

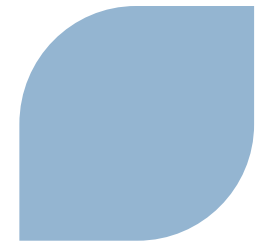
AREVA

Advanced nuclear power plants

Bernard Bastide

AREVA Brasil and South America

University of Sao Paulo, CTMSP workshop on Innovations in Nuclear Technology in 2012



- ◆ **AREVA presentation**

- ◆ **Safety of existing nuclear reactors**



AREVA
Safety Alliance

- ◆ **New build**

- ◆ AREVA EPR projects



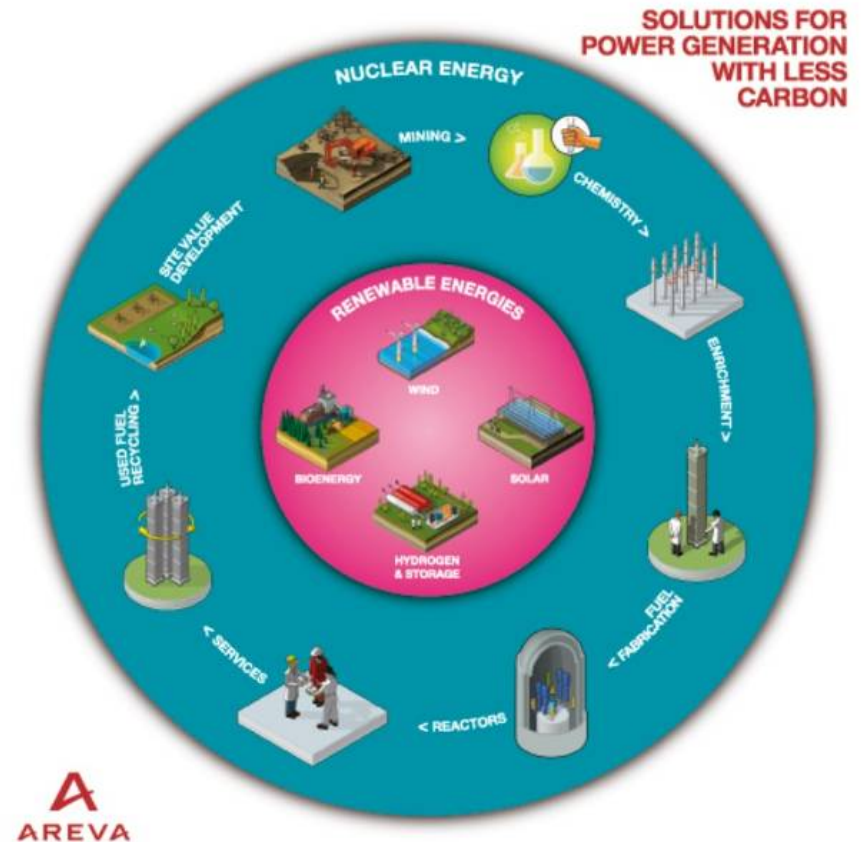
- ◆ ATMEA1 Reactor Main features



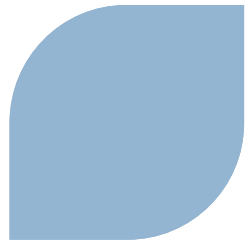
- ◆ **Conclusion**

AREVA, a world leader in nuclear power and a major player in renewable energies

- ▶ **€8.872Bn** in Annual Revenues
- ▶ **€45.6Bn** in Backlog
- ▶ **5.4%** of revenues in R&D spend
- ▶ **48,000 Employees Including:**
 - ◆ **740** Specialty Experts
 - ◆ **2,700** Scientists & Researchers
 - ◆ **6,500** in world's largest in-house nuclear EPC team
- ▶ **8,000** Active Patents held
- ▶ **51** Manufacturing Sites on **5** continents



After Fukushima, the Fundamentals for Nuclear Energy remain Unchanged



Drivers

Fundamentals

Need for more
electricity
production capacity

- ▶ Energy demand multiplied by 2 by 2050- Brasil : + 50 % in 2021

Climate change

- ▶ Greenhouse gas emissions to be cut by half by 2050- + 4deg C in 2050

Geopolitics

- ▶ Energy independence and security of supply imperative

Fossil resources

- ▶ Limited resources, short and mid-term perspectives show rising prices of fossil energies

Construction
and operating costs

- ▶ Marginal impact on Gen 3 NPP new builds

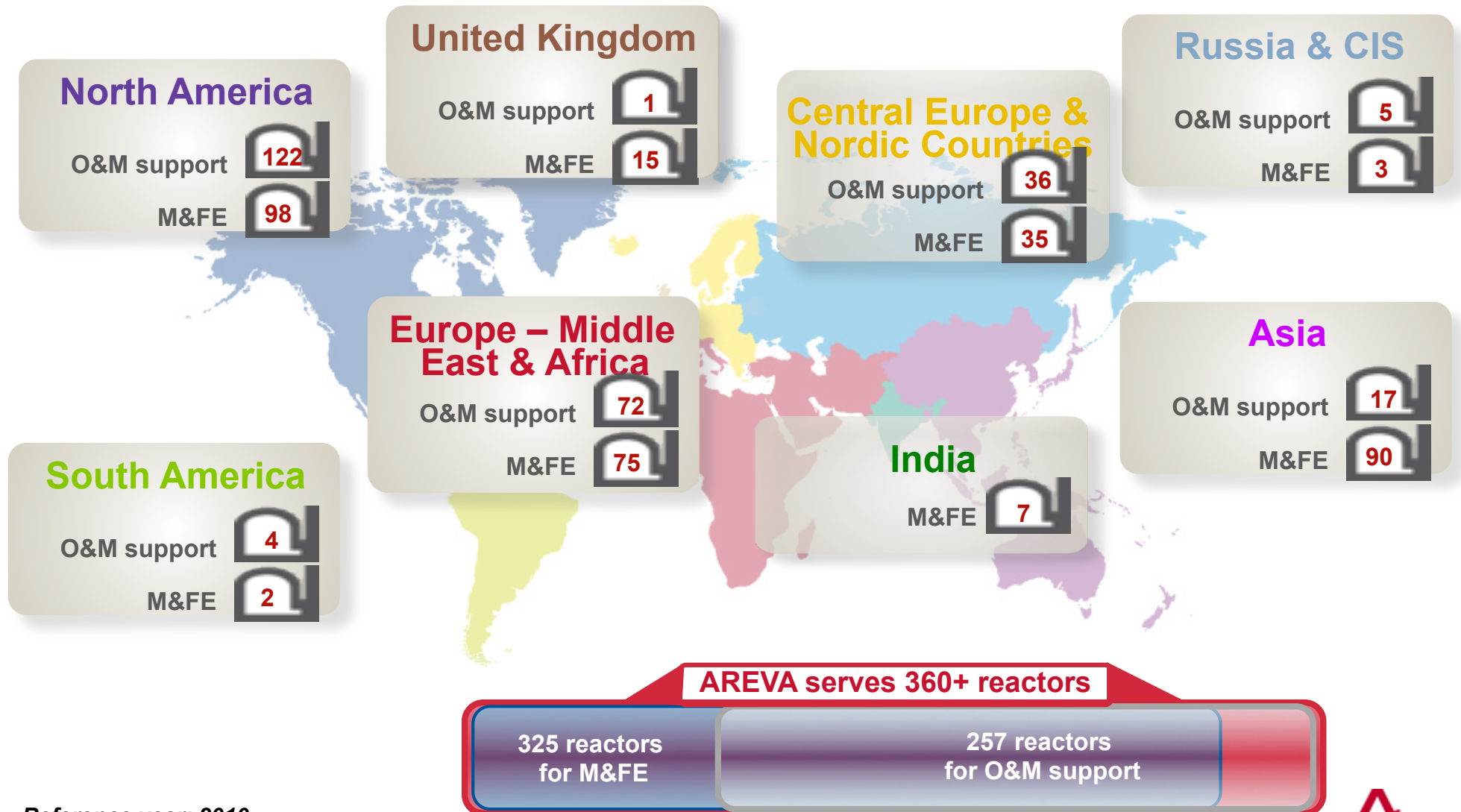
Financing

- ▶ Access to financing restricted to new build NPP projects complying with the highest safety standards

Public acceptance

- ▶ Public acceptance concerns favour nuclear technology leaders promoting highest safety standards

360 + Nuclear Reactors are served by AREVA



Reference year: 2010

AREVA, Safety is the Cornerstone of our Strategy



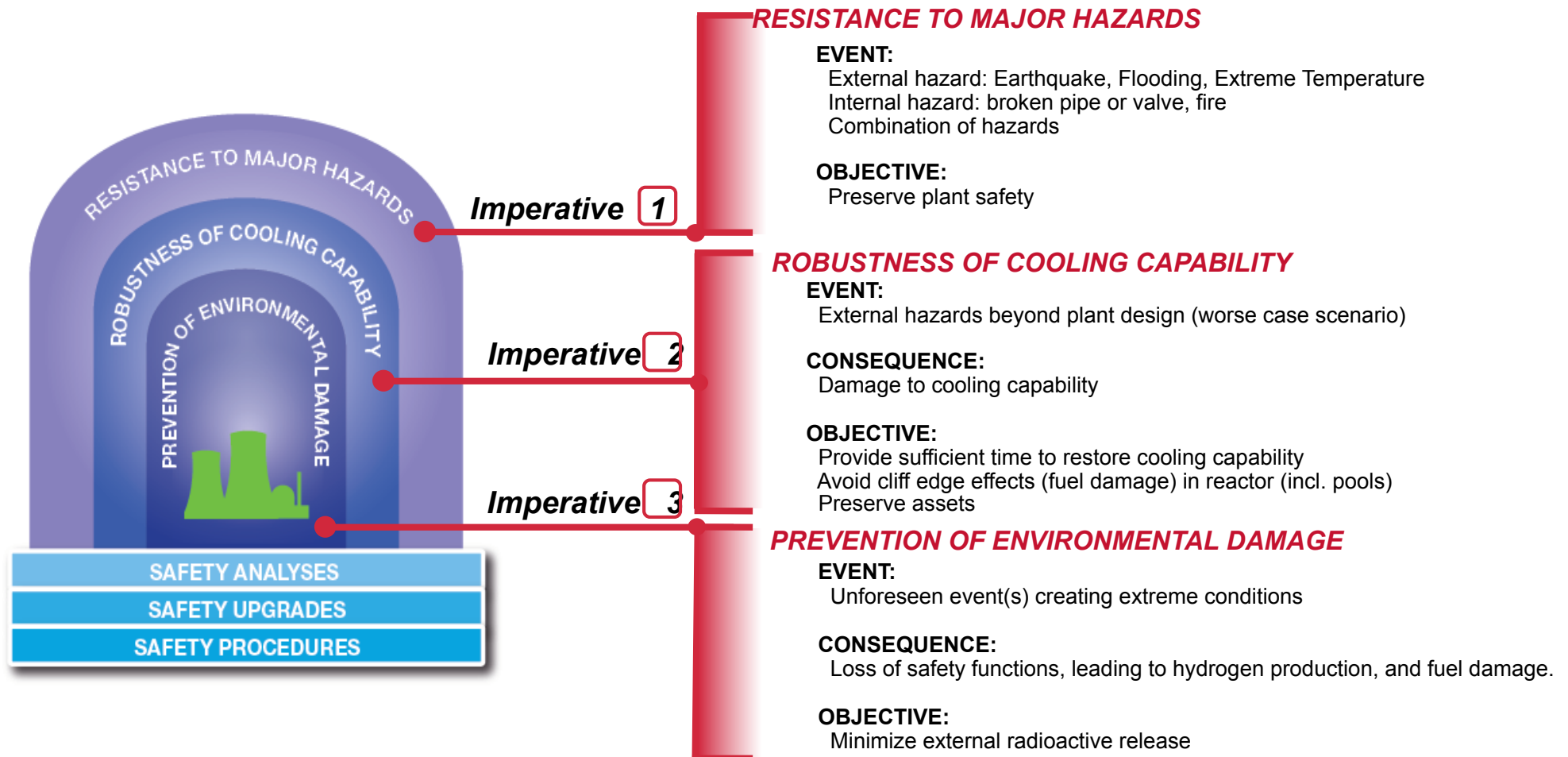
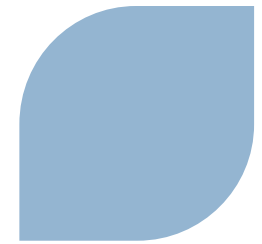
joined in July
2012





AREVA
Safety Alliance

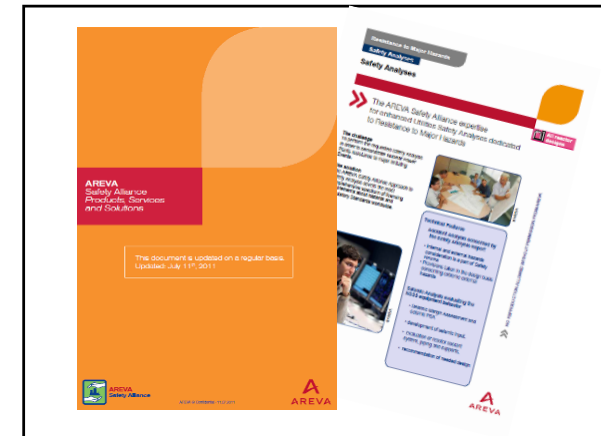
AREVA Post-Fukushima Initiative =AREVA Safety Alliance framework



AREVA Post-Fukushima Initiative and Innovations

- ▶ **A catalog of 30+ selected products and services across AREVA's full nuclear portfolio:**
 - ◆ Hardened Emergency Diesel Generator (beyond design conditions)
 - ◆ Flooding protections
 - ◆ Passive Autocatalytic Recombiners (H₂)
 - ◆ Containment Filtering & Venting systems
 - ◆

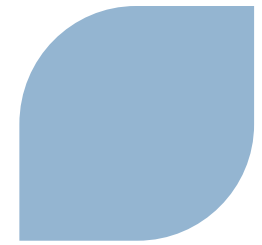
- ▶ **A dedicated R&D organization for prioritized projects**



AREVA, a wide GEN3+ Reactor Portfolio to better serve Utilities' needs

Main Technical Data	 	 	 
Thermal power	4,590 MWth	3,150 MWth	3,370 MWth
Net power	1,650 Mwe	1,150 Mwe	1,250 Mwe
Thermal efficiency	37%	37%	37%
Target design availability	92%	92%	92%
# loops	4	3	N/A
(secondary) Steam pressure	77 bar	72 bar	75 bar
Operation cycle length	up to 24 months	up to 24 months	up to 24 months
Collective dose	<0.5 manSievert/yr	<0.5 manSievert/yr	<0.5 manSievert/yr
Design service life	60 yrs	60 yrs	60 yrs
I&C	Full digital	Full digital	Full digital

» AREVA constantly innovates to improve and optimize existing models and prepare new ones to meet utilities' needs worldwide



◆ AREVA presentation

◆ Safety of existing nuclear reactors



AREVA
Safety Alliance

▶ New build

▶ AREVA EPR projects



◆ ATMEA1 Reactor Main features



◆ Conclusion

AREVA capabilities serving new build project

Track Record: 100+

Nuclear reactors built or under construction



Localization:

Past and on-going strong experience



Ulchin
(Korea)

Daya Bay
(China)

Koeberg
(RSA)

Angra 2
(Brazil)

Support to Plant Completion: Engineering, Procurement & Safety Upgrade



Angra 3



Bellefonte (U.S.)

4 ongoing EPR™ Construction Projects:



Olkiluoto 3
(Finland)

Flamanville 3
(France)

Taishan 1
(China)

Taishan 2
(China)

Olkiluoto 3

82%

percentage of completion
at 6/30/12 (AREVA scope)

- Installation and start of testing of I&C cabinets for power distribution
- Installation of all fuel handling equipment in the fuel and reactor buildings
- Successful completion of leak-tightness tests in all pools
- Installation of internals in the reactor vessel and of control rod drive mechanisms in the vessel head
- 75% completion (vs. 70% at year-end 2011) of on-site construction work (electro-mechanical installation work and all finishing work)

Flamanville 3

62%

percentage of completion
at 6/30/12 (AREVA scope)

- ASN validates the architecture design for the digital I&C system
- Completion of manufacturing of the four steam generators
- Installation of the RIS pumps (safety injection system), RBS pumps (boron safety system) and the reactor vessel annular support

Start of engineering work for hot test configuration

Taishan 1&2

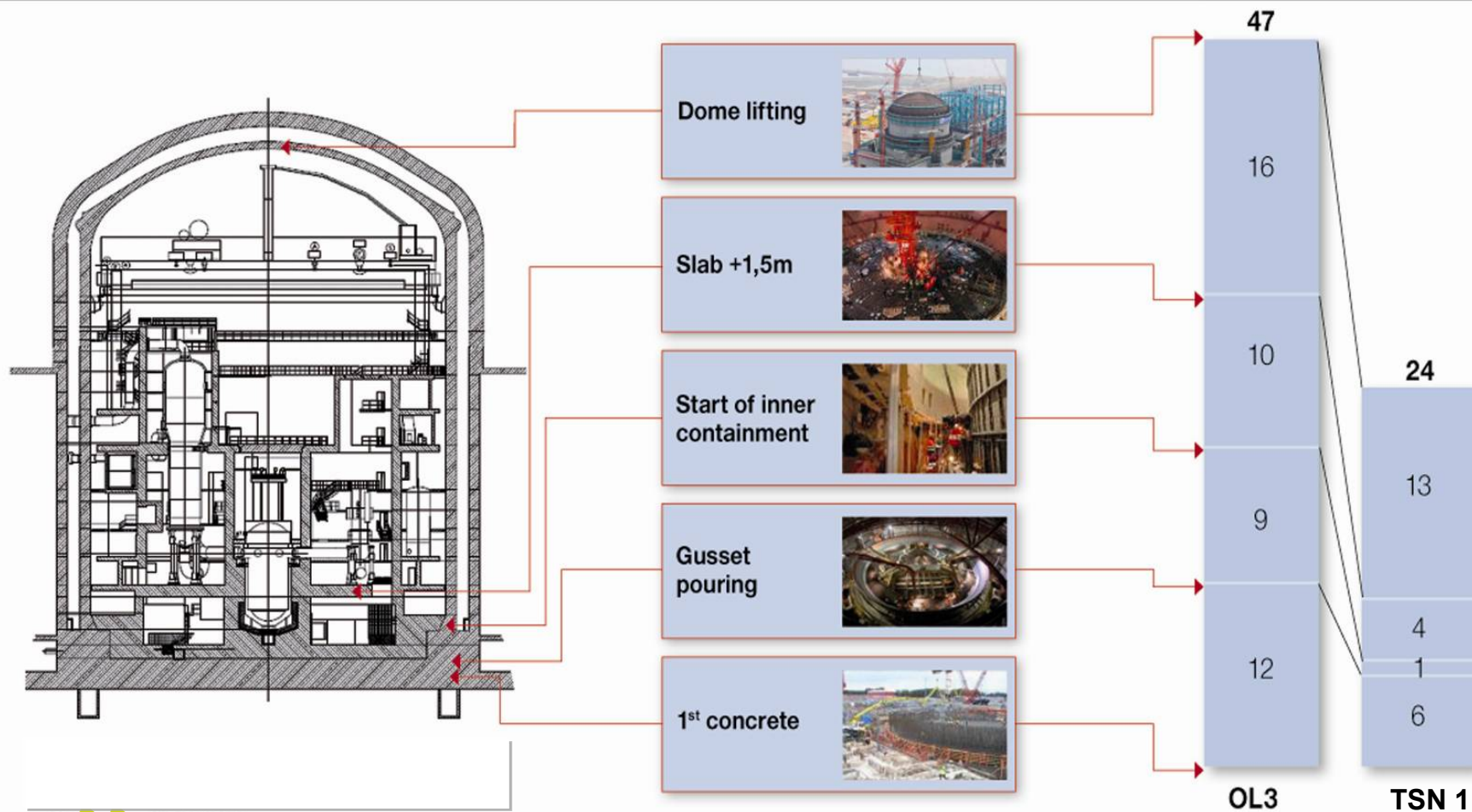
79%

percentage of completion
at 6/30/2012 (AREVA scope) –
design and engineering activities

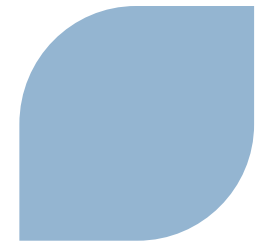
- The generators, pressurizer and reactor vessel internals for Unit 1 delivered on site
- Successful testing of the Unit 1 polar crane
- Submittal of the final safety analysis report
- Introduction of the Taishan 1 reactor vessel
- Imminent dome lifting for Unit 2

The value of AREVA experience

Construction duration from first concrete to dome lifting
(# of months)



>> AREVA experience will be leveraged in new build project



- ◆ **AREVA presentation**

- ◆ **Safety of existing nuclear reactors**

- ▶ **New build**

- ◆ AREVA EPR projects



- ▶ **ATMEA1 Reactor Main features**



- ◆ **Conclusion**

Brief Overview of The Company



Brief Overview of The Company

ATMEA's Expertise and Capabilities



- Company name: **ATMEA S.A.S.**
- Office Location: **Paris La Defense**
- President & CEO: **Philippe Namy**
- Deputy CEO: **Satoshi Utsumi**
- Establishment: **November 2007**
- Capital: **126 Million Euros**

- Scope of activities: Development, Marketing & Sales, Construction & Commissioning activities for the **1100 MWe class Generation III+ ATMEA1 Nuclear Island**
- The ATMEA company is the **exclusive vendor** for the **ATMEA1 Nuclear Island**



ATMEA1 Reactor: A mid-sized Generation III+ PWR

Brief Overview of The Company

ATMEA's Expertise and Capabilities



Unrivalled experience and resources



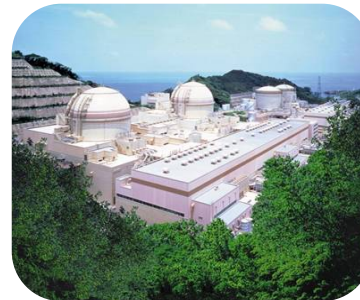
- Extensive and outstanding experience from almost 130 Nuclear Power Plants built all over the world including 4 EPR™ reactors under construction (Gen.III+ technology)
- Engineering, procurement, manufacturing and construction expertise



Civaux, France



OL3, Finland



Ohi, Japan



Tomari, Japan

Brief Overview of The Company

ATMEA's Expertise and Capabilities

- **Engineering and nuclear experts:**

- More than 50,000 experienced nuclear professionals world-wide

- **Manufacturing capabilities:**

- In-house state-of-the-art manufacturing workshops and technology which assures delivery schedule and high-quality



Reactor Pressure Vessel machining at AREVA Chalon St-Marcel Heavy Components Plant



Steam Generators at MHI Kobe

Brief Overview of The Company

ATMEA's Expertise and Capabilities

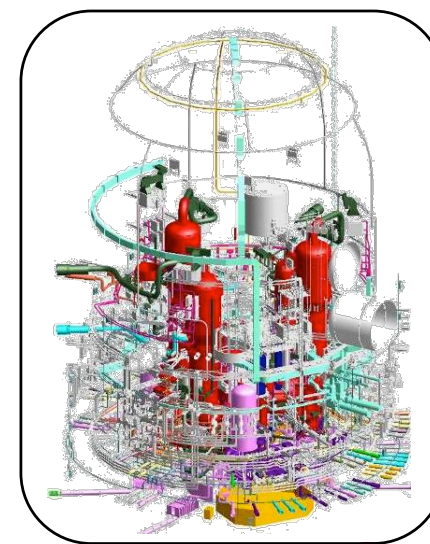
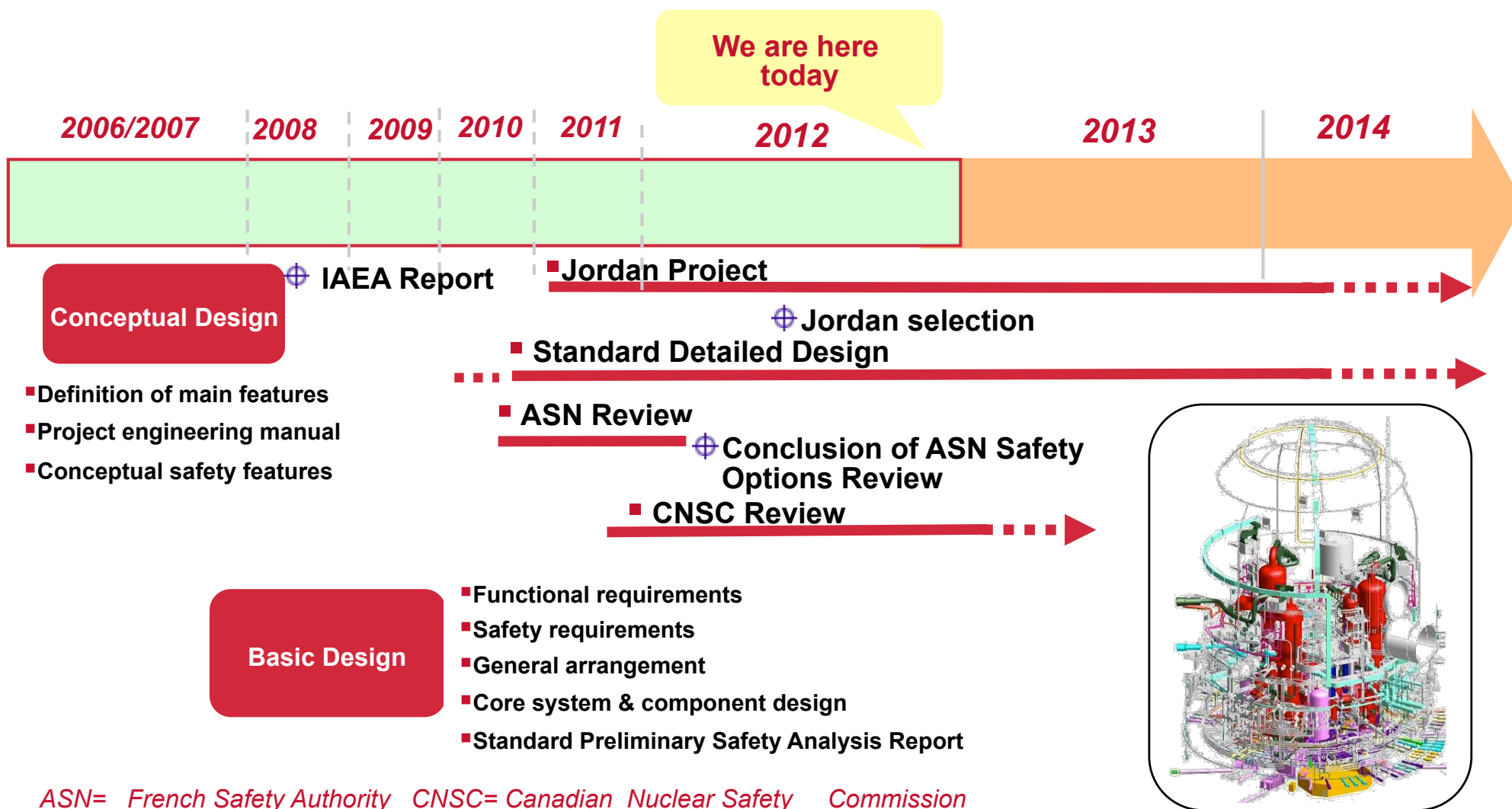
Well established & proven supply chain with:

- **Large Forgings suppliers :** Japan Steel Works, Japan Casting & Forging Corp (Group company of Mitsubishi), Creusot forge (Sfarsteel, subsidiary of AREVA)
- **Long- lead material suppliers :** Sumitomo Metal Inc., Valinox, Sandvick, for Steam Generator tubings



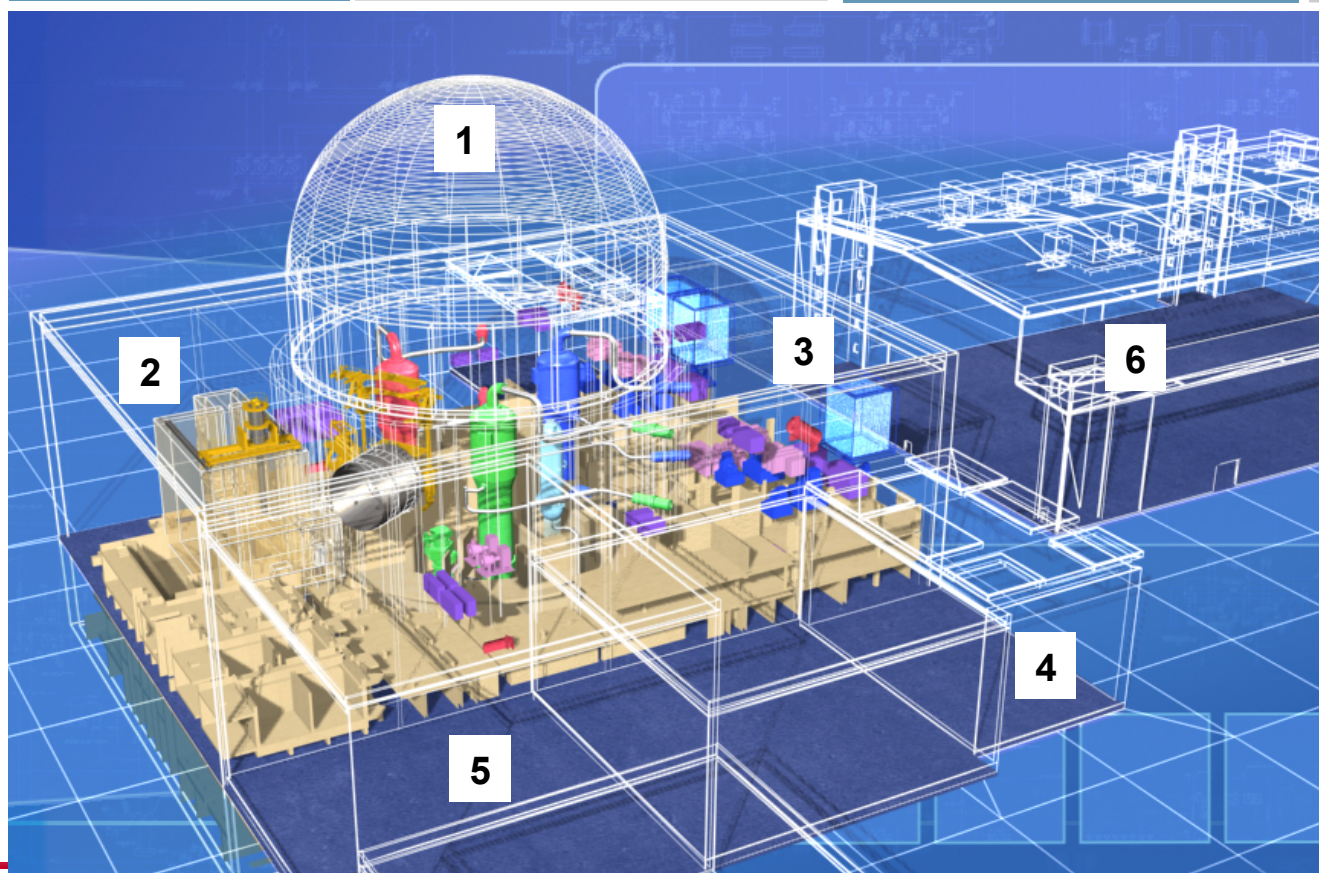
The Sfarsteel forging facility

Achievements and current activities



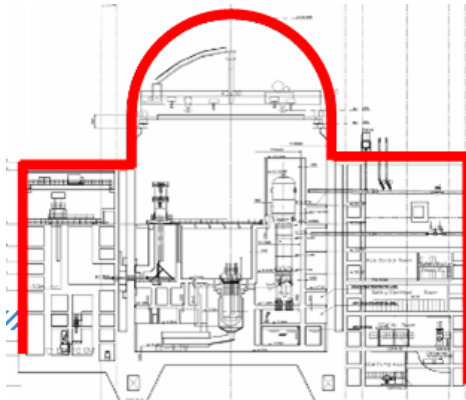
ATMEA1 Main Features

Reactor Type	3-Loop PWR	Safety System	3-Train reliable systems with passive features
Electrical output	1100 – 1150 MWe (Net)	Severe Accident Management	Core catcher Hydrogen re-combiners
Core	157 Fuel Assemblies	Resists airplane crash	Pre-stressed Concrete Containment Vessel
Steam Pressure	More than 7 MPa	I&C	Digital

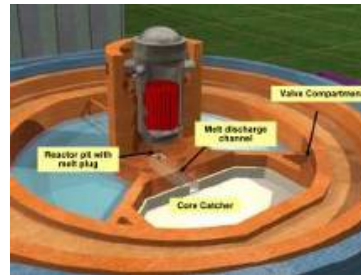


1. Reactor Building
2. Fuel Building
3. Safeguard Building
4. Emergency Power Building
5. Nuclear Auxiliary Building
6. Turbine Building

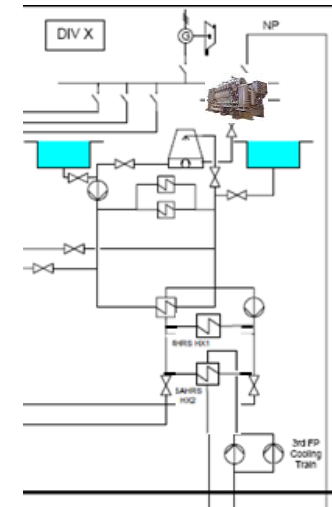
Main ATMEA1 Strengths



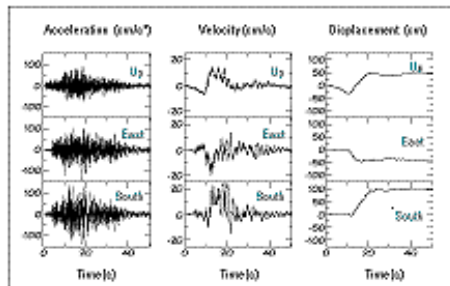
APC PROTECTION



**SEVERE
ACCIDENT
MITIGATION**



**DIVERSITY IN HEAT SINKS
& Emerg. Power Source
(DIVISION X)**



**HIGH SEISMIC
RESISTANCE**



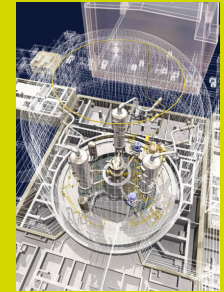
PROVEN DIGITAL I & C



AREVA

ATMEA1 Reactor : Proven Technology

ATMEA1, a fully validated reactor design



The ATMEA1 reactor is composed of fully-operated, licensed, or verified systems and components of AREVA and MHI

- ▶ Technology is coming from the latest Generation III+ design, EPRTM and APWR
- ▶ Experience feedback from about 130 nuclear power plant constructions and operation

ATMEA1 Reactor :

Top Level Safety as Generation III+
ATMEA1 robust design with its redundant and diversified safety features ensures best-in-class safety

Internal events - External hazards - Internal hazards



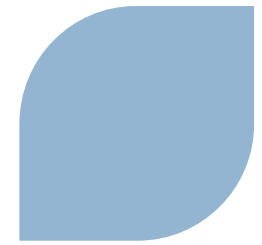


WELCOME TO THE ATMEA DAY

Rio De Janeiro

Centro de Convenções

November 28, 2012



- ◆ **AREVA presentation**

- ◆ **Safety of existing nuclear reactors**



AREVA
Safety Alliance

- ◆ **New build**

- ◆ AREVA EPR projects

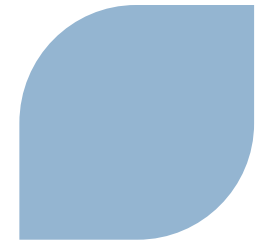


- ▶ ATMEA1 Reactor Main features

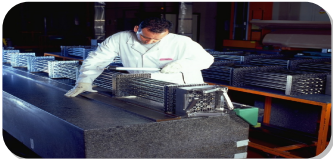


- ▶ **Conclusion**

Bringing AREVA experience to support the success of new build construction in Brasil



- Leveraging AREVA unique **project delivery experience and best practices** in Gen III+ reactors



- **Supporting** mining and **fuel** fabrication



- Serving Brazilian industry through **localization**



- **Capitalizing** on **25** years experience of **technology transfer** to Brasil



 **Obrigado!**