



EPR Projects: Updates

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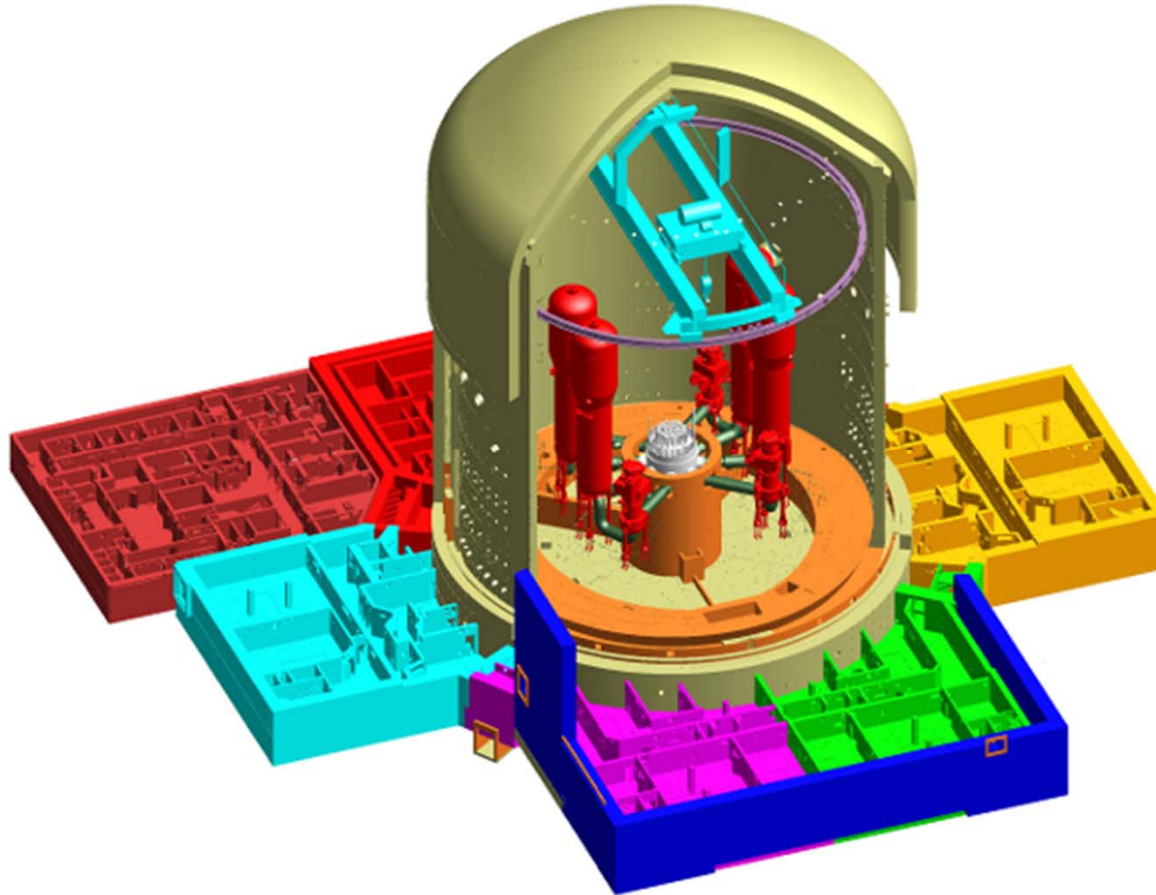
Presented at SC-2, Meeting 11-01
June 15-17, 2011, Gothenburg, Sweden



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Overview of U.S. EPR™ Reactor

- ▶ Redundant safety systems are physically separated into four divisions, which protect the individual integrity of the electrical and mechanical safety systems.



The four divisions of safety systems are consistent with an N+2 safety concept.

One division can be out of service for maintenance

One division can fail to operate

The remaining two divisions are available to perform the necessary safety functions even if one of the two remaining trains becomes inoperable due to the initiating event.

Overview of the U.S. EPR™ Design

- ▶ Evolutionary 4-loop PWR designed for a rated core thermal power level of 4590 MWt.
- ▶ The U.S. EPR™ unique design features include:
 - ◆ Four redundant trains of emergency core cooling.
 - ◆ Containment and shield building.
 - ◆ Core melt retention system for severe accident mitigation.
- ▶ The plant design objective is 60 years. The design provides for the replaceability of major components, including the steam generators.
- ▶ The Reactor Building is an integrated structure consisting of an inner Reactor Containment Building, an outer building called the Reactor Shield Building, and an annular space between the two buildings that separates them for protection against external hazards (including aircraft impact).

Highlights of Recent U.S. EPR Activity General



- ▶ **The U.S. EPR design application is currently under NRC review.**
 - ◆ **A total of 4140 formal RAIs and 180 open items have been received as of April 22. AREVA has responded to 3846 questions and 130 open items.**
 - ◆ **Phase 1 review of the application, i.e., preliminary SER and all RAIs issued, was completed on 1/28/09. Phase 2 review (i.e., development of the SER with open items) and Phase 4 (i.e., development of the Advanced SER with no open items) on some sections is currently in progress.**
 - ◆ **A total of eleven chapter SERs with open items and three partial SERs with open items have been received to date and thirteen associated ACRS meetings completed.**
 - ◆ **Schedule date for NRC approval of the design application is June 2012.**
 - ◆ **Key issues involve Seismic and Structural Analysis, I&C, and resolution of GSI-191 related to sump strainer clogging.**
 - ◆ **Of the 11 active topical reports, 6 have been approved, 4 have been issued a draft SER, and 1 is under active review.**

Regulatory Status Regarding ASME QME-1 2007



- ▶ **NRC issued revision 3 of RG 1.100 in September 2009 which endorses ASME QME-1-2007 with exceptions and clarifications (e.g., use of either earthquake experience data or test experience data for seismic qualification needs to be submitted for NRC review and approval).**
- ▶ **AREVA uses ASME QME-1-2007 as guidance for qualifying active mechanical equipment with the exception that a separate mechanical equipment qualification (MEQ) program for the U.S. EPR™ design will not be maintained as noted in U.S. EPR™ FSAR Tier 2, Section 3.11.2.2 for nonmetallic subcomponents.**

Engineering Implementation of ASME QME-1 2007



- ▶ **IEEE Standards 323-1974, 334-2006, 344-2004, and 382-2006 are used for qualification.**
- ▶ **Environmental Qualification (EQ)**
 - ◆ **EQ of electrical appurtenances meets the requirements of IEEE 323-1974.**
 - ◆ **EQ of the valve actuator meets the requirements of IEEE 382-2006.**
 - ◆ **EQ of the pump motor meets the requirements of IEEE 334-2006.**
 - ◆ **EQ of the valve is limited to the nonmetallic parts of the valve. EQ follows the guidance of non-mandatory Appendix QR-B of QME-1 for nonmetallic parts of the valve.**

Engineering Implementation of ASME QME-1-2007



- ▶ **The AREVA position regarding QME-1-2007 has been documented in an internal AREVA NP position paper. Design Specifications ensure consistency with regard to the application of QME-1-2007.**

- ▶ **Examples of design specifications that refer to QME-1-2007:**
 - ◆ **ASME Class 1 Valves**
 - ◆ **ASME Class 2 and 3 Valves**
 - ◆ **ASME Section III Pump/Motor Assemblies**
 - ◆ **Control Rod Drive Mechanism**
 - ◆ **Main Steam and Full-Load Feedwater Isolation Valves**
 - ◆ **Pressurizer Safety Relief Valves**
 - ◆ **Pressurizer Solenoid Spray Valve**

FSAR Incorporation of ASME QME-1-2007 Elements



- ▶ Elements of QME-1-2007 have been incorporated into the U.S. EPR™ FSAR.
- ▶ U.S. EPR FSAR Tier 2, Table 1.9-2 was revised to change the reference from RG 1.100, Revision 2 to Revision 3.
- ▶ The following FSAR Sections have been revised to indicate that the functional design and qualification testing of safety-related pumps, valves, and snubbers is performed in accordance with ASME QME-1-2007 as endorsed by RG 1.100, Revision 3, with clarifications regarding the non-mandatory appendices of ASME QME-1-2007:
 - ◆ 3.9.3, “ASME Code Class 1, 2, and 3 Components, Component Supports, and Core Support Structures”
 - ◆ 3.9.6.1, “Functional Design and Qualification of Pumps, Valves, and Dynamic Restraints”
 - ◆ 3.10, “Seismic and Dynamic Qualification of Mechanical and Electrical Equipment”
 - ◆ 3.11, “Environmental Qualification of Mechanical and Electrical Equipment”

FSAR Incorporation of ASME QME-1-2007 Elements



- ▶ **Consistent with RG 1.100 Rev. 3, U.S. EPR FSAR Tier 2, Section 3.10 addresses the applicability of the non-mandatory appendices of QME-1-2007. Examples are listed below:**
 - ◆ **Non-mandatory Appendix QR-A is not utilized because seismic qualification is in accordance with IEEE 344-2004, which is consistent with QME-1-2007. Additionally, Section 10.2, Earthquake Experience Data, QR-A7400 and QR-A7500, is not utilized by AREVA .**
 - ◆ **Qualification of non-metallic parts is consistent with non-mandatory Appendix QR-B as described in FSAR Section 3.11.**
 - ◆ **The provisions for the design and qualification of snubbers is consistent with Section QDR and non-mandatory Appendices QDR-A, QDR-B, and QDR-C. Snubbers in safety-related systems include provisions to allow access for IST program activities.**
 - ◆ **AREVA is not utilizing non-mandatory Appendices QP-A through QP-E, because pump and motor assemblies are designed and qualified in accordance with applicable standards (e.g., ASME B&PV Code, QME-1, ASME B16, IEEE 323, IEEE 334, IEEE 344, RG 1.84, ASME NQA-1).**
 - ◆ **Non-mandatory Appendix QV-A, “Functional Specification for Active Valves for Nuclear Power Plants,” is used as guidance in the development of valve specifications to demonstrate that lessons learned from industry experience are included in the specifications.**

EPR Projects

4 EPR™ Reactors under construction



Flamanville 3



Olkiluoto 3



Taishan 1&2





Olkiluoto 3 Project Update

March 2011



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General Orientation – Olkiluoto Island



Benefits for the local region's economy



▶ **Benefits during construction works**

- ◆ **On employment: 3,500-6,000 people employed directly or indirectly**
- ◆ **Unemployment rate halved in comparison with 2004**
 - **Eurajoki: 6,4%, among the lowest unemployment rates in Finland**
- ◆ **On production: 200-400 million euros**
- ◆ **Gross Domestic Product of the region increased by 2,6%**
- ◆ **180 companies in Satakunta region involved**
- ◆ **Annual turnover increase in construction sector over 2006/2007 +29,4%**

▶ **Permanent benefits**

- ◆ **Yearly increase of procurement amounts and needs for external services**
- ◆ **Larger yearly NPP revisions – hundreds of external subcontractors**
- ◆ **Increase in knowledge and other human values**
- ◆ **Impact on taxation (Eurajoki – see also next page)**

Benefits for the local region's economy



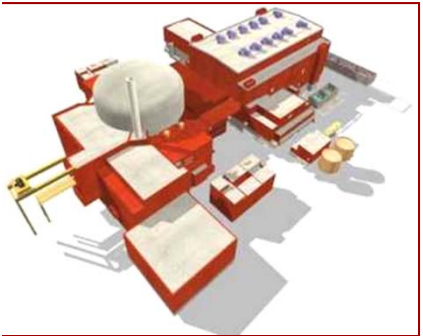
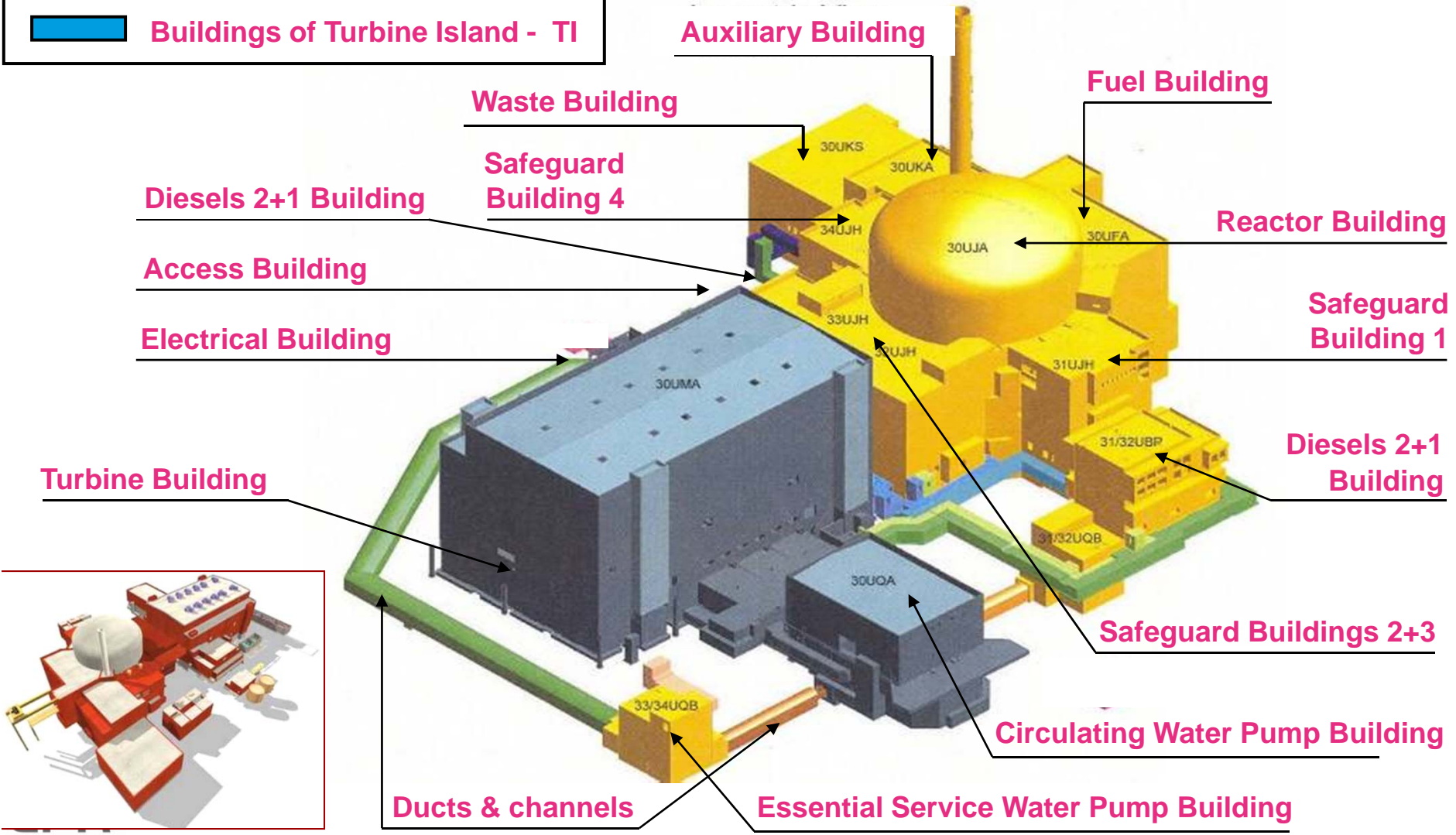
► Taxes, services and housing sector

- ◆ Increased estimate of municipal tax (workforce needed for operations) by ~ 60% in Rauma and 25% in Eurajoki for a national average of 5%
- ◆ Income taxes represent around 14-15 millions €, which is over 30% of the total collected taxes
- ◆ Estimated increase of real estate tax of nuclear power from ~ 3 million to ~ 7-8 million € by 2011
- ◆ Clear current national boom in housing industry
- ◆ Utilization rates in region's hotels exceeding +60%
- ◆ Significant increase in services such as: restaurants, retail trade, etc.



NI/TI Buildings

	Buildings of Nuclear Island - NI
	Buildings of Turbine Island - TI



by AREVA

General view of NI



by AREVA

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Turbine Hall (UMA)



by AREVA

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NI Progress



▶ Construction

- ◆ ~ 57% completed
- ◆ External dome to be completed by June
- ◆ Total of 270,000m³ to be poured (NI + TI: 336,000m³)
- ◆ Pre-stressing completed
- ◆ 80% backfilling completed
- ◆ Electro-mechanical activities
 - 580km of cables pulled
 - 64% progress for HVAC
 - 42% of piping installation completed
 - 87% piping-related equipment installed
- ◆ Primary components installation completed: Reactor Pressure Vessel and closure head, Pressurizer, 4 Steam Generators

▶ Tests and commissioning ramping-up

- ◆ Documentation: 137 System Commissioning Programmes out of 158 issued
- ◆ Polar crane and auxiliary crane pre-operational tests completed

OL3 I&C

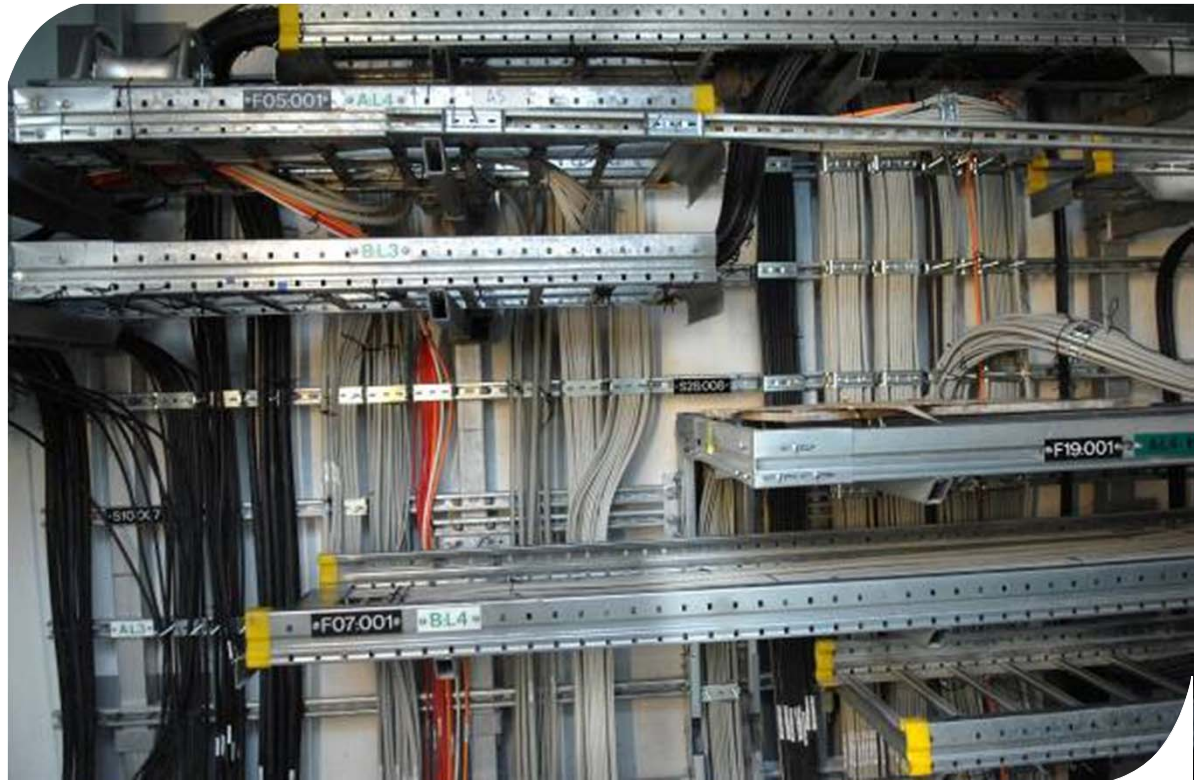
Overall status



- ▶ **Architecture accepted by STUK, regulator, with application of conditions**
 - ◆ **Systems independency for safety and process functions**
 - ◆ **Hardwire Back-up System (HBS)**
- ▶ **Overall test concept to be approved by TVO, utility, as soon as possible**
- ▶ **I&C time schedule under reassessment**
- ▶ **Local platforms on site for modifications during Commissioning**
- ▶ **Full scope simulator**
 - ◆ **Delivery to site Spring 2011**

Electro-mechanical installation

Electrical installation progress

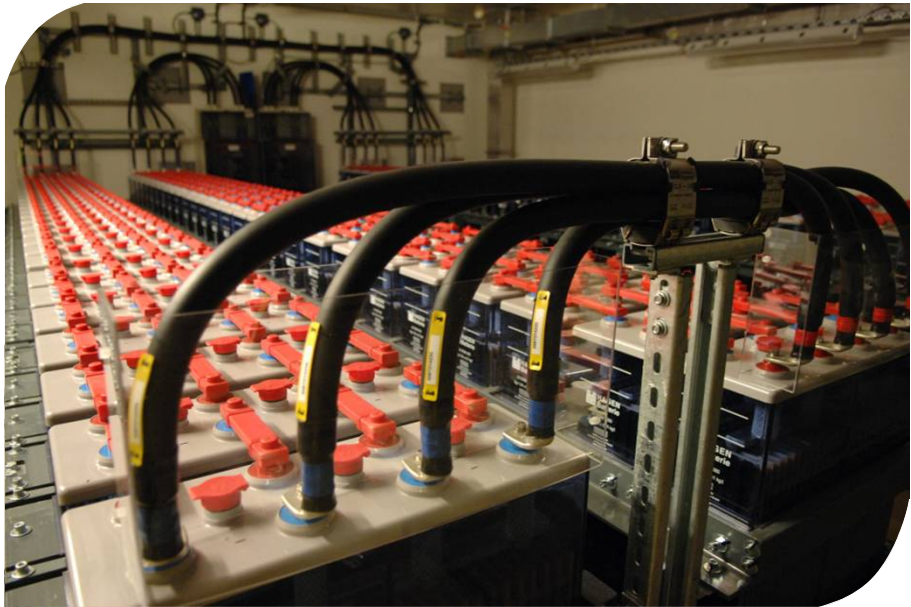


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Electro-mechanical installation

Battery Room



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Electro-mechanical installation TELEPERM™ XS Cabinets

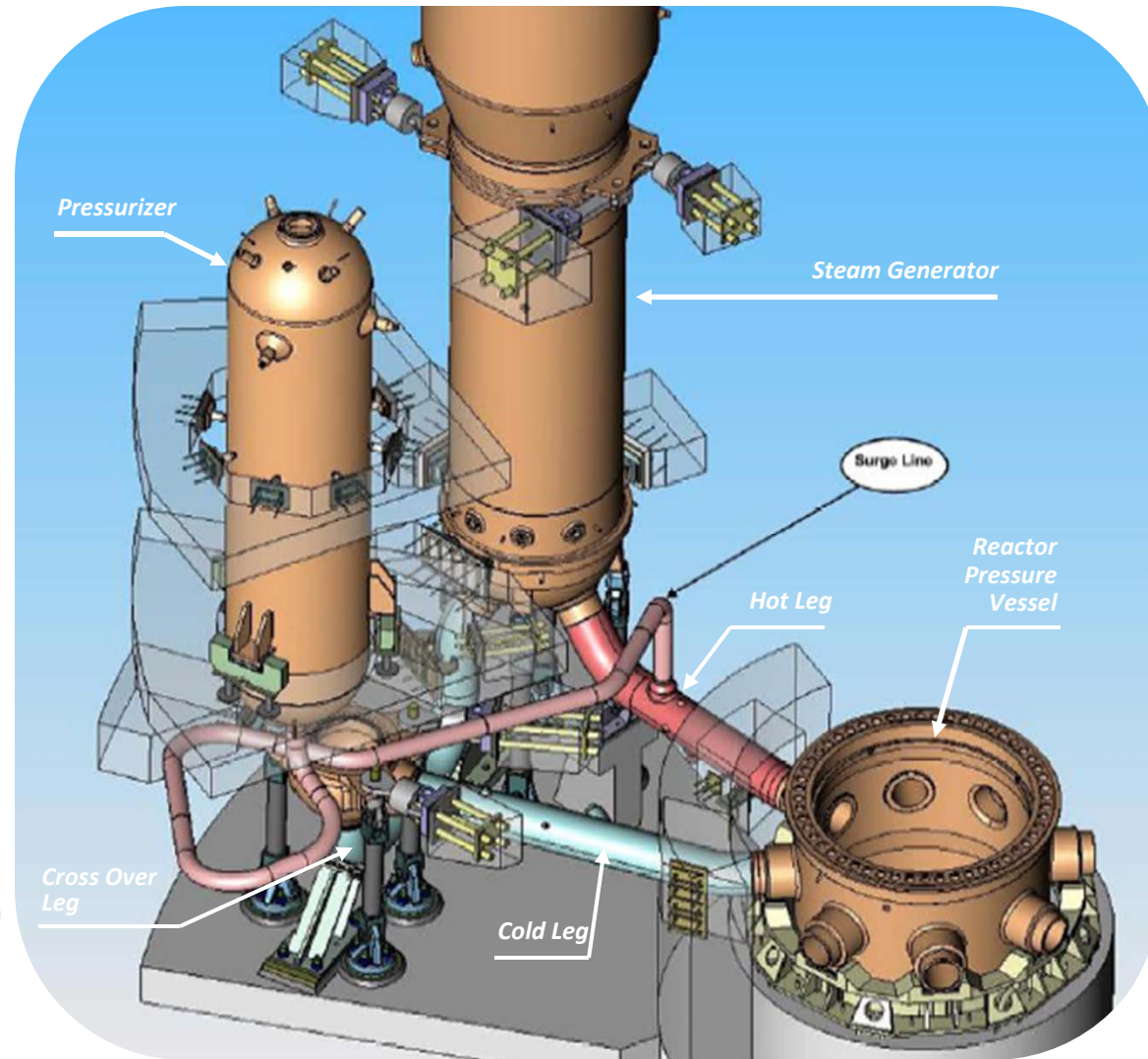


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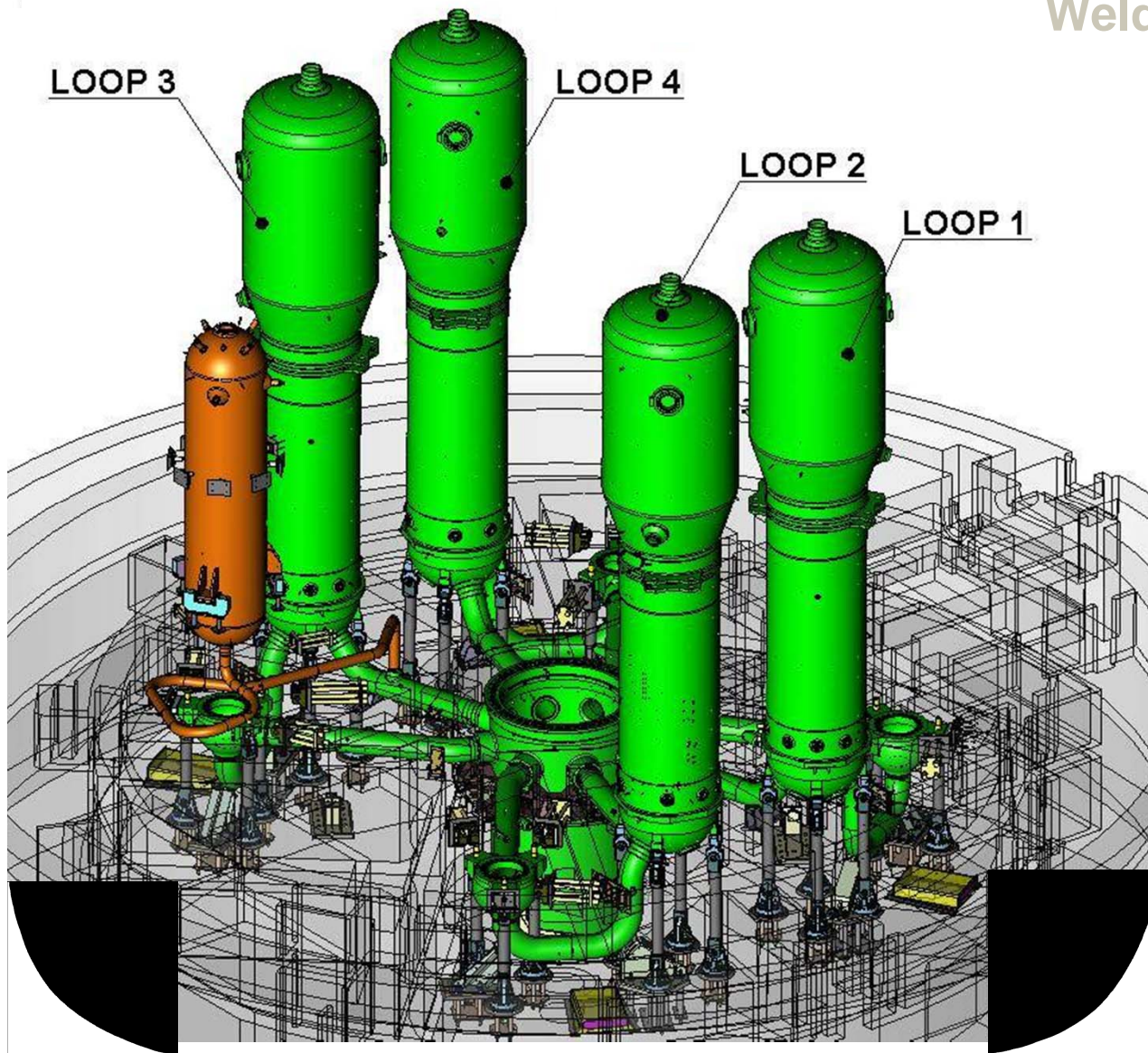
Primary Circuit

Complete loop



Primary circuit

Welding completed



 *Welding completed*

 *Welding ongoing*

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Primary components

Installation of Steam Generators



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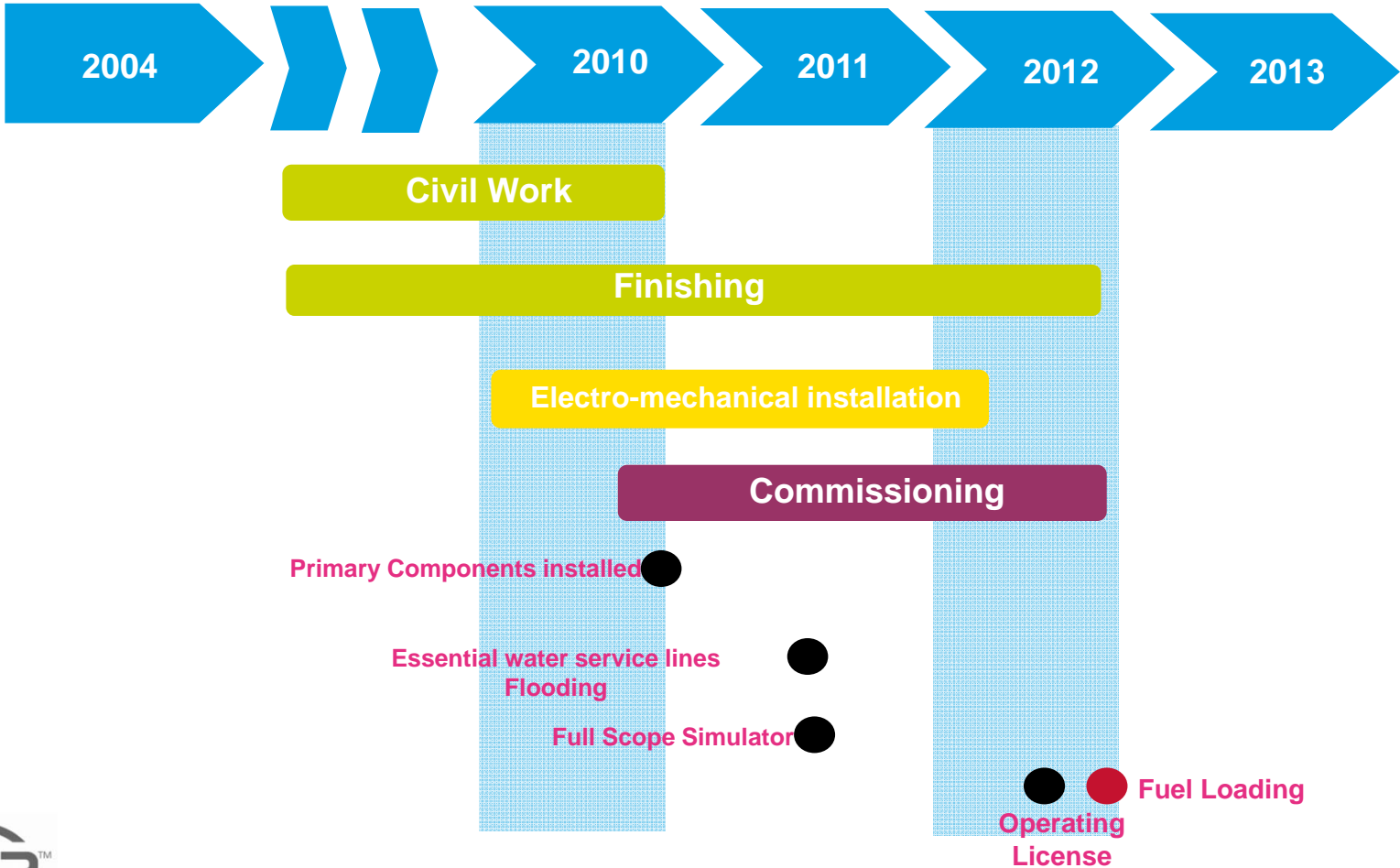
Manpower/Nationality

February 2011



Country	% of site population
Finland	29%
Germany	19%
Poland	18%
Croatia	9%
France	6%
Estonia	4%
Bosnia and Herzegovina	2%
Others	12%

OL3 General time schedule



Next steps 2011



- ▶ **Completion of outer dome**
- ▶ **Completion of the primary circuit**
- ▶ **Completion of electro-mechanical installation**
- ▶ **Pre-operational tests & Commissioning ramping up**
 - ◆ **Configuration management implementation**
 - ◆ **Integration of TVO staff in Operation Integrated Organization**
 - ◆ **86% of System Commissioning Program issued**

» **Objectives: Fuel loading end of 2012**



“AREVA and the companies operating in the background are still the world’s leading nuclear suppliers. They have the best and safest product. We have no reason to doubt it and we have no reason to doubt their honesty either.” Jukka Laaksonen, STUK Director, on Finnish TV channel MTV3, August 22, 2008



***“The EPR™ is the most advanced technology worldwide.”
Martin Landtman, Senior Vice President, Project OL3, TVO, in Handelsblatt,
Germany, August 13, 2007***

Flamanville 3 Project Progress of the works

April 2011



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EPR™ Flamanville 3 Project



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SC-2/11-01 - June 15-17, 2011

FA 3 Site Progress April 2011



Scope of Work

- ▶ **AREVA is responsible for the turnkey NSSS, including design, procurement, erection and commissioning work**
 - ◆ Similar scope compared to previous series (N4 was a reference for contractual aspect)
 - ◆ Civil works awarded to Bouygues, turbine island to Alstom
- ▶ **April 11, 2007: Contract signed between EDF and AREVA**
- ▶ **April 10, 2007: Approval of the construction permit**
- ▶ **December 3, 2007: First concrete pouring**
- ▶ **2014: Start of commercial operation**



Project progress

▶ Achieved and ongoing deliveries:

- ◆ IRWST lines
- ◆ Primary anchors
- ◆ Embedded excore tubes & tanks
- ◆ RPV support ring and reactor vessel-to-cavity seal ring
- ◆ Auxiliary racks
- ◆ Venturi Tubes (diameter: 250mm et 500mm)
- ◆ Various sensors
- ◆ SIS Pumps
- ◆ Valves
- ◆ SIS Accumulators
- ◆ SIS Exchangers
- ◆ Some valves



Flamenville
site,
April 2011

▶ Installation:

- ◆ Installation of the first embedded tanks (RPE, Pressurizer Relief Tank), first pumps (SIS pumps) and first exchangers (SIS exchangers)
- ◆ Welding of the first supports at the end of 2010.

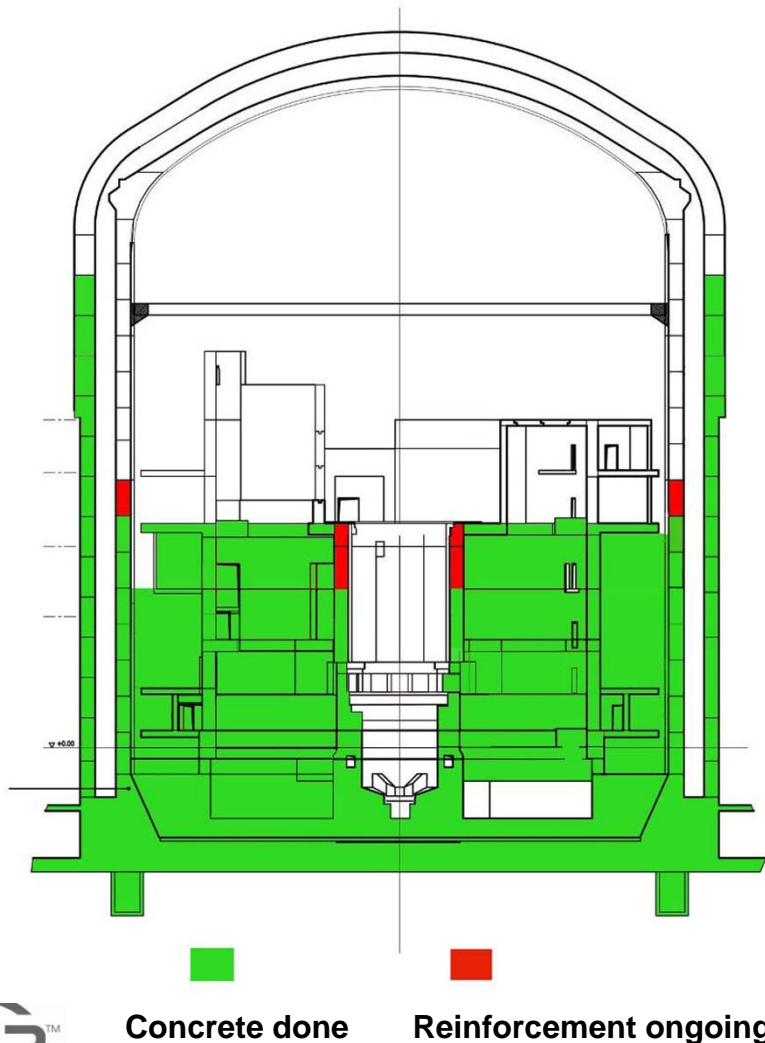
▶ The Safety Analysis Report (SAR) for the Operating License Application has been delivered in October 2010.

▶ Manufacturing of primary components is on going.



Engineering and procurement are on track with the customer's schedule.

Reactor building Civil Work progress



▶ Civil work under EDF responsibility

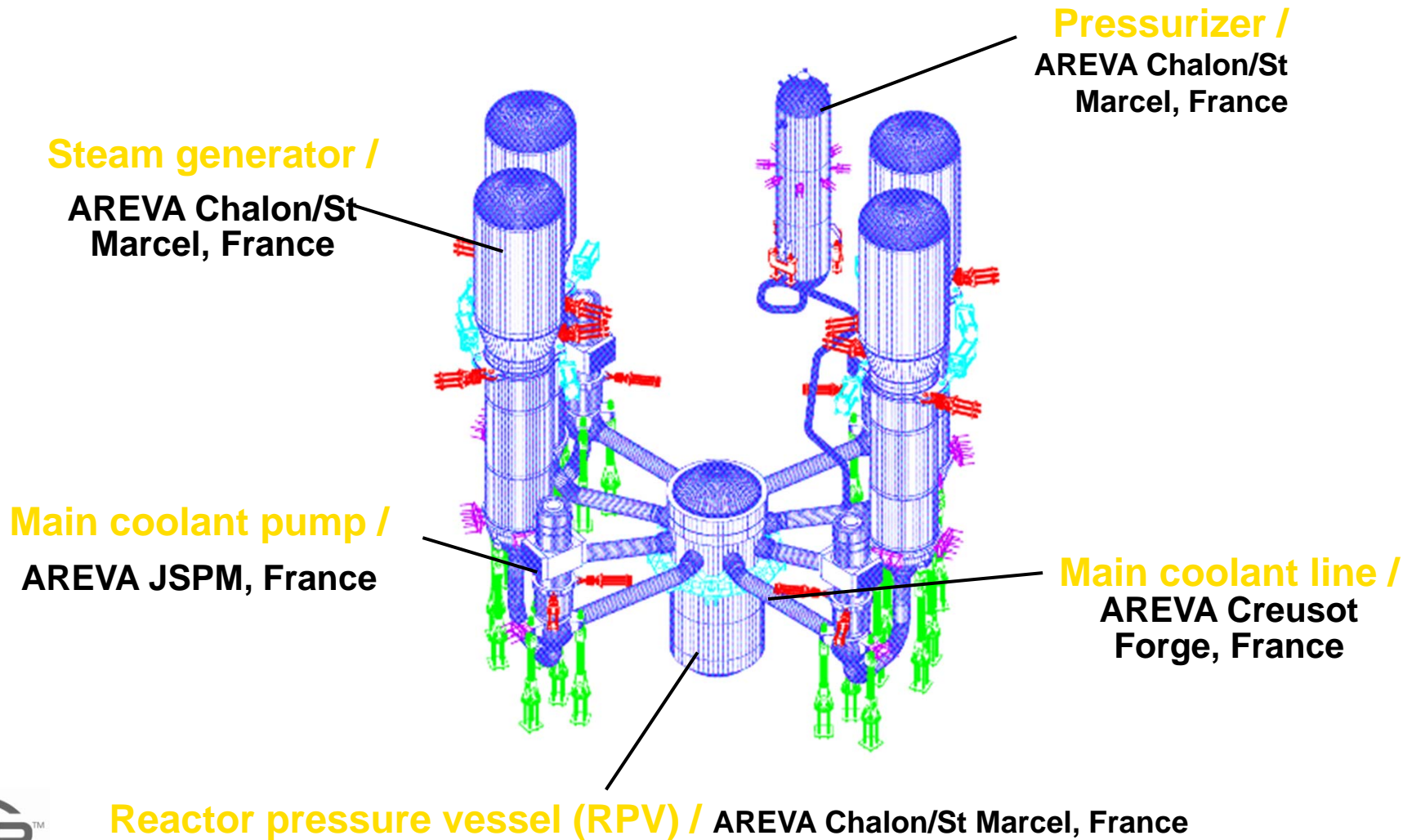
- ◆ Tenth lift of the outer containment done since august 2010
- ◆ 8th lift of the inner containment done.
- ◆ The walls of the pools are almost finished

▶ The Reactor Building re opened.

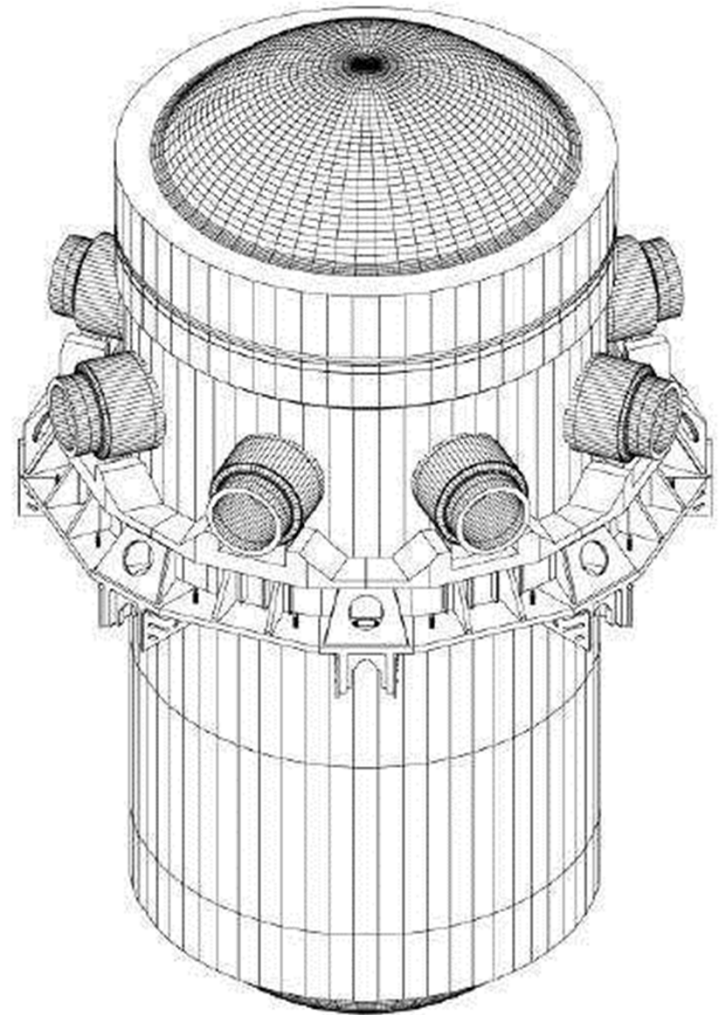
▶ Current progress:

- ◆ Vessel, Steam Generators and Pressurizer are under manufacturing in AREVA Chalon/St Marcel, France
- ◆ First supports welded end of 2010.

Main components



Equipment Manufacturing: Reactor Pressure Vessel



AREVA Chalon/Saint Marcel

Heat exchanger in the auxiliary safeguard building



welding of supports for cable paths in auxiliary safeguard building



Cables in the electrical building



Pipes coming in and out of the turbine



Taishan 1&2 Project



Taishan Project - General View



Taishan 1&2



September 2009



The largest contract ever signed in the civil nuclear industry





Taishan 1&2 Project Progress of the works

台山

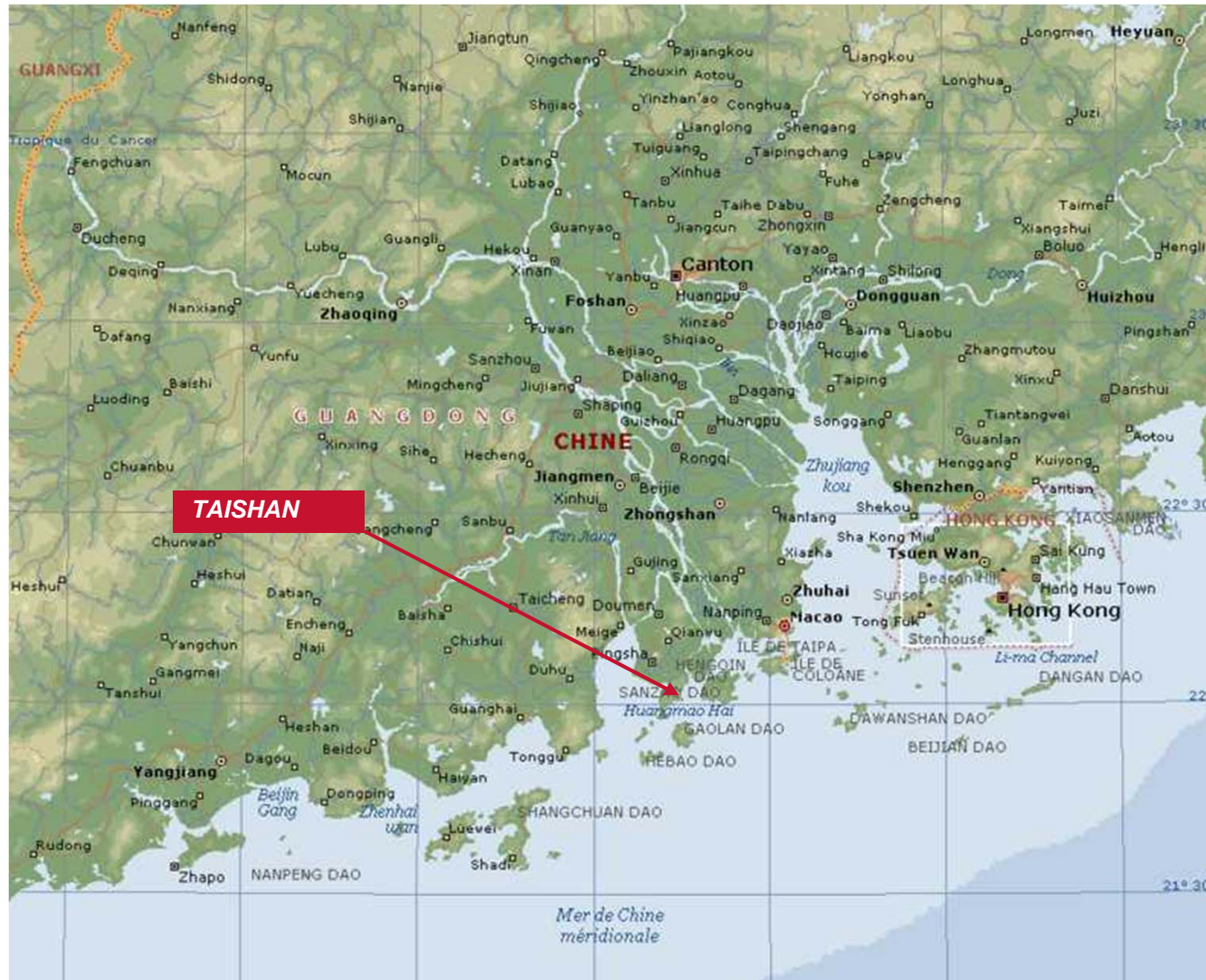
February 2011



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Site location



Taishan 1 & 2 – Progress update



TSN 1&2 Key Facts

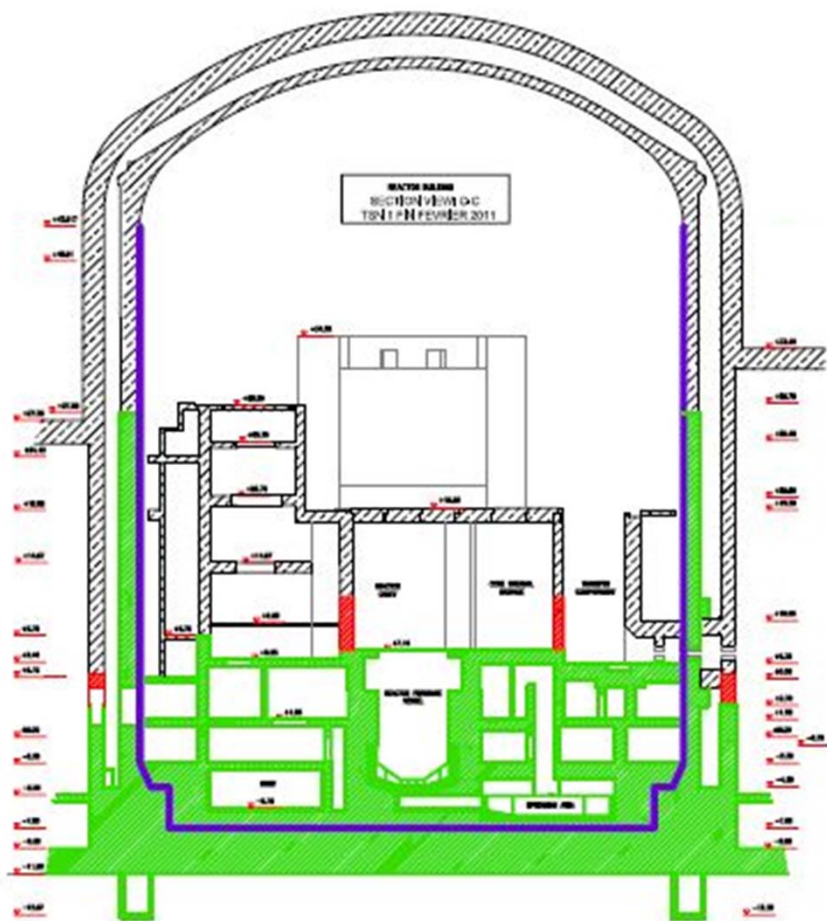
- ▶ **AREVA scope**
 - ◆ Procurement: 80% orders made
 - ◆ Engineering: 60% completed
 - ◆ All main components are being manufactured
 - ◆ Engineering JV with CGNPC set up successfully

- ▶ **Outside AREVA scope**
 - ◆ Unit 1: Liner up to +43,90m
Almost ready for dome lifting
Inner wall concreted up to +25.00m
 - ◆ Unit 2: common raft poured in April 2010
Liner installed up to +12m
 - ◆ Piping prefabrication started by the Client based on AREVA design

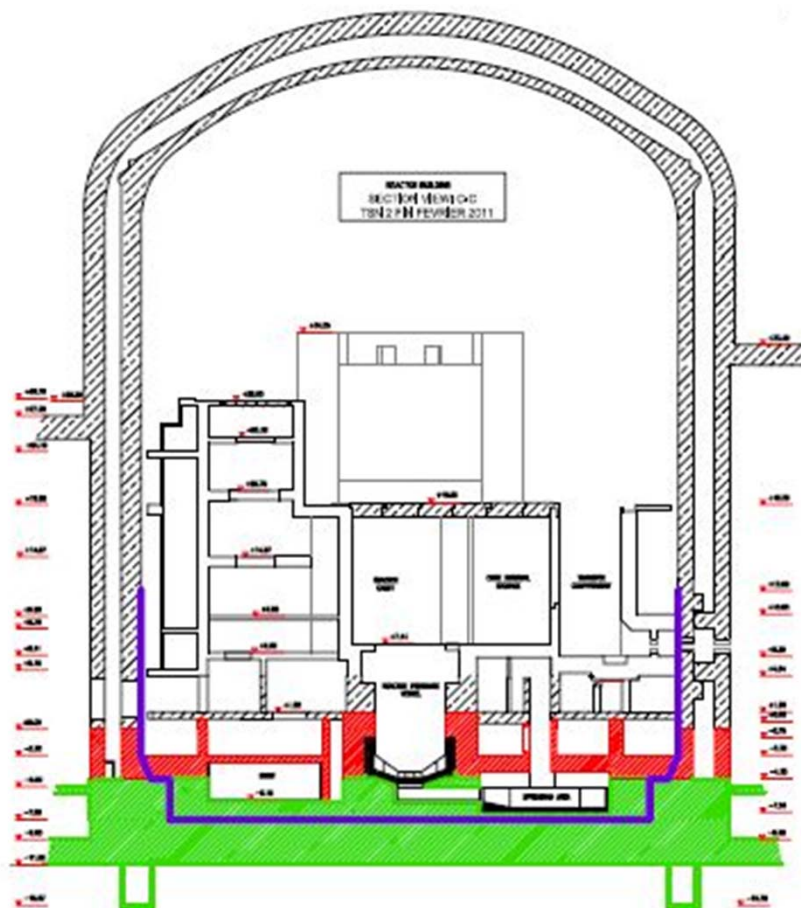
- ▶ **More than 12,000 people are working on site every day**

Taishan Reactor Building Progress

February 2011 – Unit 1



February 2011 – Unit 2



Achievements to date



► Engineering

- ◆ PSAR & licensing activities are well on track with NNSA
- ◆ Project is now more than mid way and more than 60% of engineering activities are completed
- ◆ Basic Design is in an ending phase and gives path to the detail design currently under progress within the JDO organization set-up in China mid 2009 (for Piping and Electrical)
- ◆ Civil work detail design for Reinforcements & Formworks very close to Nov. 2011 forecast

► Procurement

- ◆ Order placement is about to be finished by first months of 2011
- ◆ Polar Crane manufacturing activities at DHI/DCW .
- ◆ CNPEC is improving its efficiency in terms of expediting & inspection.

► Site activities

- ◆ The AREVA NP site related activities are evolving with the mobilization of Design Liaison Team and ongoing discussions on possible technical assistance for installation and commissioning.

Project overview

Customer CGNPC



- ▶ **CGNPC – China Guangdong Nuclear Power Holding Corp. Ltd.**
- ▶ **One of the 5 Chinese Electrical Companies**
- ▶ **Developing a nuclear program historically in the Guangdong province (Daya Bay, Ling Ao I&II...) and now in other provinces**
- ▶ **Capital: CNNC (45%), Guangdong Province (45%) & China Power Investment (10%)**
- ▶ **Today, CGNPC wants to create its own nuclear industry to position itself as the major player of the electronuclear development in China**
- ▶ **CGNPC involves many of its own subsidiaries into the Taishan Project, among them; China Nuclear Power Engineering Company (CNPEC) and China Nuclear Power Design Company (CNPDC)**

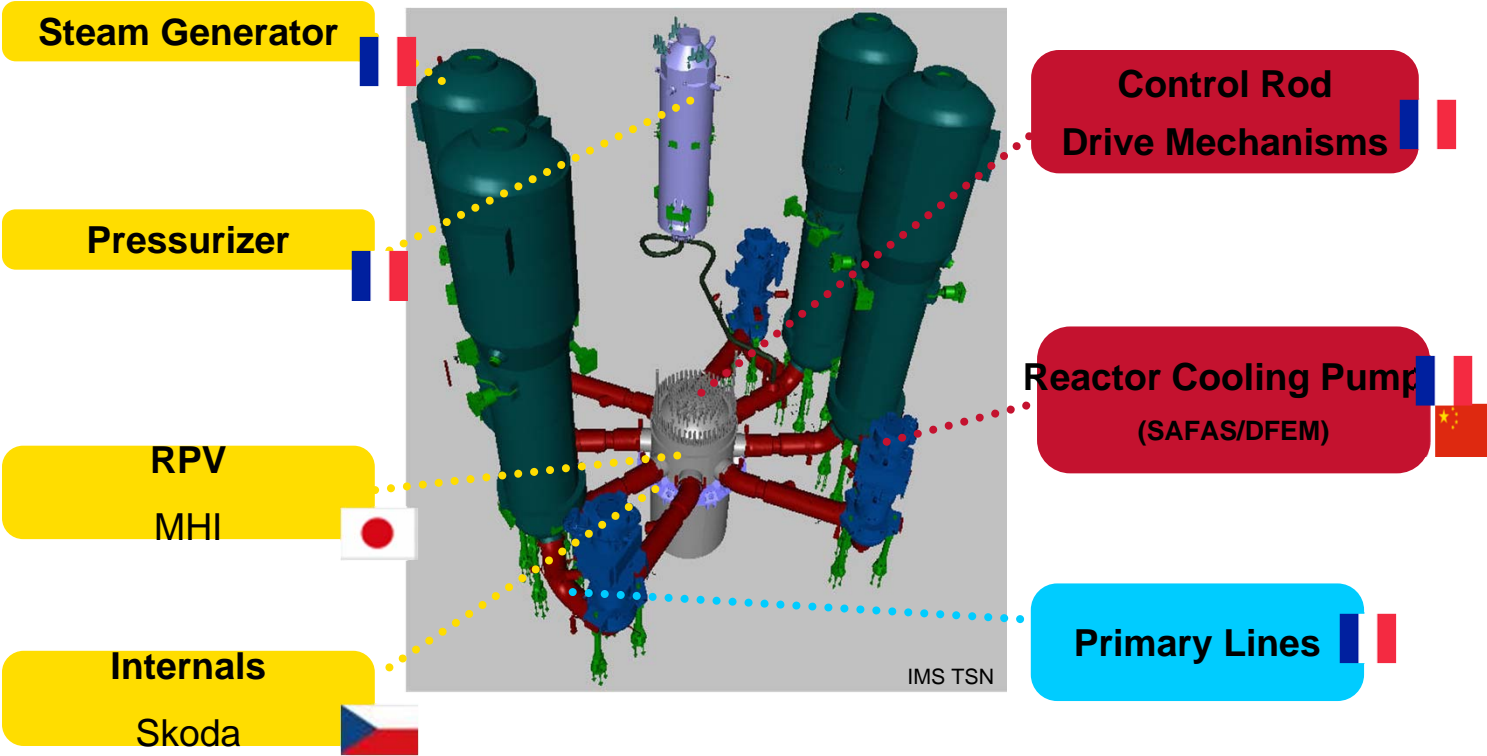
Overview of NI EP Contract



- ▶ **Contract signed between TNPJVC & AREVA/CNPEC/CNPDC Consortium**
- ▶ **Contract structure and principles based on Ling Ao phase I**
- ▶ **Scope**
 - ◆ **Design & Engineering of NI**
 - ◆ **FOB Supply of the Equipment (or Ex-Works for China)**
 - ◆ **Technical Assistance (upon demand)**
 - ◆ **Civil work detailed design (confirmed at contract's signature)**
- ▶ **First options to be confirmed**
 - ◆ **Primary loop erection and commissioning (EM2/EM11.2 package)**
- ▶ **Civil construction, Installation & Commissioning performed by TNPJVC**
- ▶ **Technical Assistance (upon demand) on installation, commissioning, civil, maintenance, operation, etc.**
- ▶ **Turbine island: Consortium Dongfang/Alstom**
- ▶ **Reference power plant: mainly FA3**
- ▶ **Project duration: 76 months (24+52 months) with 10 months difference between the 2 units**

Primary Loop for Taishan Unit 1

■ Contrat
 ■ Chalon Saint-Marcel
 ■ JSPM
 ■ Creusot Forge



Primary Loop for Taishan Unit 2



Pressurizer
DFHM

Steam Generator
SENPEC / DFHM

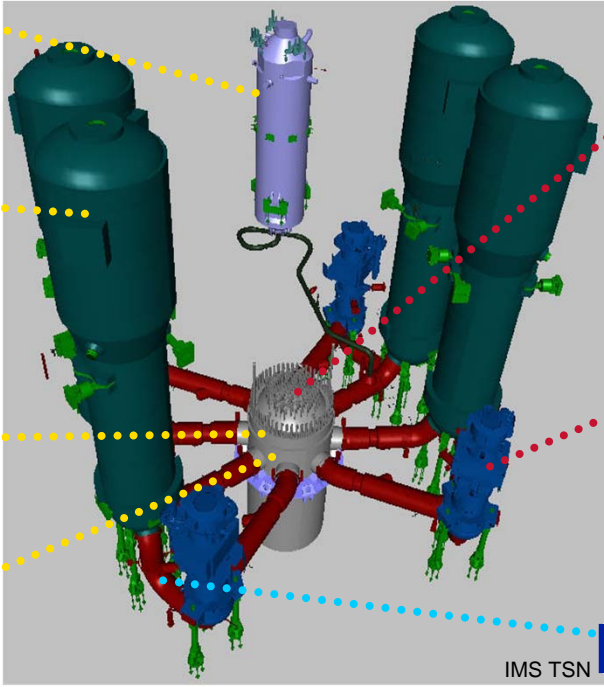
RPV
DFHM

Internals
Shanghai Number 1

Control Rod Drive Mechanisms
JSPM / Shanghai Number One

Reactor Cooling Pumps
JSPM / ADJV / DFEM / SAFAS

Primary Lines



Key figures

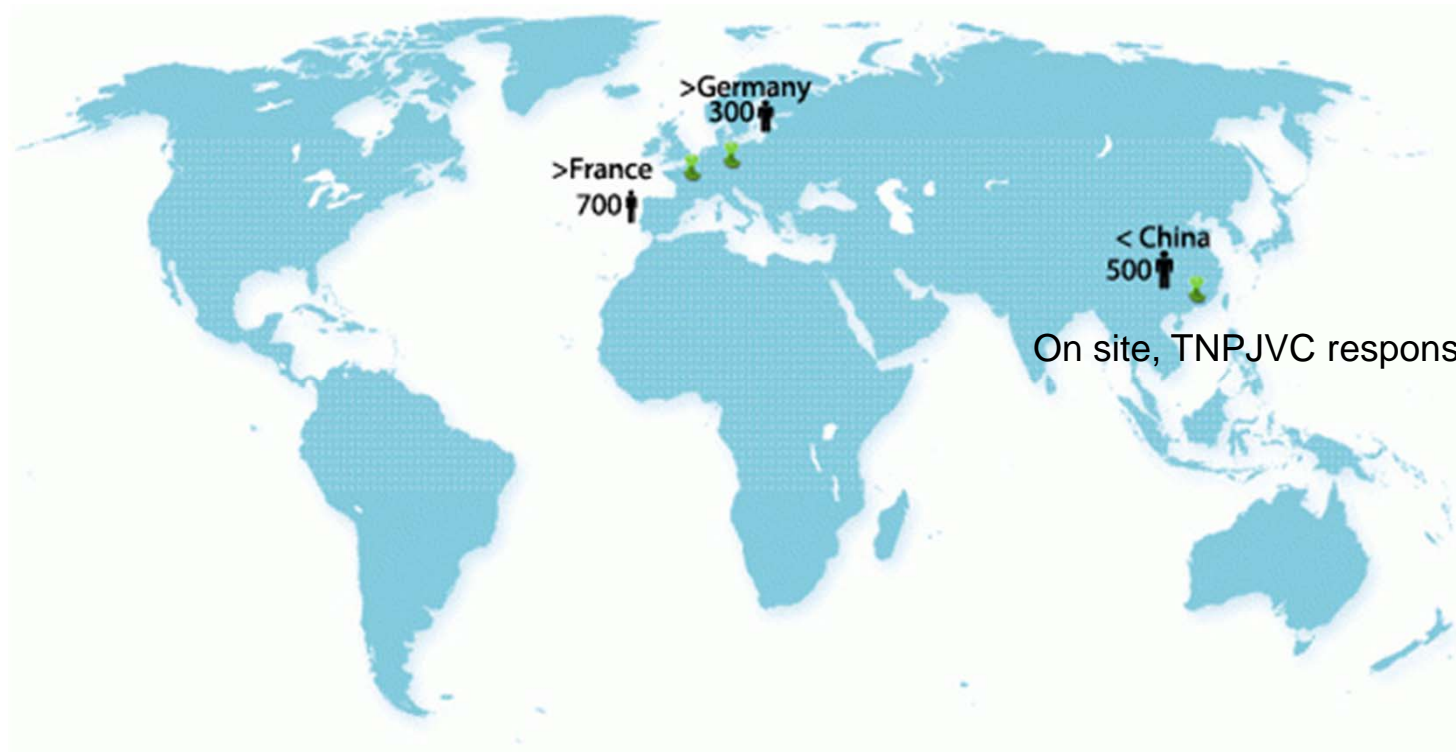


- ▶ **125,000 documents**
 - ◆ 7,000 civil works drawings
 - ◆ 400 technical files for requisition
 - ◆ 220 system Design Manuals
 - ◆ 500 installation instructions
 - ◆ 150 working procedures
- ▶ **Piping**
 - ◆ 72 Km Large Bore / 150 Km Small Bore
- ▶ **Electrical**
 - ◆ 45,000 cables / 90,000 heads
 - ◆ 400,000 connections points
 - ◆ 3,500 Km cables
 - ◆ 60 Km Main Cable Trays / 20 Local Cable Trays
 - ◆ 14,000 supports
- ▶ **Total weight equipments: 10,000 T**

Great amount of resource is mobilized



More than 1,500 people working for the NI EP Consortium
1,000 AREVA and more than 500 CNPDC/CNPEC



On site, TNPJVC responsibility: 12,000 people

Next steps 2011



Deadlines

Next steps

- | | |
|----------------|--|
| ▶ May 2011 | ▶ Delivery of Civil Dependant equipment for Dome Lifting (Polar crane, RCP / RIS...) |
| ▶ July 2011 | ▶ Dome Lifting |
| ▶ October 2011 | ▶ Reactor Pressure Vessel (FOB) boarding from MHI Japan to Taishan China |
| ▶ End 2011 | ▶ Primary Loop installation starts |