9/14/2009 (4)

AP1000 IN CHINA

HU LIGUANG

CONTENT

- Nuclear Power Plant in China mailand
- Construction of AP1000 in Sanmen 1st Unit
- Safety Review of NNSA
- Inspection of NNSA
- Conclusion

1/19

The Nuclear Power Plant in China

- 11 units in operation, 9.1GWe
- 1.27% of electricity generating capacity, 1.92% of total electricity supply in 2007, 5% in 2020 hopefully
- 18 units under construction, 26 units is being applied to NNSA.
- 40GWe in operation, 18GWe under construction in 2020, maybe more

The Nuclear Power Plant in China

NPPs in Operation		Unit code	Reactor type	Rated power (MWe)	Date of FC	Date of commercial operation
Qinshan		CN-1	PWR	310	1985/03/21	1994/04/01
Daya Bay	Unit 1	CN-2	PWR	2×984	1987/08/07	1994/02/01
	Unit 2	CN-3			1988/04/07	1994/05/06
Qinshan Phase II	Unit 1	CN-4	PWR (CNP650)	2×650	1996/06/02	2002/04/15
	Unit 2	CN-5			1997/04/01	2004/05/03
Lingao	Unit 1	CN-6	PWR	2×990	1997/05/15	2002/05/28
	Unit 2	CN-7			1997/11/28	2003/01/08
Qinshan Phase III	Unit 1	CN-8	PHWR (CANDU)	2×700	1998/06/08	2002/12/31
	Unit 2	CN-9			1998/09/25	2003/07/24
Tianwan	Unit 1	CN-10	PWR (WWER)	2×1060	1999/10/20	
	Unit 2	CN-11			2000/09/20	

The Nuclear Power Plant in China

NPPs in Construction		Reactor type	Rated power (MWe)	Date of FC
Lingao	Unit 3	PWR (CPR1000)	2×1080	2005/12/15
	Unit 4			2006/06/15
Qinshan Phase Ⅱ	Unit 3	PWR (CNP650)	2×650	2006/04/28
	Unit 4			2007/01/28
Hongyanhe	Unit 1	PWR (CPR1000)	2×1080	2007/08/18
	Unit 2			2008/03/28
Ningde	Unit 1	PWR (CPR1000)	2×1080	2008/02/18
	Unit 2			

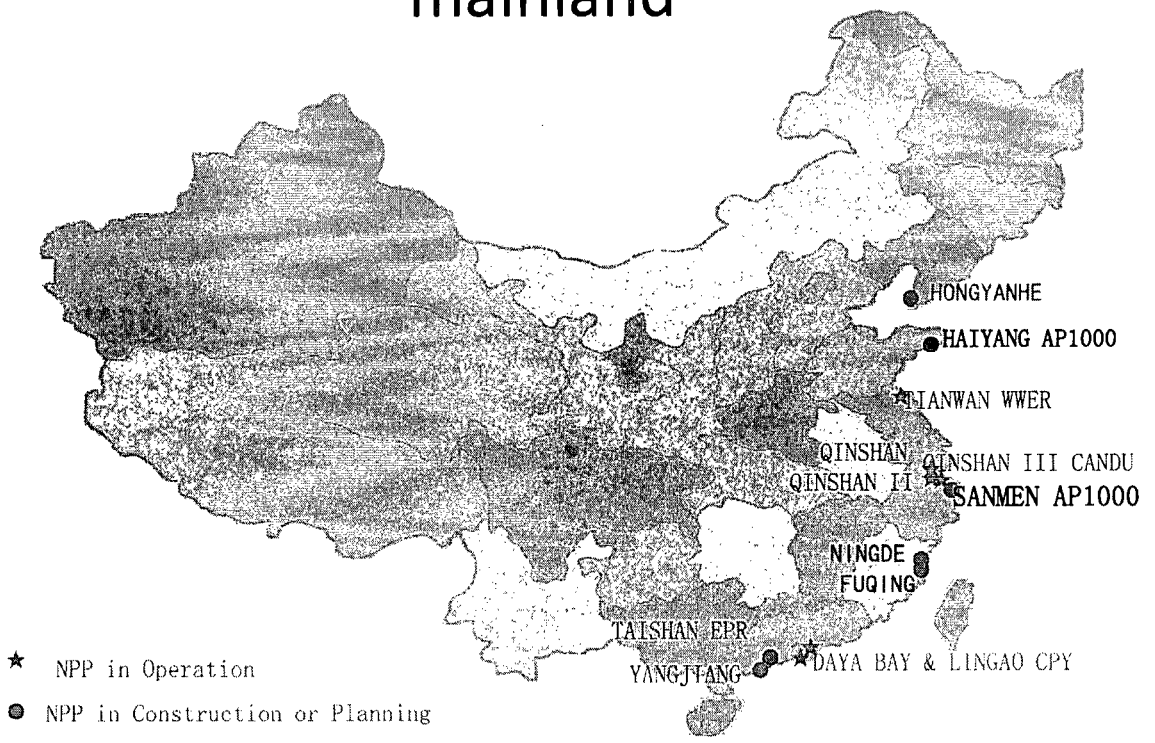
The Nuclear Power Plant in China

NPPs in construction		Reactor type	Rated power (MWe)	Expected date of FCD
Fuqing	Unit 1	PWR (M310)	2×1000	2008
	Unit 2			2009
Hongyanhe	Unit 3	PWR (CPR1000)	2×1080	2008
	Unit 4			2009
Yangjiang	Unit 1	PWR (CPR1000)	2×1080	2008
	Unit 2			2009
Fangjiashan	Unit 1	PWR (CPR1000)	2×1000	2009
	Unit 2			2009
Sanmen	Unit 1	PWR (AP1000)	2×1250	2009
	Unit 2			2010
Haiyang	Unit 1	PWR (AP1000)	2×1250	2013
	Unit 2			2014
Taishan	Unit 1	PWR (EPR)	2×1750	2009/09
	Unit 2			2010

The Nuclear Power Plant in China

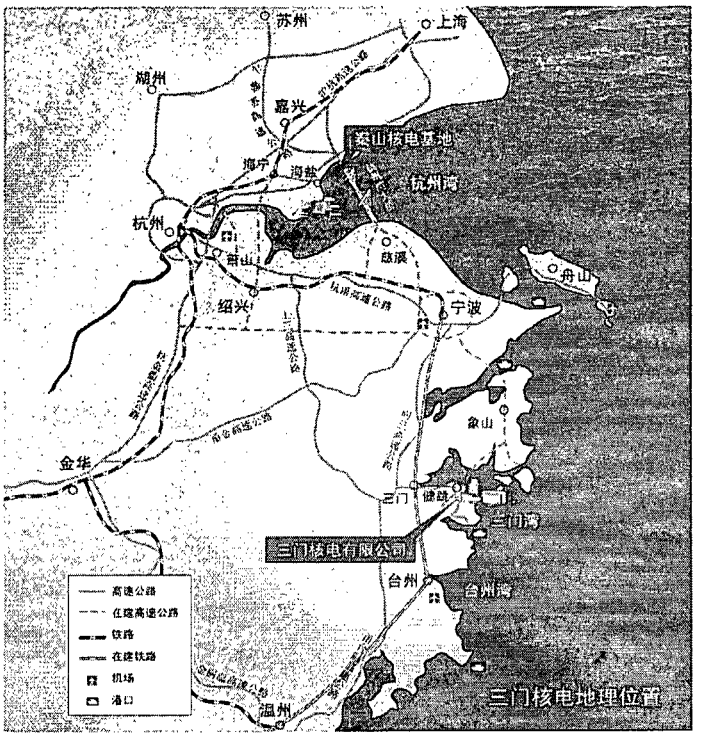
- Multi-types: PWR, VVER, Candu, AP1000, EPR, HGTR(CP recently), FBR (Fuel loading recently)
- Multi-technologies: PWR and others, hard to integrate
- Multi-codes: ASME, RCC, Russian
- Multi-importations: France, Russia, US, Canada, and domesticated

The Nuclear Power Plant in China mainland



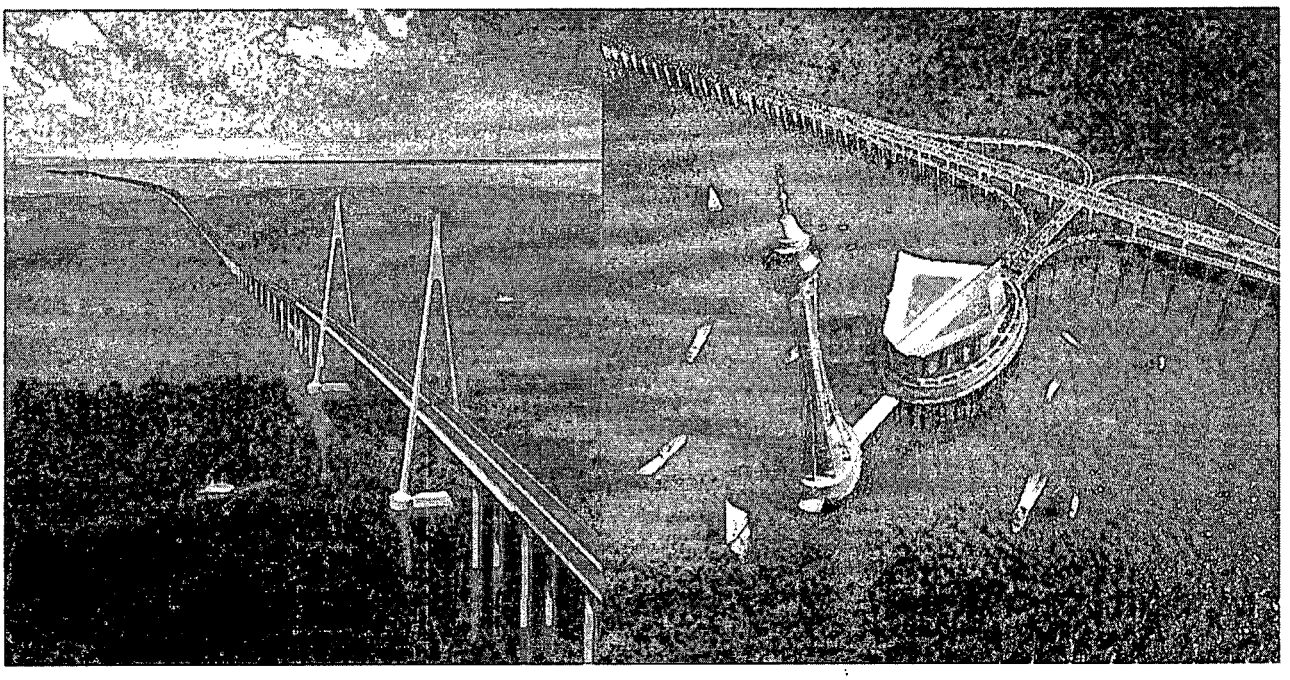
The Construction of AP1000 in Sanmen 1st Unit

- Location



Ningbo:85 km
Sanmen:26km
Taizhou:50km

The Construction of AP1000 in Sanmen 1st Unit

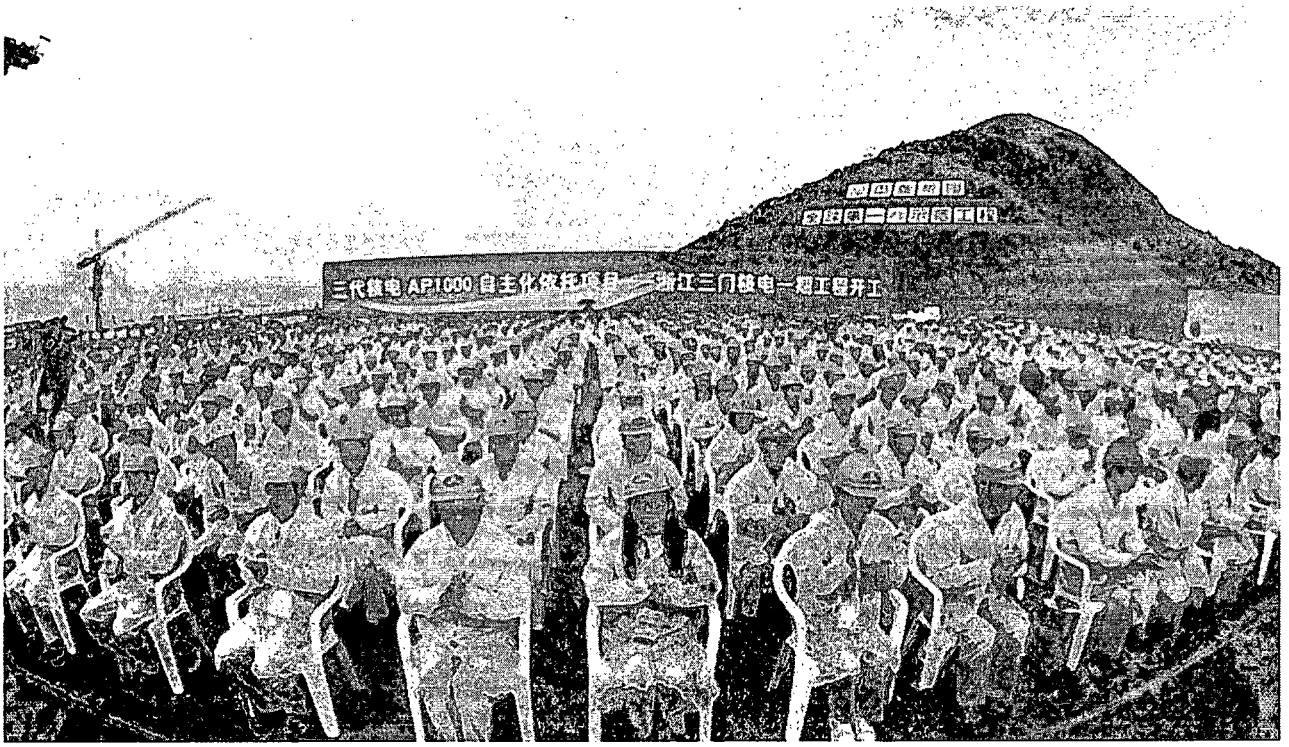


The Construction of AP1000 in Sanmen 1st Unit

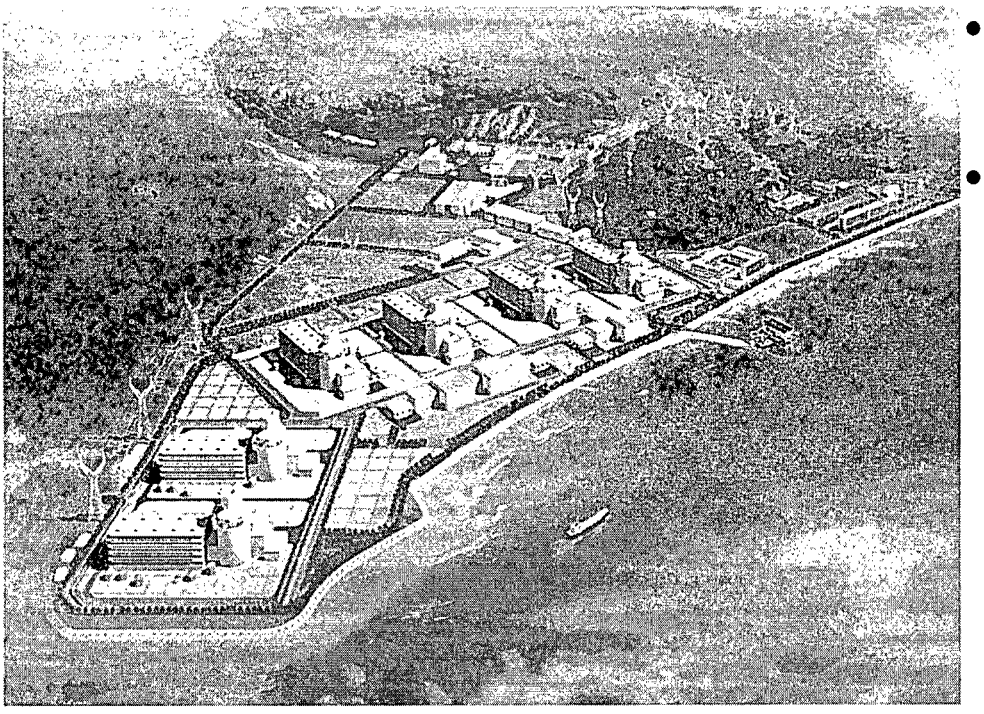
- July 24th 2007 , AP1000 NI Contract was signed between China and US in Beijing
- Dec. 31th 2007， The world's first AP1000 Nuclear Power Project was authorized to proceed (ATP) in Sanmen
- Feb.25th 2008,The application of construction permit for Sanmen Unit1&2 to NNSA, together with PSAR
- March 26th, 2009, CP of NNSA
- April 19th 2009, the Formally Startup Ceremony of Sanmen Phase Ⅰ Project

The Construction of AP1000 in Sanmen 1st Unit

The Construction of AP1000 in Sanmen 1st Unit



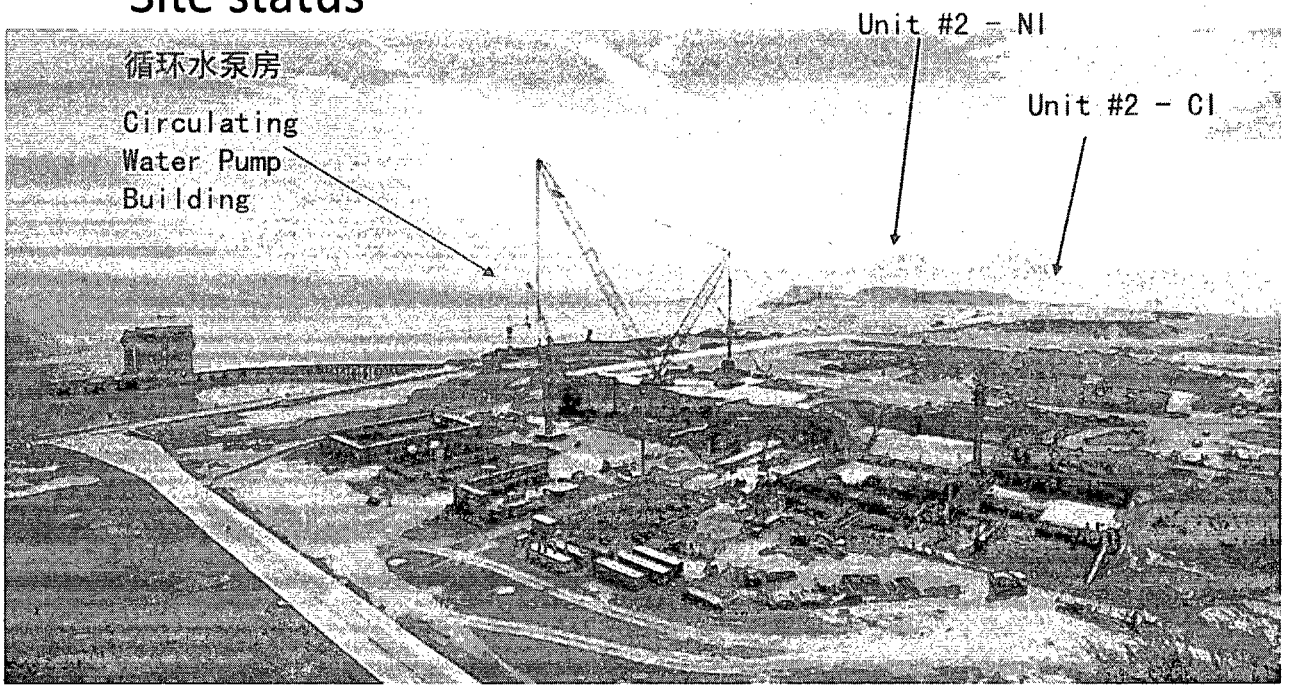
The Construction of AP1000 in Sanmen 1st Unit



- 6 units on schedule
- 2 units in 1st stage

The Construction of AP1000 in Sanmen 1st Unit

- Site status



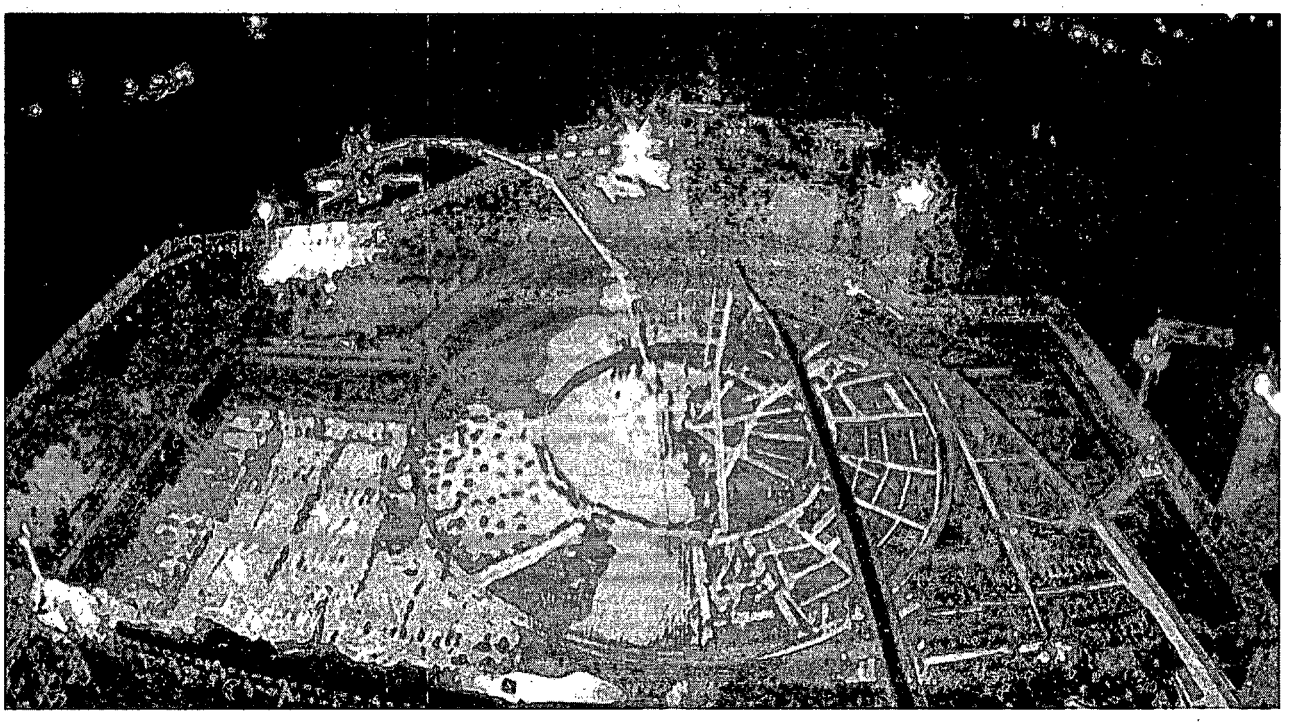
The Construction of AP1000 in Sanmen 1st Unit

Buildings	Start Date	Finish Date	2009	2010	2011	2012	
Containment	June 2009	Sep. 2012					39
Shield Bldg	Jan. 2010	Oct. 2012					33
Aux Bldg	Mar. 2009	Aug. 2012					41
Annex Bldg	Aug. 2009	Oct. 2011					26
Railwaste Bl dg	Sep. 2010	Sep. 2011					12
Diesel Bldg	Jan. 2011	Dec. 2011					11
Turbine Bldg	Feb. 2009	Oct. 2012					39

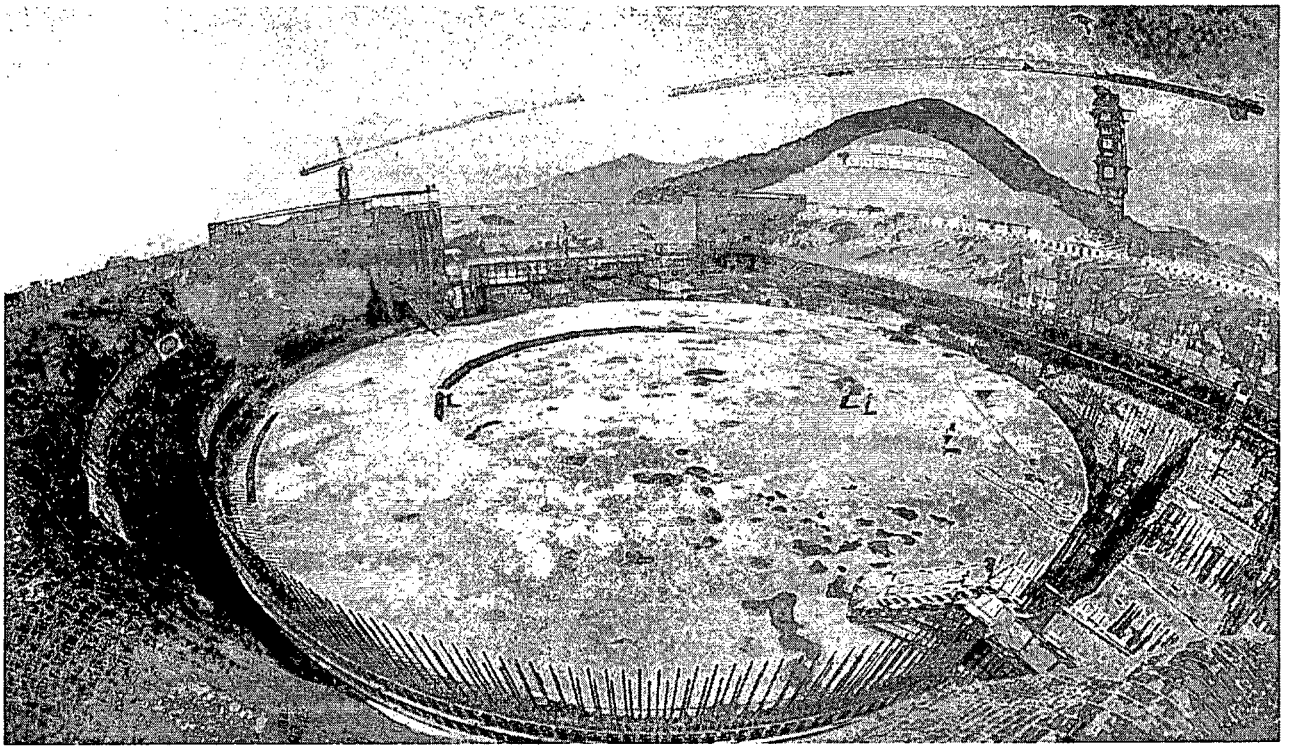
The Construction of AP1000 in Sanmen 1st Unit

- The one-time integrated placement of Sanmen NPP Unit 1 NI foundation concrete started at 15:08pm on March 29, 2009, and the continuous operation performed by project constructors lasted for 47 hours. Up till 14:06pm on March 31, the placement was completed successfully with a concrete volume of 4982 cubic meters for one-time integrated placement.

The Construction of AP1000 in Sanmen 1st Unit

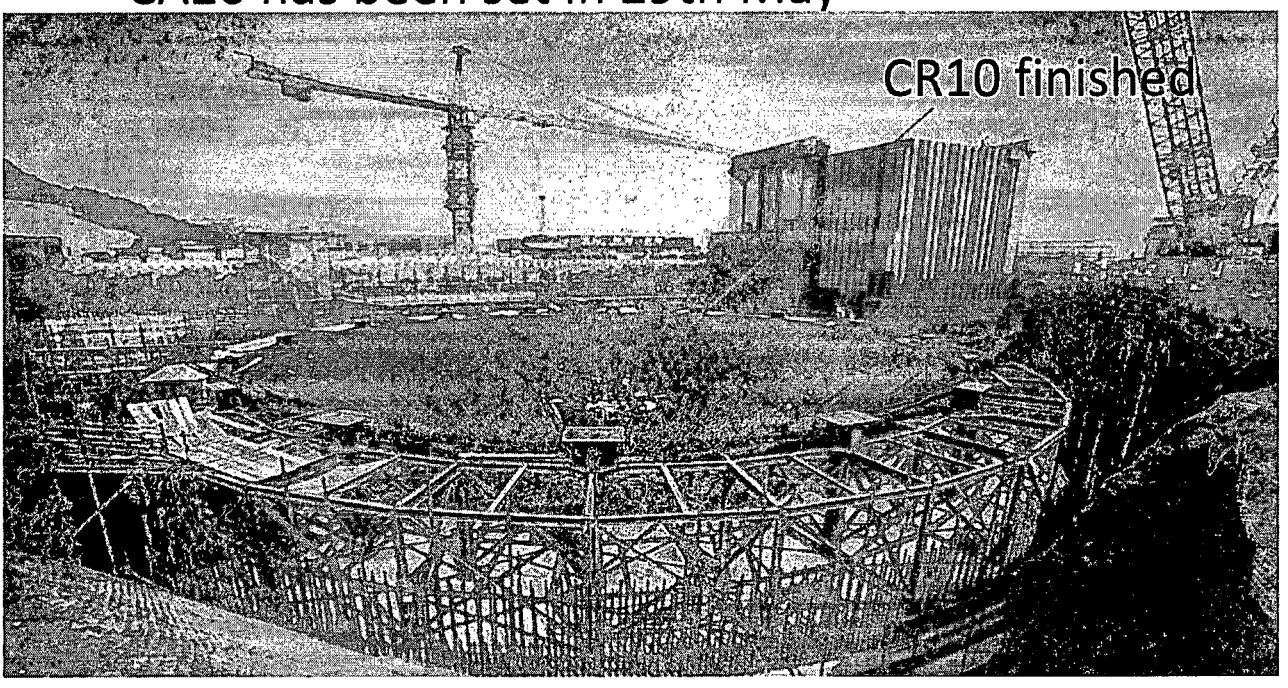


The Construction of AP1000 in Sanmen 1st Unit



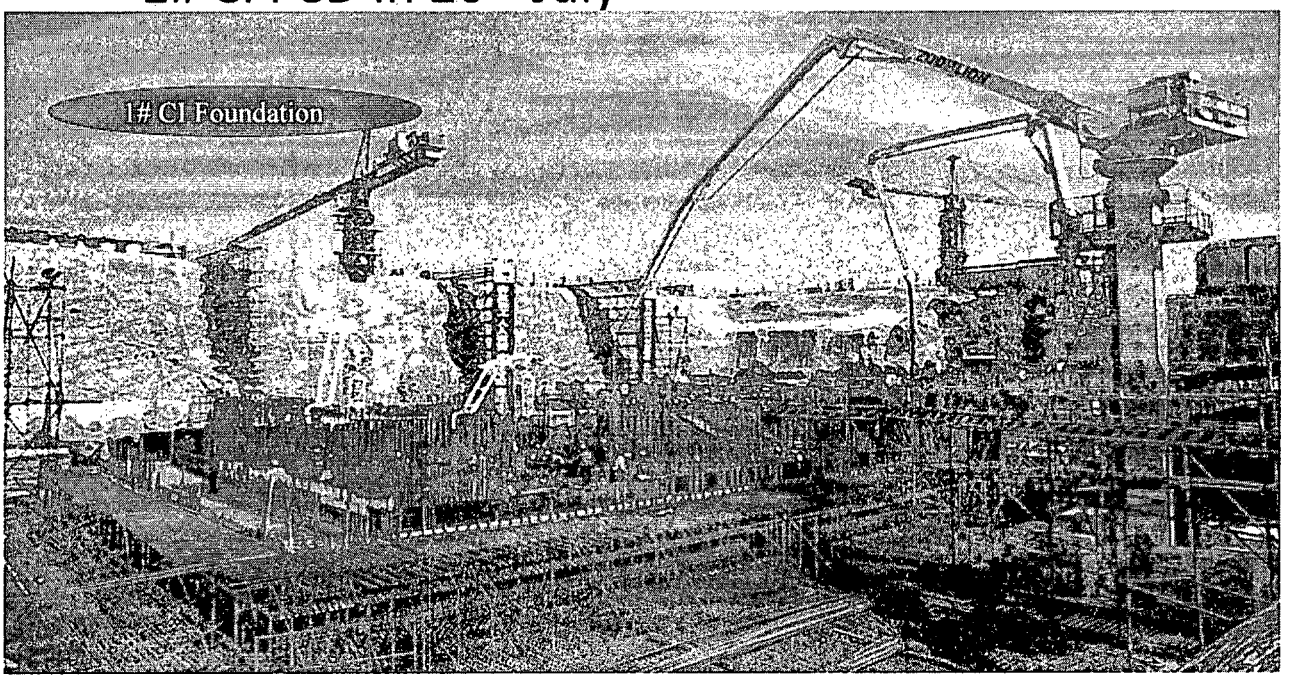
The Construction of AP1000 in Sanmen 1st Unit

- CA20 has been set in 29th May



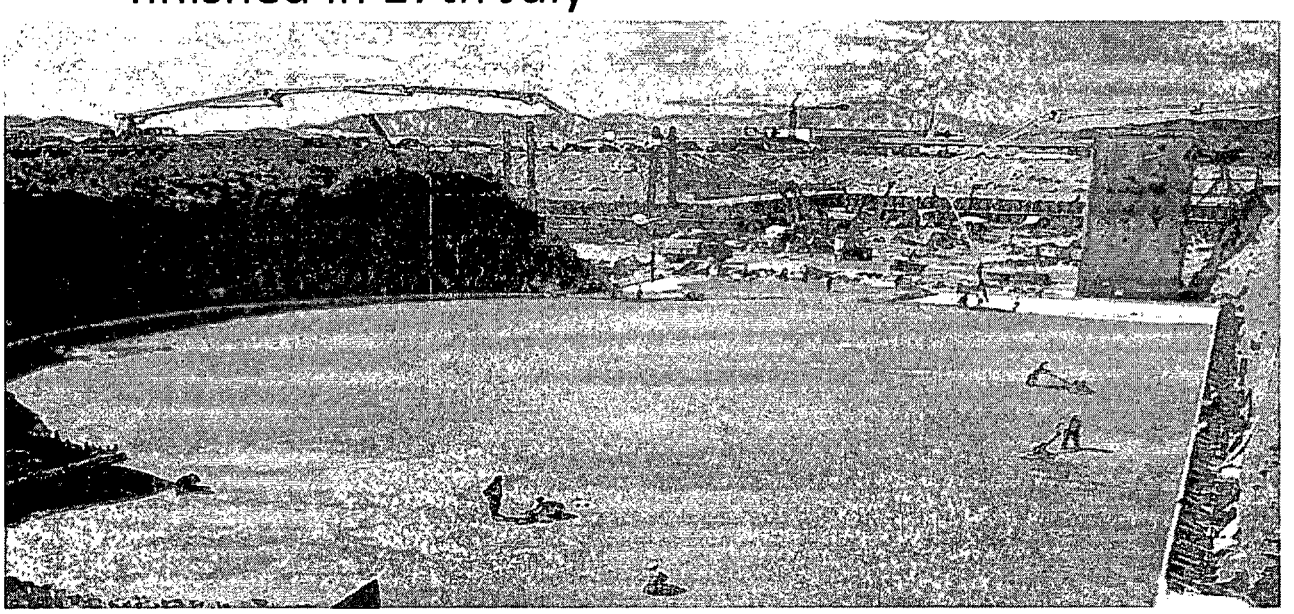
The Construction of AP1000 in Sanmen 1st Unit

- 1# CI FCD in 20th July



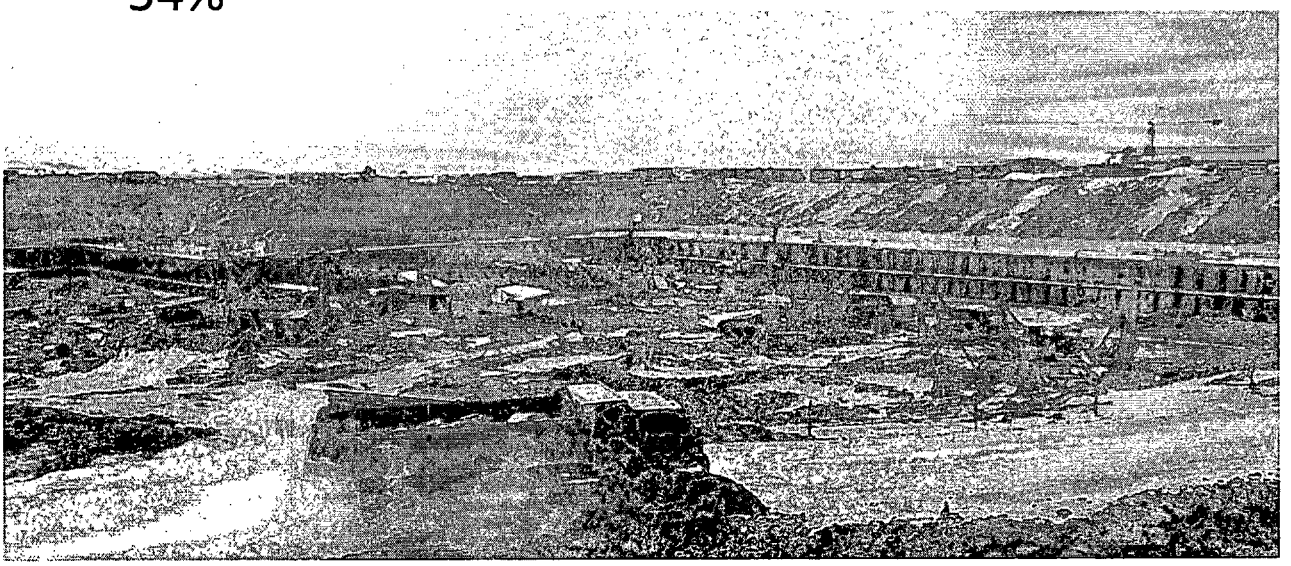
The Construction of AP1000 in Sanmen 1st Unit

- 2# NI Upper mudmat concrete placement finished in 17th July

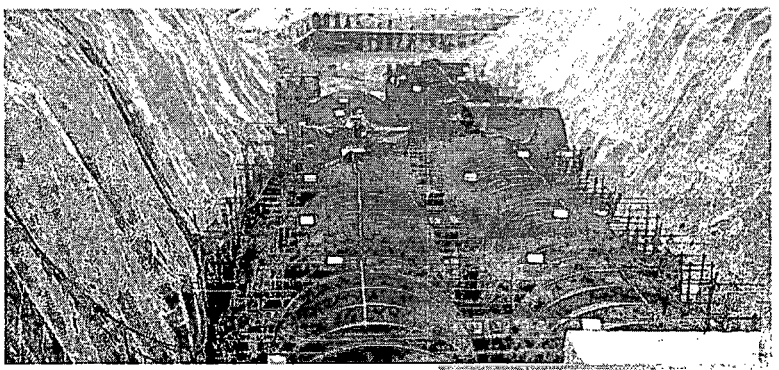


The Construction of AP1000 in Sanmen 1st Unit

- 2# CI is in step of excavating, shorting pile completed 79%, cast-in-place pile completed 54%

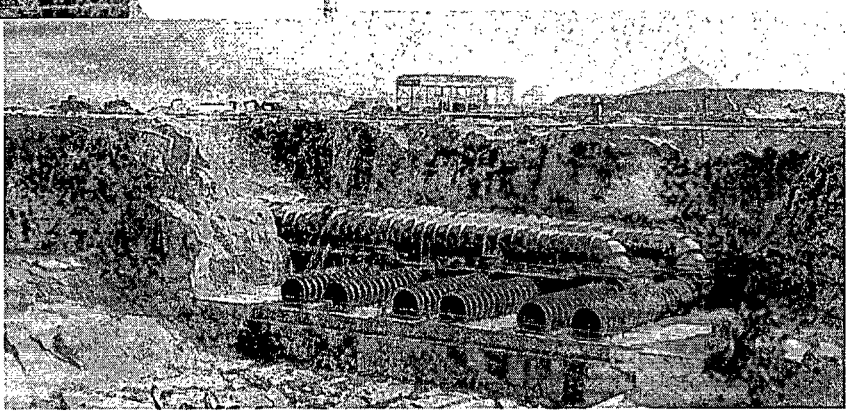


The Construction of AP1000 in Sanmen 1st Unit



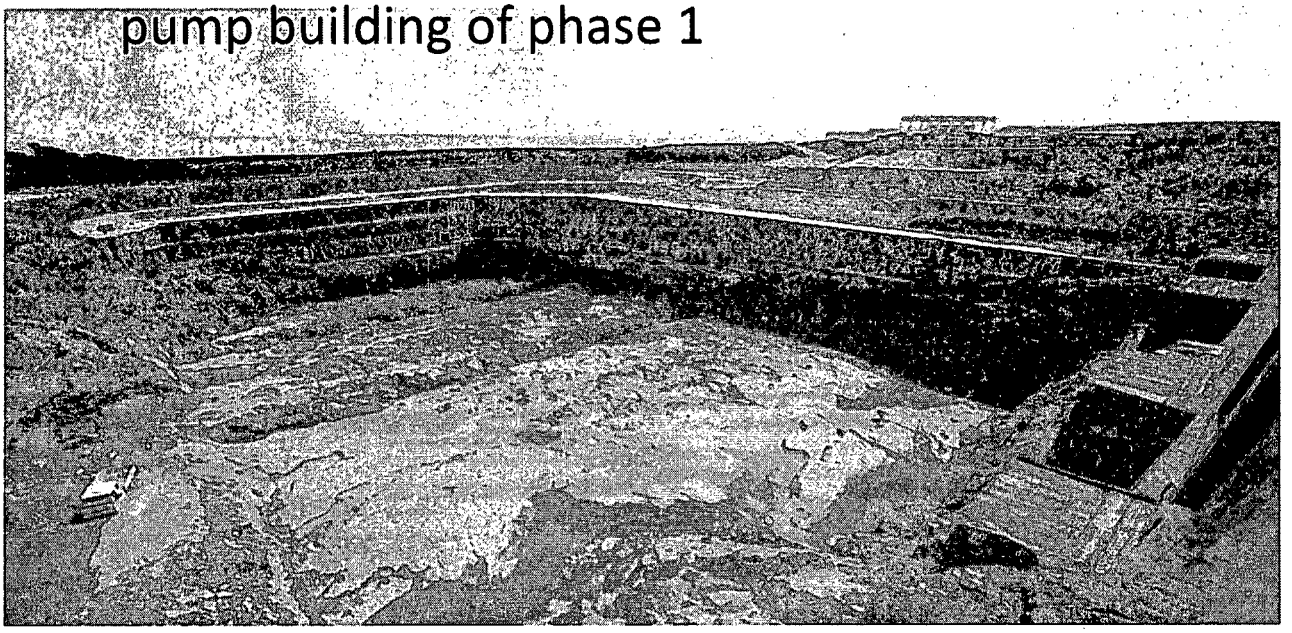
Unit1#/2# respectively use two steel pipes that the inside diameters of which are 4.1 meters to supply and drain water.

The total length of Circulating Water pipes of Unit1#/2# is more than 1800 meters.



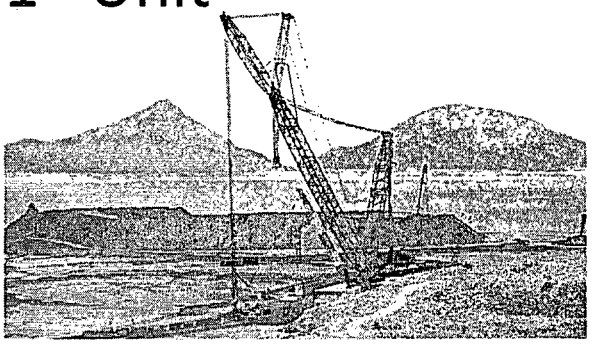
The Construction of AP1000 in Sanmen 1st Unit

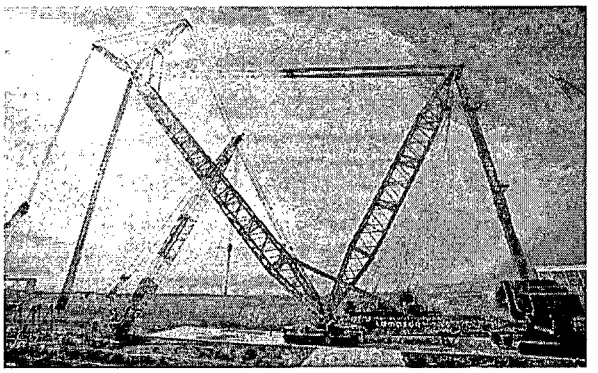
- The Excavation supporting of basemat and waist rail constructions of Circulating water pump building of phase 1



The Construction of AP1000 in Sanmen 1st Unit

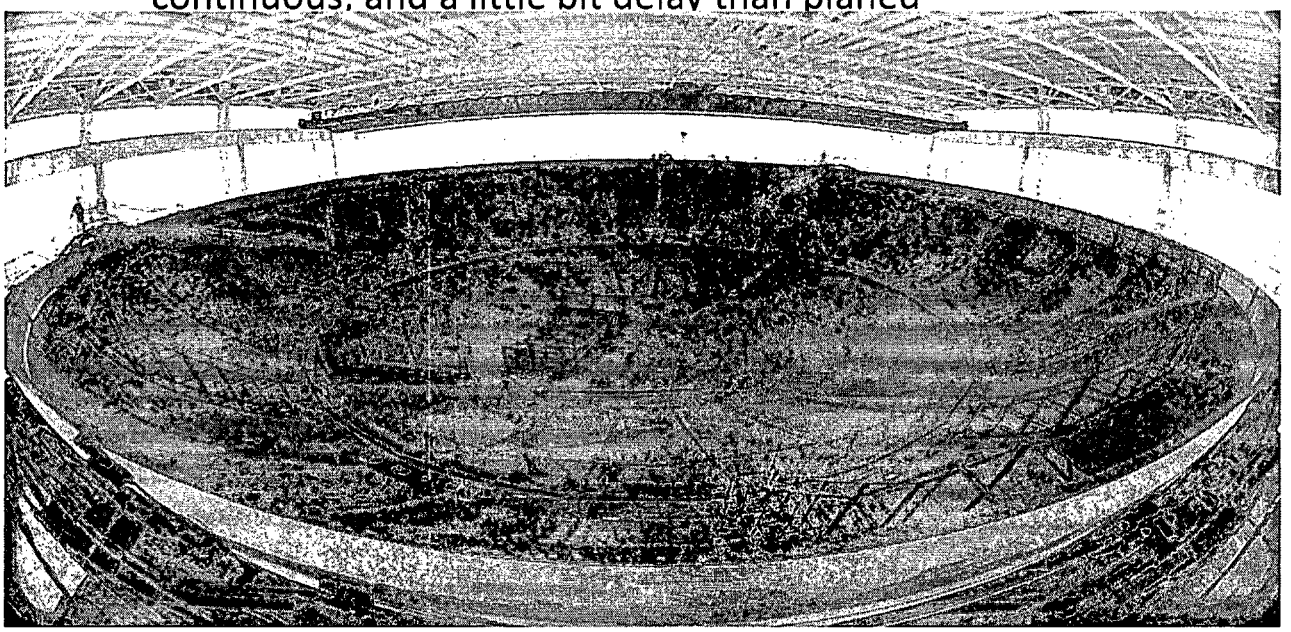
- The large crane, typed LTL2600B, has finally finished its assembly and installment, and has obtained authority license.
- The large crane, typed LTL2600B is the crawler crane with the most powerful lifting capacity in the world, and its maximum lifting capacity extends to 1283.8 tons under 50-meter operation radius and 500 tons under 100-meter operation radius.





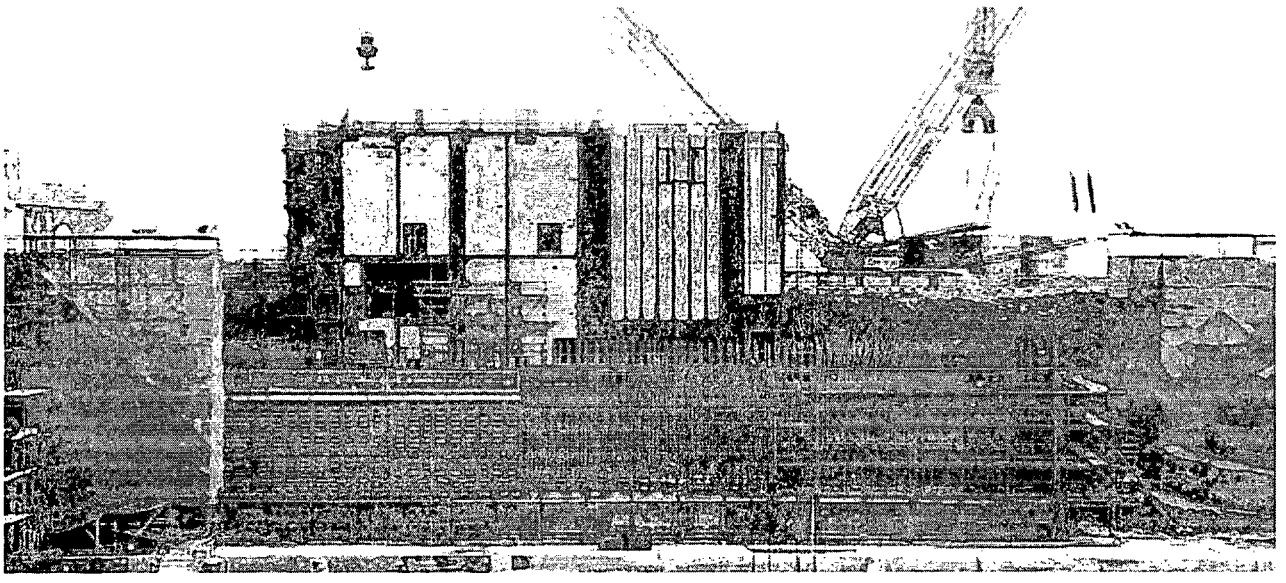
The Construction of AP1000 in Sanmen 1st Unit

- The CVBH assembling has completed, Now welding is continuous, and a little bit delay than planed



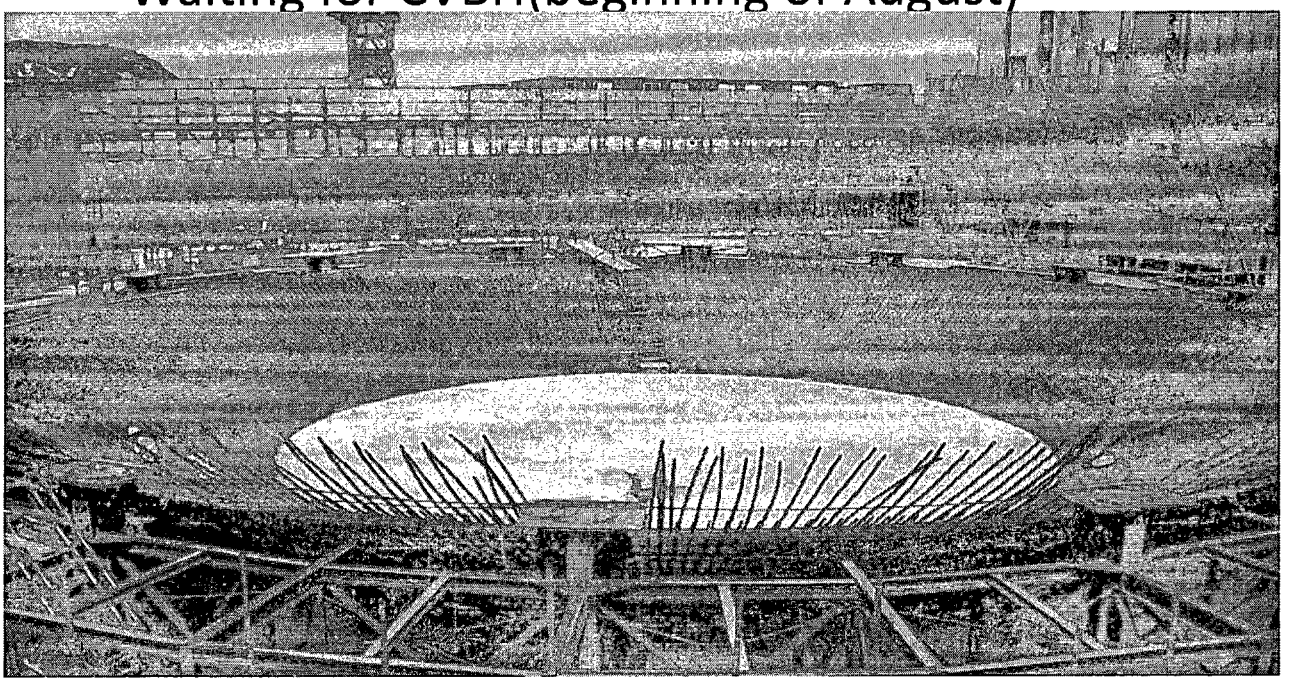
The Construction of AP1000 in Sanmen 1st Unit

- Auxiliary building(end of July)

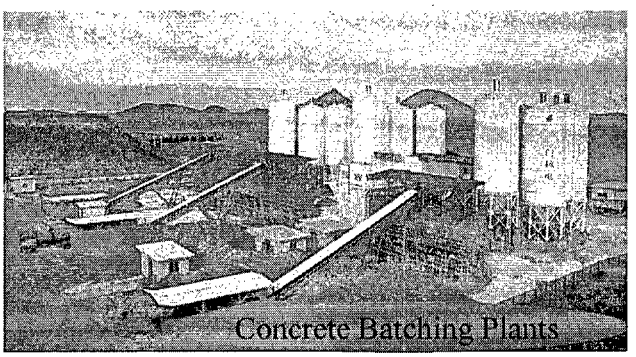


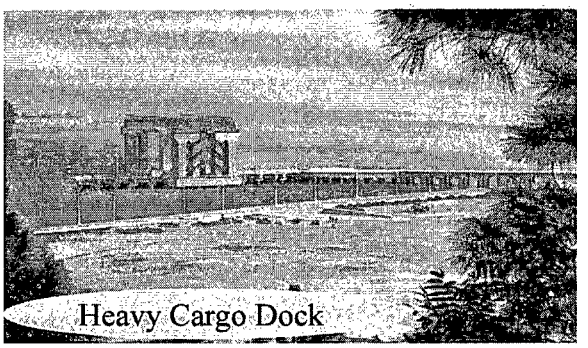
The Construction of AP1000 in Sanmen 1st Unit

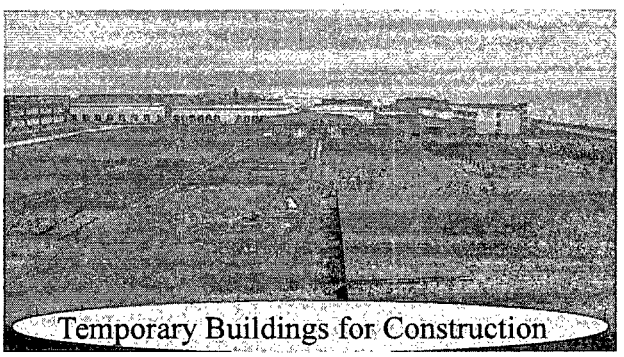
- Waiting for CVBH(beginning of August)

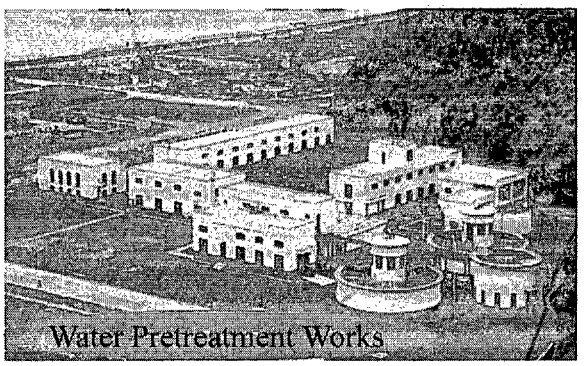


The Construction of AP1000 in Sanmen 1st Unit

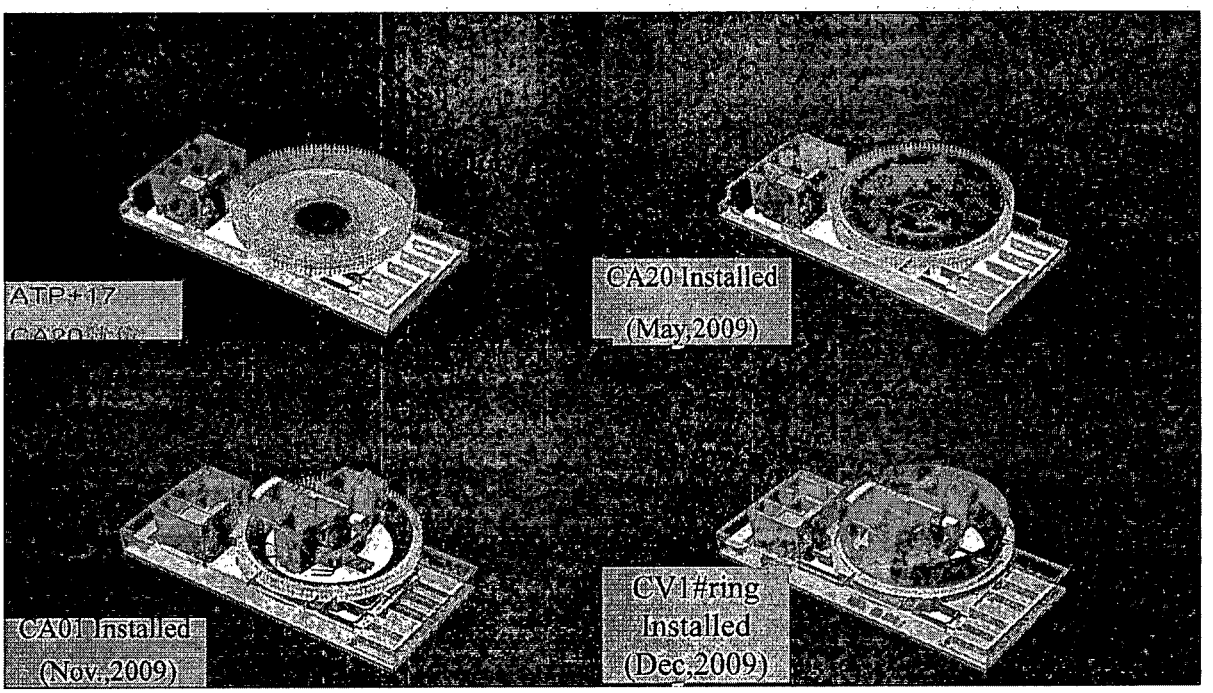








The Construction of AP1000 in Sanmen 1st Unit



The Safety Review of NNSA

- **Target : to verify AP1000**
  - Comply with the Nuclear Safety Codes of the nation and the Regulatory Requirements of the Nuclear safety authority.
  - In compliance with the requirements of Nuclear safety.

The Safety Review of NNSA

- Principles:
  - Codes, regulations and standards stated about Environment Protection and Nuclear Plant Safety.
  - Regulations of government departments
  - Valid guidelines of government departments
  - Relevant laws and codes of the US
  - Guidelines, Regulations and Standards adopted by NRC

The Safety Review of NNSA

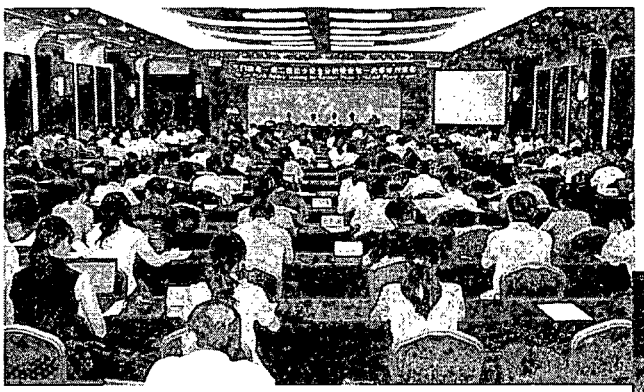
- Proceeding

Step	Project	Date
1	Received PSAR	Feb.27th 2008
2	Sent information questions (68)	Mar.31st 2008
3	Received reply of the information questions	May 23rd 2008
4	Sent the 1st batch questions(1572)	May 30th 2008
5	Received reply of the 1st batch questions	July 25th 2008
6	1st review meeting, 663 action sheets were raised	Aug. 11-15th 2008
7	Received reply of the 1st batch action sheets	Sep.16th 2008
8	Sent the 2nd questions(698)	Oct.17th 2008
9	Received reply of the 2nd batch questions	Nov.17th 2008

The Safety Review of NNSA

Step	Project	Date
10	2nd review meeting , 269 action sheets were raised	Dec. 3-5th 2008
11	Received reply of the 2nd batch action sheets	Jan. 5th 2009
12	Set 51 review topics	Jan. 23rd 2009
13	1st Topical Review Meeting and 44 action sheets were raised	Feb. 3-4th 2009
14	Expert committee Meeting review < The Technical Sight of AP1000 Self-reliance Project Nuclear Safety Review>	Mar. 6-7th 2009
15	2nd Topical Review Meeting and 35 action sheets were raised	Mar. 9-10th 2009
16	Expert committee Meeting review The Result of Sanmen Nuclear Plant PSAR Review	Mar.13th 2009

The Safety Review of NNSA



The Safety Review of NNSA

- The 1st batch review questions:1572
- The 1st review meeting action sheets:663
- The 2nd batch review questions:698
- The 2nd review meeting action sheets:269
- Topical questions:51

The Safety Review of NNSA

- 31 opinions of nuclear safety commitee:

1. The protection against malice attack by commercial aero plane was not required, but the future developments in WEC and NRC should be noticed and followed.
2. The seismic design of 10CFR50 Appendix S is acceptable for AP1000
3. The new stainless-steel in RPV and of reactor internal needs further assessments before acceptance.

The Safety Review of NNSA

4. The ISI of flywheel could be acceptably avoided, but the quality control in design and manufacture should be intensified.
5. The highest pressure in containment when DBA is acceptable, if the value in FSAR would be under limitation.
6. The classification of passive safety injection system to be ASME 3 is acceptable.

The Safety Review of NNSA

7. The post-accident monitor(different from RG1.97) is acceptable
8. The time of control rod dropping should be evaluated under the consideration of earthquake effect.
9. The new structure of shield building should be evaluated.
10. How to renew SG needs further investigation.

The Safety Review of NNSA

11. The safety function of CRDM needs further investigation if the seismic testing would be avoided.
12. The of S-N co-relation should be considered in analysis—should be finish within 6 moths by the condition of CP
13. The identification of squib-valve was needed, and its failure mode should be analyzed.
14. The design of sump screen needs further evaluation

The Safety Review of NNSA

15. Non-accordance of outside power system with SDJ161-85 3.2.6 (the technical guideline of electricity system design)is acceptable from the safety point of view.
16. Multi-tube rupture in SG needs further assessment after CP.
17. Software of digital system needs further investigation, especially the reliability and the failure mode, and V&V.

The Safety Review of NNSA

18. Quality assurance program should be revised before CP to fit the NI main contractor changing .
19. More height of chimney is needed.
20. Gaseous effluents monitoring system should satisfy both domestic engineering performance and ANSI N13.1-1999

The Safety Review of NNSA

21. Liquid waste release needs further study considering the requirement of environment law, environmental impact, feasibility and economy.
22. The occupational exposure should satisfy GB18871. The recommended individual dose constraint is 15 mSv/a.
23. Requirement of radiation zoning that 10uSv/h within Control zone II.

The Safety Review of NNSA

24. Source term and emergency planning zone should be analysed.
25. The package of waste how to fit disposal site should be investigated.
26. The radiation impact on marine biology should be further investigated.
27. The C-14 source term should be checked.
28. The radiological consequence of SGTR should be followed .

The Safety Review of NNSA

29. The final disposal of low and medium radioactive waste should be settled ASAP.
30. The fact that the 1st phase would occupy large amount of the control value of annual emissions of radioactive effluent should be noticed.
31. The mechanical population increase should be limited.

The Safety Review of NNSA

●Condition of CP

- Conform to the law
- Conform to application and the commitments
- Conform to QA program
- Safety should be re-evaluated in case of the site significantly changed.

The Safety Review of NNSA

- The COL action and ITAAC should be conducted via 10CFR52 and report to NNSA the progress .
- The joint between conventional and steel reinforced concrete should be studied.
- Environmental monitoring program should be send within 2 moths after CP.
- Primary pump qualification test program should be submitted 2 moths before testing, and the results is also required after testing.

The Safety Review of NNSA

- Source term study is needed.
- what is required within 6 months after CP

✓ submit stress analysis report of 1 Class piping

✓ the feasibility of SG renew

✓ justifying of CRDM safety and seismic classification

✓ the basis of limitation value of linear heat density during super-power transient

The Safety Review of NNSA

✓ a new design of chimney

✓ a amended gaseous effluents sample design

✓ describe the measures of keeping occupational exposure dose under 15 mSv/a

✓ describe the measures to keep the dose under 10uSv/h in control-zone II

✓ the further justification of conservation of dropping time of control rod(NRC bulitine IN-88-47)

The Safety Review of NNSA

- ✓ checking of source of C-14
- ✓ justification of liquid waste release design
- Following is required within 12 moths after CP
- ✓ for squib-valve: failure mode, qualification program, testing proceeding plan, results of testing.
- ✓ the design of slot discharge of second loop leakage.

The Safety Review of NNSA

- ✓ the calculation report of source term and emergency planning zone of SA
- ✓ analysis the SGTR radiation consequence
- ✓ further explanation of equipment surveillance frequency
- ✓ to plan the general annual emissions of radioactive effluent with consideration of future

The Safety Review of NNSA

- Following is required within 2 years after CP

✓ a new fatigue analysis considering the coolant environment.

✓ the report of SG seismic and vibration analysis.

The Inspection of NNSA

- Inspection on preparation before NI first concrete pouring
- 10^{th} -12^{th} ,Match, 2009
- The remained work of foundation construction
- Preparation of construction
- QA

The Inspection of NNSA

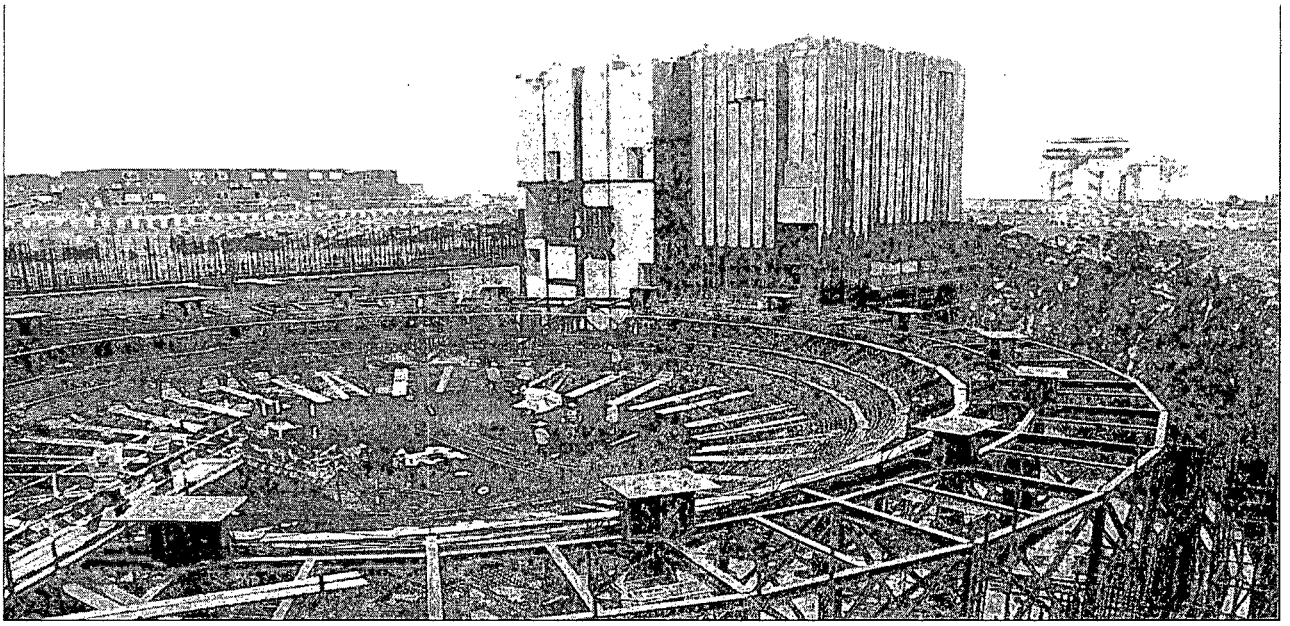
- Checking on the below-ground excavation
  - 10^{th} -12^{th} ,March, 2009
  - Documents and records
  - QA and Non-accordance item
  - The geographic condition of the pit

The Inspection of NNSA

- The inspection of first concrete pouring
  - 27^{th} -31^{st} , March, 2009
  - Review on the technology
  - Process surveillance
- The audit on the curing of poured concrete
  - 17^{th},April,2009
  - The technical parameters of curing

The Inspection of NNSA

- Inspection of QA&CA20 model
- 25th -26th ,June



Conclusion

- AP1000 needs China, China needs AP1000
- Glories future of cooperation between China and US
- Urgency of cooperation between NNSA and NRC
- Pleasure of sharing information with colleagues in other countries

Thank you for your attention