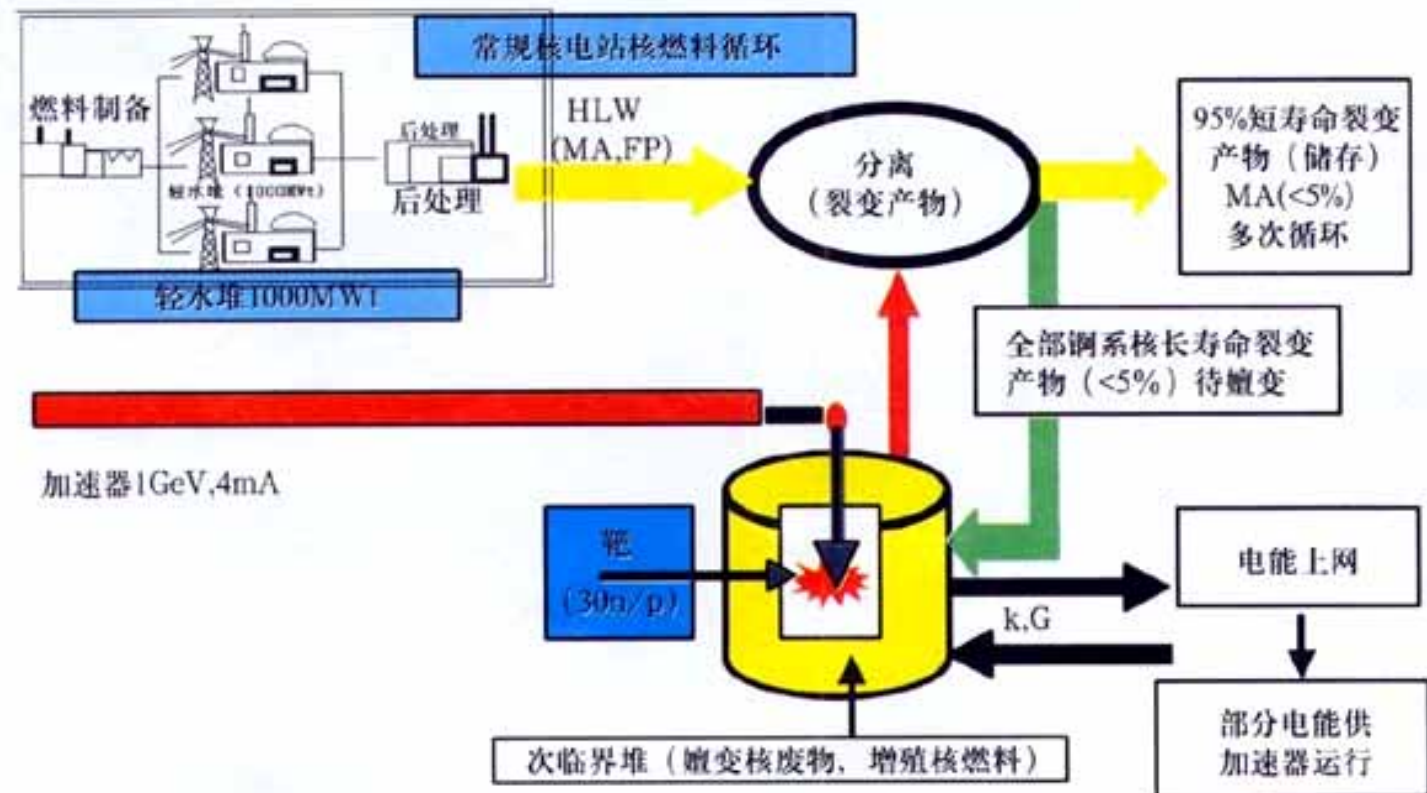
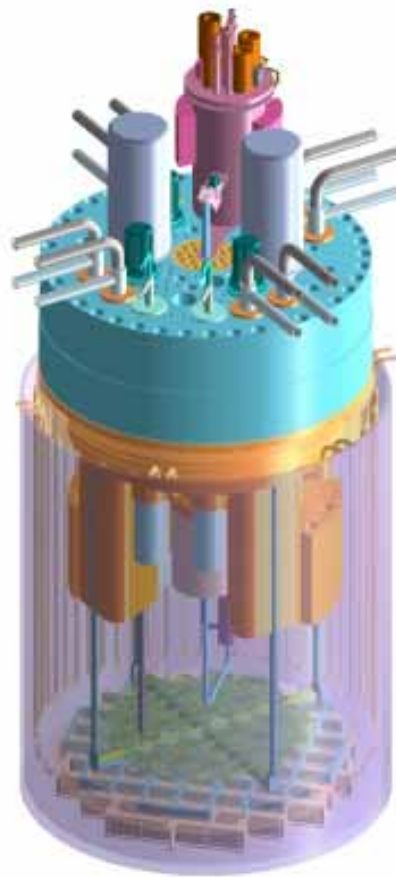
# Qinshan-3 nuclear power plant



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- According to the preliminary research, in 2020 the Chinese nuclear electricity production will surpass 4% of the total electricity production. At that time, 1.2 trillion tons of crude coal will be saved per year, thus will save the limited energy resource on earth and reduce the stress of environmental protection and transportation as well.

# Accelerator Driven System (ADS)


Power generation combined with nuclear waste mutation and nuclear fuel proliferation





# Collaboration in Nuclear Tech application between China and Japan



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- The widespread use of electron accelerators and non-destructive testing techniques in China for numerous industrial applications has also been promoted with cooperation of Japan enterprises.

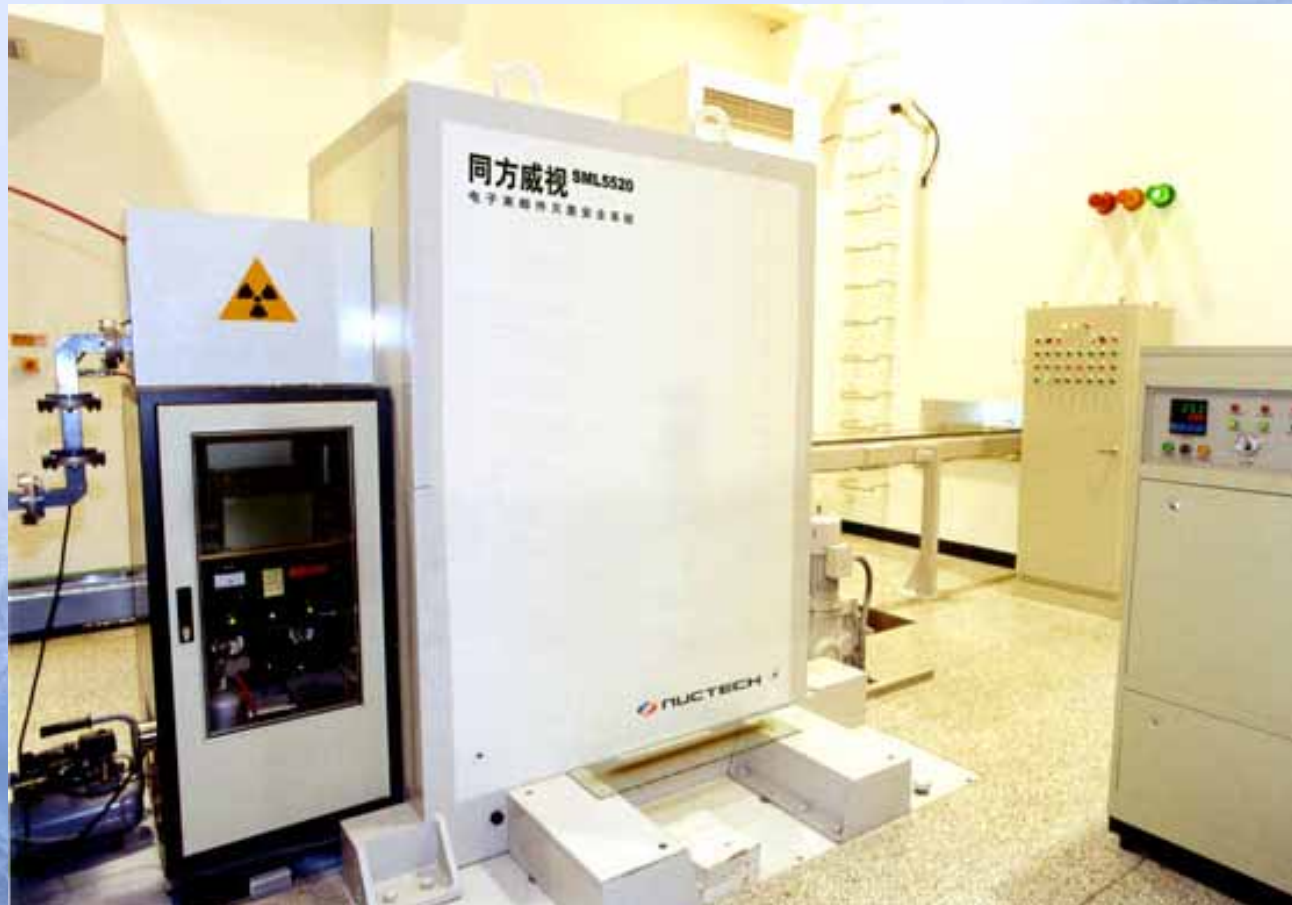
# Japan EBARA Electron Beam Desulfurization System



应用于成都热电厂的电子束脱硫工程

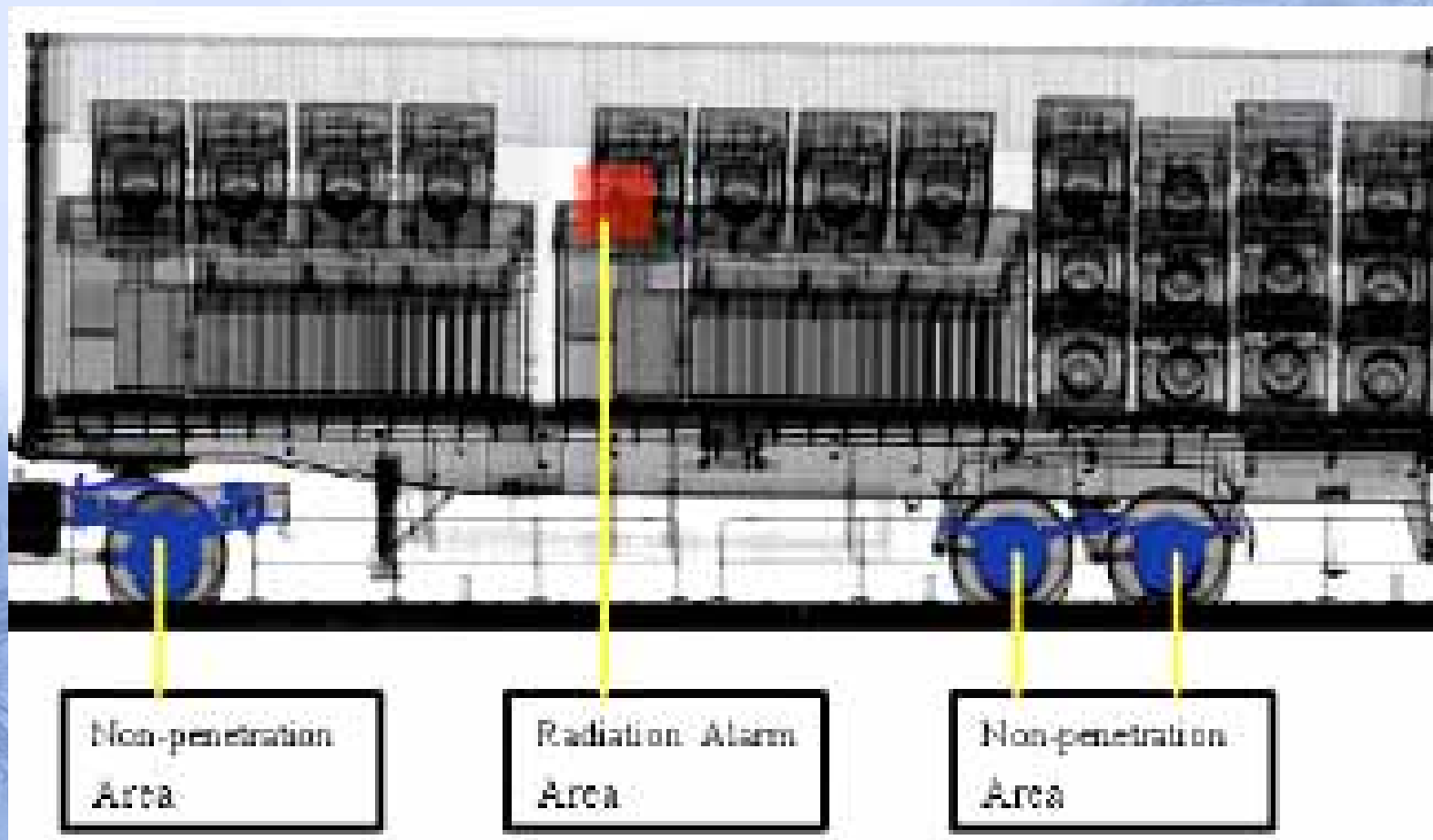
Located in Chengdu thermoelectricity plant, Sichuan, China

# Anti-bio-terrorism




Post sterilization with NUCTECH mini electron linear accelerator

# Anti-nuke-terrorism

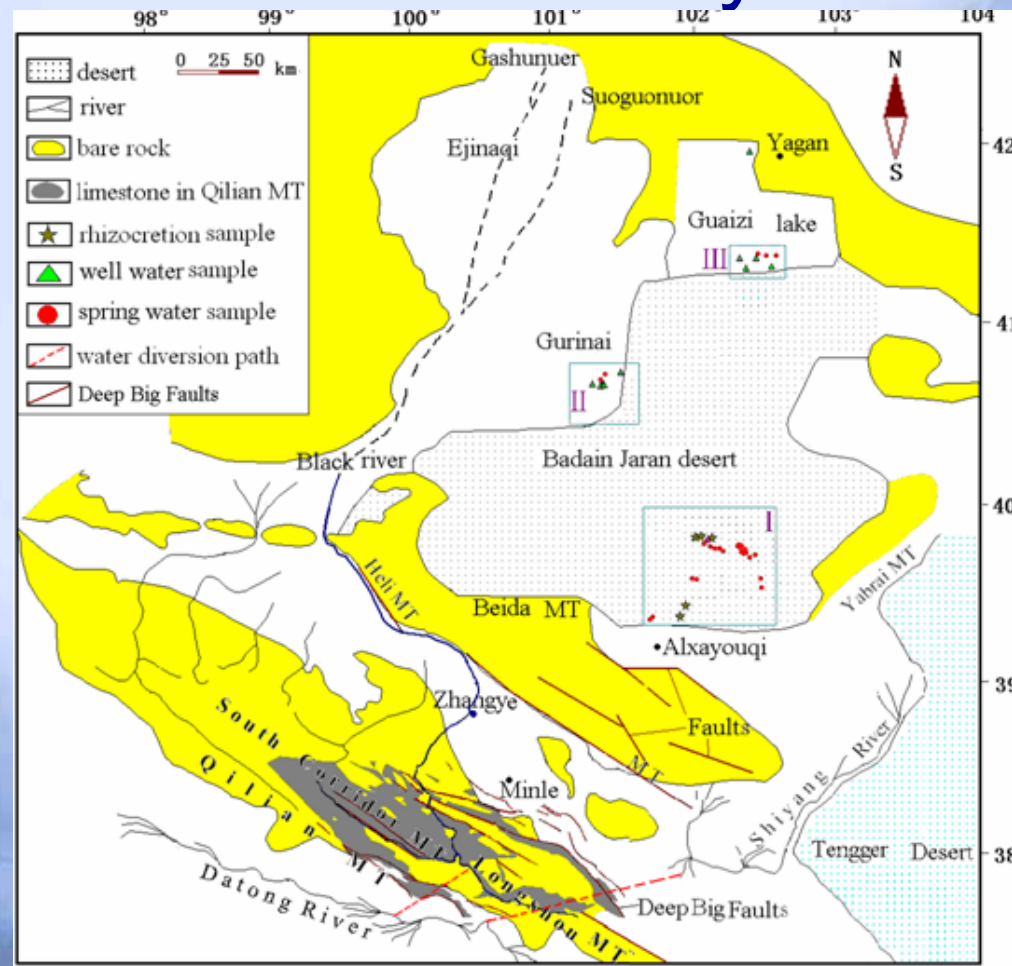


THSCAN Radioactive Monitor



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- Surveys for improved water management using isotope hydrology and the use of nuclear technology for environmental monitoring and control have likewise become practical and beneficial with the multilateral cooperation including support by Japanese nuclear industries.

# Underground river discovered under Chinese desert area by tracing $^{18}\text{O}$



Jian Sheng Chen et.al, Nature 432, 459-460, 2004

# Prospect

- At present, contribution of Nuclear Technology in total GDP is about 0.4% in China (4% in GDP of Japan), which implies there is a potentially huge market of nuclear technology application in China and a bright future for cooperation between China and Japan.



Thanks to MEXT Program !

Hot spring hotel, Takasaki

2005 9 30



Thank you !