Clean and Low Carbon, Sustainability and Development
清洁低碳，持续发展

State Nuclear Power Technology Corporation

Lin FENG

Deputy Chief of SNPTC Brazil Office

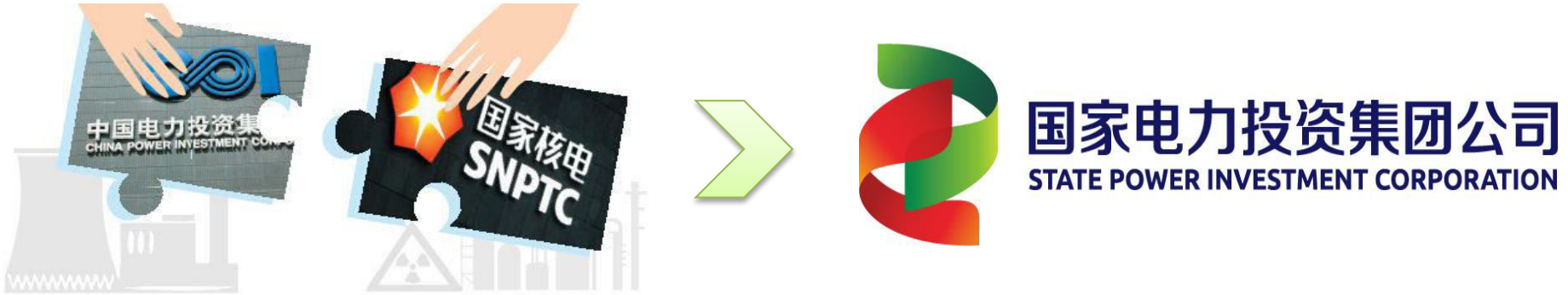
Oct 6th 2015

CONTENTS
目录

SNPTC and CPI Reorganization SNPTC与CPI重组

May 2015, led by Chinese government, two large state-owned key enterprises SNPTC and CPI were reorganized to form SPIC.

2015年5月，在中国政府主导下，国家核电技术公司与中国电力投资集团公司两家大型国有骨干企业重组，成立国家电力投资集团公司。



- **One of the three nuclear power investors and operators in China**
  中国三大核电投资运营商之一
- **One of the five power generation groups**
  中国五大发电集团之一
- **Transferee of American AP1000 nuclear power tech.**
  美国AP1000核电技术的受让主体
- **Developer and owner of the indigenous tech. CAP1400**
  中国自主知识产权CAP1400的技术开发和拥有者

SNPTC and CPI Reorganization SNPTC与CPI重组

CPI

1. NPP Development, Investment & Operation (One of the three nuclear power investors and operators in China)
核电站开发投资运营（中国三大核电投资运营商之一）
2. Thermal Power and New Energy Invest. & Ops.
火电、新能源投资运营
3. Hydro Power Invest. & Ops.
水电投资运营
4. Electrolytic Aluminum Industry Invest. & Ops.
电解铝产业投资及运营
5. Development of Coal and Bauxite Mines
煤和铝土矿开发
6. Railway and Port Invest. & Ops.
铁路和港口投资及运营
7. EP Industry R&D, Equip. Manuf., and Invest. & Ops
环保产业技术研发、设备制造和投资运营
8. Financial Industry
金融产业

SNPTC

1. Transferee of Gen III AP1000
AP1000三代核电技术的受让主体
2. R&D of Advanced NP Technology
先进核电技术的研发设计
3. NPP EPC
核电工程EPC建造
4. NP Equipment Self-Reliant System
核电装备自主化体系
5. Developer, Designer, Constructor and Owner of China FOAK CAP1400 with Independent IPR
中国首台自主知识产权CAP1400研发、设计、建造和拥有
6. LPP Module Construction and Dev. & EQ of Key Equip. and Material
大型非能动核电站模块制造和关键设备材料的研制及EQ试验
7. R&D, Design and EPC of Thermal Power and New Energy
火电和新能源发电技术的研发、设计及EPC建造
8. Financial Industry
金融产业

SNPTC

SNPTC and CPI Reorganization SNPTC与CPI重组

SPIC

1. Thermal Power and New Energy Invest. & Ops.
火电、新能源投资运营

2. Hydro Power Invest. & Ops.
水电投资运营

3. Electrolytic Aluminum Industrial Invest. & Ops.
电解铝产业投资及运营

4. Development of Coal and Bauxite Mines
煤和铝土矿开发

5. Railway and Port Invest. & Ops.
铁路和港口投资及运营

6. EP Industry R&D, Equip. Manuf., and Invest. & Ops
环保产业技术研发、设备制造和投资运营

SNPTC

1. NPP Development, Investment & Operation (One of the three nuclear power investors and operators in China)
核电站开发投资运营（中国三大核电投资运营商之一）

1. Transferee of Gen III AP1000
AP1000三代核电技术的受让主体

2. R&D of Advanced NP Technology
先进核电技术的研发设计

3. NPP EPC
核电工程EPC建造

4. NP Equipment Self-Reliant System
核电装备自主化体系

5. Developer, Designer, Constructor and Owner of China FOAK CAP1400 with Independent IPR
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6. LPP Module Construction and Dev. & EQ of Key Equip. and Material
大型非能动核电站模块制造和关键设备材料的研制及EQ试验

7. R&D, Design and EPC of Thermal Power and New Energy
火电和新能源发电技术的研发、设计及EPC建造

8. SPIC Financial Industry and Enterprise Bank
SPIC金融产业和企业银行

SPIC Overview SPIC基本情况

- **The total assets over 700 billion RMB (~114 billion USD), 140,000 employees and the annual revenue over 200 billion RMB (~33 billion USD).**

  新集团资产超过7000亿元(约1140亿美元)，员工人数近14万人，年营业收入近2000亿元(约330亿美元)。

- **Comprehensive energy group engaged in power, coal, aluminum, logistics, finance, environmental protection, and high-tech industries.**

  集电力、煤炭、铝业、物流、金融、环保、高新产业等产业于一体的综合能源集团。

- **The only energy company in China that holds assets of hydropower, thermal power, nuclear power and renewable energy simultaneously.**

  是中国唯一同时拥有水电、火电、核电、新能源资产的能源企业。

- **The total installed capacity exceeds 100 GW, 39.41% of which is clean energy, ranking 1st among China's top five power generating groups.**

  装机容量超过1亿千瓦，清洁能源比重占39.41%，位居中国五大发电集团之首。

SNPTC Overview SNPTC基本情况

Mr. WANG Binghua
Chairman of SPIC and SNPTC
王 炳 华
国家电投与国家核电董事长

- **SNPTC is an energy company controlling held by SPIC. Its main business includes nuclear power R&D, engineering and technical services. SNPTC is one of the three nuclear power investors and operators in China, owning more than 30 subsidiaries, about 15,000 employees, and the total assets over 100 billion RMB (~ 16.3 billion USD).**

SNPTC是国家电力投资集团控股的产业集团，主要从事先进核电技术研发、工程及技术服务，是中国三大核电投资和运营商之一。SNPTC拥有30余家成员单位，约15000名员工，总资产超过1000亿元人民币（约163亿美元）。

国家核电 SNPTC

SNPTC Subsidiaries SNPTC所属单位

Engineering Design 工程设计	R&D 研发	Nuclear Power Plant 核电站	Project Management 工程管理	Equipment Manufacture 设备制造	Technical Service 技术服务	Materials 材料
Shanghai Nuclear Engineering R&D Institute 上海核工院	Shanghai Nuclear Engineering R&D Institute 上海核工院	Shandong Rongcheng CAP1400 NPP 山东荣成CAP1400核电站	State Nuclear Power Engineering Company 国核工程公司	Shandong Nuclear Power Equipment Manufacturing Company 山东设备制造厂	State Nuclear Power Plant Service Company 国核运行服务公司	State Nuclear Bao Ti Zirconium Industry Company 国核宝钛锆业公司
State Nuclear Power Technology R&D Centre 国核电力院	SNPTC R&D Center 国核研发中心	Shandong Haiyang NPP 山东海阳核电站	CPI Engineering Company 中电投工程有限公司	State Nuclear Power Automation System Engineering Co. 国核自仪公司	Shanghai Complete Equipment R&D Institute 上海成套院	National Nuclear-Class Zirconium Material R&D and Testing Centre 国家核级锆材研发与检测中心
Shandong Electric Power Engineering Consulting Institute 山东电力院	SNPTC Software Center 国核软件中心	Liaoning Hongyanhe NPP 辽宁红沿河核电站		Shanghai Complete Equipment R&D Institute 上海成套院	SNPTC WEC Service Center 国核服务中心	State Nuclear WEC Zirconium Hafnium Company 国核维科锆铪公司
	SNPTC University 国核大学	Jiangxi NPC 江西核电 Guangxi NPC 广西核电 Jilin NPC 吉林核电 Hunan NPC 湖南核电				CNNC Baotou Nuclear Fuel Co.（minor share）中核包头燃料元件股份有限公司（参股）

Nuclear Power Projects of SNPTC SNPTC核电项目

- **Operational capacity with controlling share: 2240 MWe**

  控股运行机组容量224万千瓦

- **Constructional capacity with controlling share: 5860 MWe**

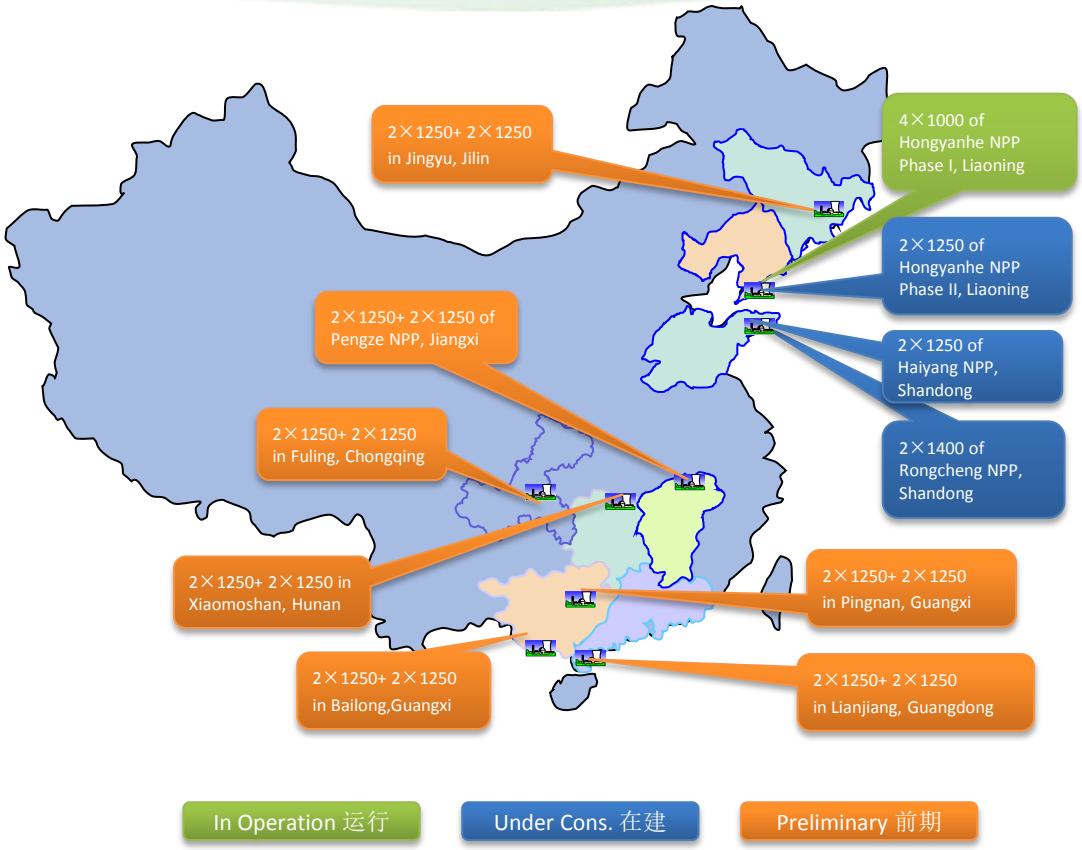
  控股在建机组总容量586万千瓦

- **Reserve a lot of sites with outstanding condition carrying out preliminary work**

  储备了大量优秀厂址正在开展前期开发工作

- **By 2020, SNPTC will have 14 GWe operational capacity and 10 GWe constructional capacity**

  到2020年，投运核电装机容量1400万千瓦，在建核电装机容量达到1000万千瓦。



CONTENTS
目录

AP1000 Self-Reliance Program Supporting Project

AP1000自主化依托项目

- **In 2007, Chinese government decided to introduce the Gen III nuclear power technology AP1000, and appointed SNPTC as the transferee of AP1000 technology. 4 units under construction in Sanmen Zhejiang and Haiyang Shandong are the 1st batch of AP1000 units in the world, and also the supporting projects for the Gen III nuclear power self-reliance program in China.**

  2007年，中国政府决定引进美国西屋公司的AP1000第三代核电技术，并指定SNPTC作为AP1000三代核电技术的受让方。正在浙江三门、山东海阳建设的4台AP1000机组。是世界首批AP1000核电机组，也是我国实现第三代核电自主化的依托项目。

- **Sanmen Nuclear Power Project is developed by CNNC with controlling share. An joint team formed by SNPTC, Westinghouse, and Shaw is responsible for the design, construction and project management of Unit 1 and 2 which are under construction.**

  三门核电项目由中核集团控股开发，正在建设的1、2号机组由国家核电技术公司联合美国西屋公司和绍尔工程公司负责实施自主化依托项目的工程设计、工程建造和项目管理。

- **SNPTC is the owner, constructor and operator of Haiyang Nuclear Power Project. The joint team mentioned above is responsible for the design, construction and project management of Unit 1 and 2 which are under construction.**

  海阳核电项目是国家核电控股开发、建设和运营的项目。正在建设的1、2号机组也由上述联合团队负责工程设计、工程建造和项目管理。

Effect Picture for Sanmen NPP
三门核电厂效果图

Effect Picture for Haiyang NPP
海阳核电厂效果图

Sanmen Unit 1 Progress 三门1号机组建设进展

- **Sanmen Unit 1, as the 1st AP1000 unit in the world, has encountered some difficulties during construction, and these difficulties have been or are being resolved one by one. Currently, the design has been finalized. Main equipment installation generally completed. Bulk material installation has completed 95%. New nuclear fuel has arrived at the site. Many systems have already started commissioning. For the two key equipments restricting the construction, the Squib Valve has already arrived at the site now, and the Re-E&E test for RCP has been completed. The first 2 RCPs are planned to be shipped this Nov. Unit 1 is planned to connect to the Grid before the end of 2016.**

  中国三门#1机组作为AP1000全球首堆项目，在建设过程中遇到很多困难，这些问题已经或正在逐一被解决。目前，设计已固化。主要设备已基本安装就位，大宗材料安装完成95%，新燃料已进场。部分系统已开始调试。制约工程进度的两个关键设备，爆破阀已运抵现场，主泵重新工程和耐久试验已完成，首两台主泵计划于今年11月装船发运。1号机组计划于2016年底并网发电。

- **Through the resolution of all the problems during the 1st AP1000 unit construction, the capacities of SNPTC and Chinese nuclear power equipment manufacturers have been greatly improved.**

  在解决首堆建设出现的各种问题过程中，国家核电及中国核电设备制造企业的能力得到了有力提升。

- **Haiyang #1 is 2 month later than Sanmen #1. The status of the key milestones for 2 units are generally the same.**

  海阳1#机组与三门1#机组关键节点完成情况基本一致，进度偏差在2个月以内。

NI Capping
核岛土建封顶

Main Equipment Set
主设备就位

Main Control Room Available
主控室可用

Electric, I&C Commissioning
电气、仪控调试

New Fuel Arrived
新燃料到场

Half Tube Flushing Completed
半管冲洗完成

Sanmen Project Progress 三门项目建设进展

Haiyang Project Progress 海阳项目建设进展

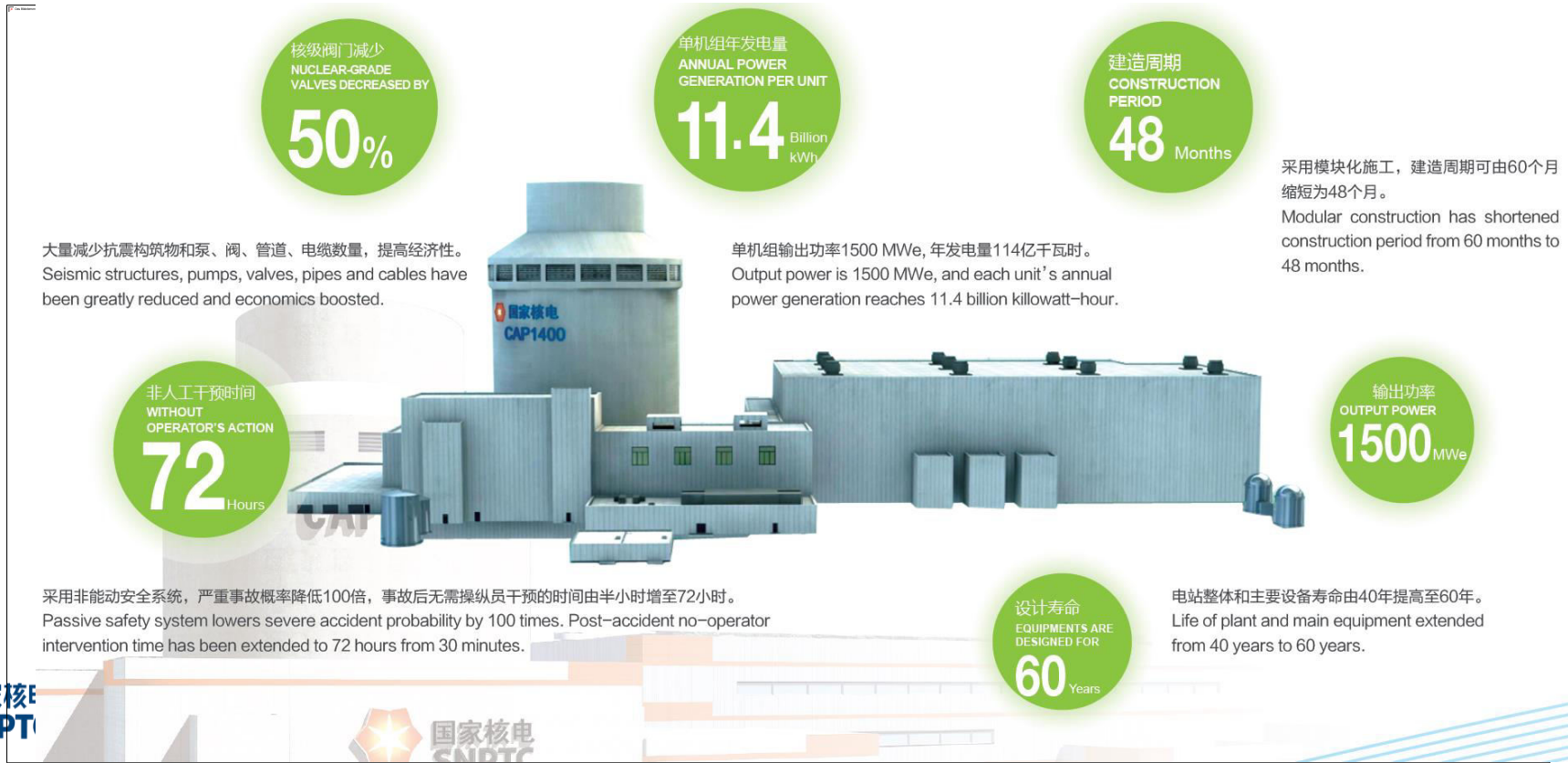
CONTENTS
目录

CAP1400 - Large Scale Passive PWR Technology

CAP1400 – 大型非能动压水堆核电技术

- **Based on China's more than 40 years of experiences in nuclear power R&D, O&M, as well as the introduction and absorption of AP1000 technology, SNPTC has successfully developed the Gen Ⅲ passive PWR nuclear power technology CAP1400 with our own independent intellectual property rights, which meets the world's highest nuclear safety standards and is an important part of China's national energy strategy.**

国家核电在中国40多年核电研发设计和建设运行经验基础上，结合AP1000引进消化吸收，开发了符合目前全球最新核电安全标准、具有自主知识产权的第三代非能动压水堆技术CAP1400，是国家确定的能源战略的重要组成部分。



CAP1400 - Large Scale Passive PWR Technology

CAP1400 – 大型非能动压水堆核电技术

Design Principles 设计原理

1. Adoption of the Latest Nuclear Safety Requirement	适应最新安全标准要求
2. Simplified System and Proven Components	简化系统及采用成熟设备
3. Passive Safety Systems and Severe Accident Prevention and Mitigation Measures	非能动安全系统和严重事故预防和缓解措施
4. Digital Reactor Protection System	全数字化反应堆保护系统
5. Full Range Probabilistic Safety Analysis	全范围概率安全分析
6. Modularization Design and Operation Technology	模块化施工技术
7. Experiences Feedback from Fukushima Accident	福岛核事故经验反馈

Key Performance Index 主要性能指标

Name 名称	Target 指标参数	Name 名称	Target 指标参数	Name 名称	Target 指标参数
Thermal Power 堆芯热功率	4040 MW	Refueling Cycle 换料周期	18 Months 18个月	Time w/o Operator Action 无需人工干预时间	72 Hours 72小时
Electrical Power 电功率	1530 MWe	Core Thermal Margin 堆芯热裕量	≥ 15%	Seismic Condition 抗震条件	0.3g SSE / 0.5g HCLPF 0.3g 安全停堆地震 / 0.5g高可信度低失效概率
Design Lifetime 设计寿命	60 Years 60年	CDF 堆芯融化频率	< 1× 10^{-6} (reactor · year) < 1× 10^{-6} (堆·年)	Primary System 回路设计	2-Loop Configuration 2回路设计
Plant Availability 机组可利用率	≥ 93%	LRF 大量放射性向环境释放频率	< 1× 10^{-7} (reactor · year) < 1× 10^{-7} (堆·年)	Severe Accident Mitigation 严重事故缓解	IVR， Hydrogen Relief Tech etc. 熔融物堆内保持、消氢等技术
Construction Period 建造周期	50 Months 50个月	Safety System 安全系统	Passive 非能动	MOX Fuel Loading MOX燃料装载	Available 可用

Validation and Verification of CAP1400 Design

CAP1400设计试验验证

- **17 tests (including 887 sub-tests) have been completed for verifying CAP1400 design.**
  已完成17项验证试验（包括887个子试验）
- **6 large scale test facilities are used for obtaining key design data.**
  使用6个大型试验设施获取关键数据
- **Design verification and validation has been completed.**
  设计试验验证已完成
- **CAP1400 design has been reviewed by special expert group organized by State Energy Administration.**
  国家能源局组织专家团队对CAP1400设计进行了审查
- **Safety review of CAP1400 has been completed by Regulator (NNSA).**
  CAP1400通过国家核安全局安全审查
- **82% Engineering Drawings have been completed.**
  82%设计图纸已完成

IVP testloop
IVR试验台架

MW Separation testloop
SG汽水分离热态试验台架

ACME testloop
非能动堆芯冷却系统综合性能试验台架

CERT
非能动安全壳冷却系统综合试验台架

Hydraulic simulation testloop
水力模拟试验台架

流致振动试验台架

国家核电 SNPTC

CAP1400 Project Site Preparation

CAP1400工程厂址准备

NI Unit 1

1号核岛

CAP1400 Project Progress CAP1400工程进展

NI
核岛

Apr 2014, NNSA inspected and accepted the foundation pit.
2014年4月国家核安全局验收了基坑

Sep 2014, reinforcement binding completed.
2014年9月完成钢筋绑扎

Dec 2014, protection shelter set up
2014年12月完成防护棚的搭设

CI
常规岛

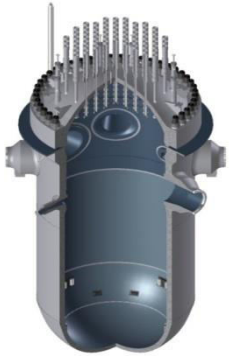
Aug 2014, excavation completed.
2014年8月，完成负挖

Under layer construction
垫层的施工

Apr 25-27 2015, 1st concrete was poured
2015年4月25-27日，第一跨基础混凝土浇筑顺利完成

CAP1400 Key Equipment Manufacture CAP1400主设备制造

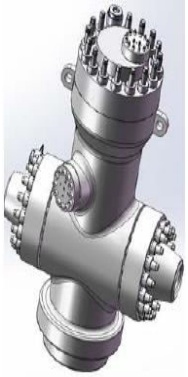
Reactor Vessel

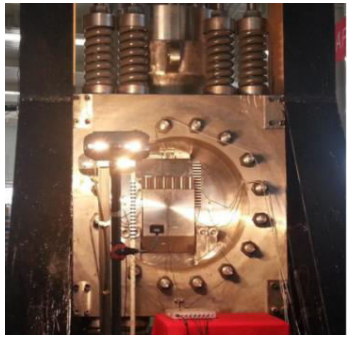



Steam Generator



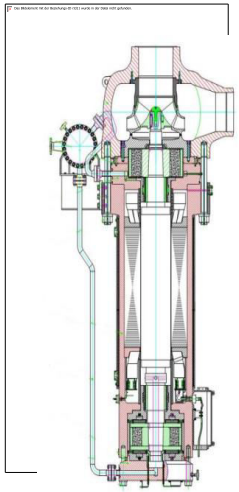

Squib Valve

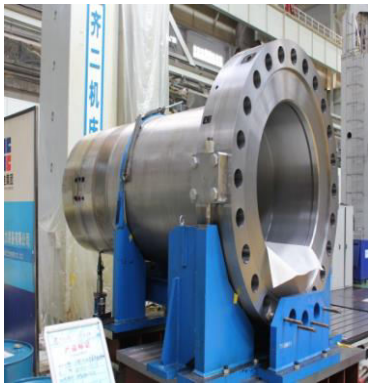


CAP1400 Key Equipment Manufacture CAP1400主设备制造

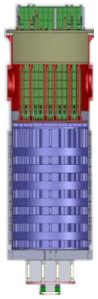
Canned RCP

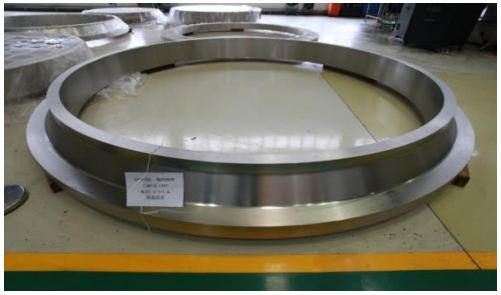




RUV RCP

Reactor Internal





Main Pipe Forging

CONTENTS
目录

Vision for Cooperation with Brazil 与巴西合作愿景

- SNPTC is willing to carry out all-round communication with Brazil energy industry, and expand cooperation opportunities. Both SNPTC and its corporation SPIC are willing to participate in the clean energy investment and development in Brazil, such as nuclear, wind, hydro and solar power.
  国家核电愿与巴西能源界开展全方位交流、拓展合作机遇。国家核电与集团公司国家电投均有兴趣参与巴西核电、风电、水电、太阳能等清洁能源的投资和开发。

- SNPTC is willing to use CAP1400 technology to participate new nuclear projects in Brazil, and to provide “Technology +Localization + Finance + Training” one-stop solution to Brazil.
  国家核电愿以CAP1400技术参与巴西新核电项目建设，为巴西提供“技术+本地化+投融资+人才培养”一站式解决方案。

- Based on our experiences and practices in nuclear industry capability building, SNPTC is willing to cooperate with Brazil nuclear industry, drive and support the development of the nuclear industry system in Brazil.
  国家核电愿利用自身核电产业能力建设的经验与实践，与巴西核电界开展合作，带动并支持巴西本国核电产业体系提升。

Vision for Cooperation with Brazil 与巴西合作愿景

- SDEPCI, a subsidiary of SNPTC, is the EPC contractor constructing Tractebel Energia's UTE Pampa 340MW thermal plant, using the clean coal-fired power generation technology.

  国家核电所属企业山东院使用清洁燃煤技术正在为Tractebel Energia公司EPC总承包建设UTE Pampa 340 MW 燃煤电站。

- SNPTC has already established Brazil Office, please don't hesitate to contact:

  Mr. FENG Lin (Deputy Chief)

  fenglin@snptc.com

  Ms. YANG Zhe (Marketing Manager)

  yangzhebrazil@snptc.com

  国家核电已在巴西设立代表处，请随时与我们联系。

国家核电
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Safe Nuclear Energy
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Thank you！