

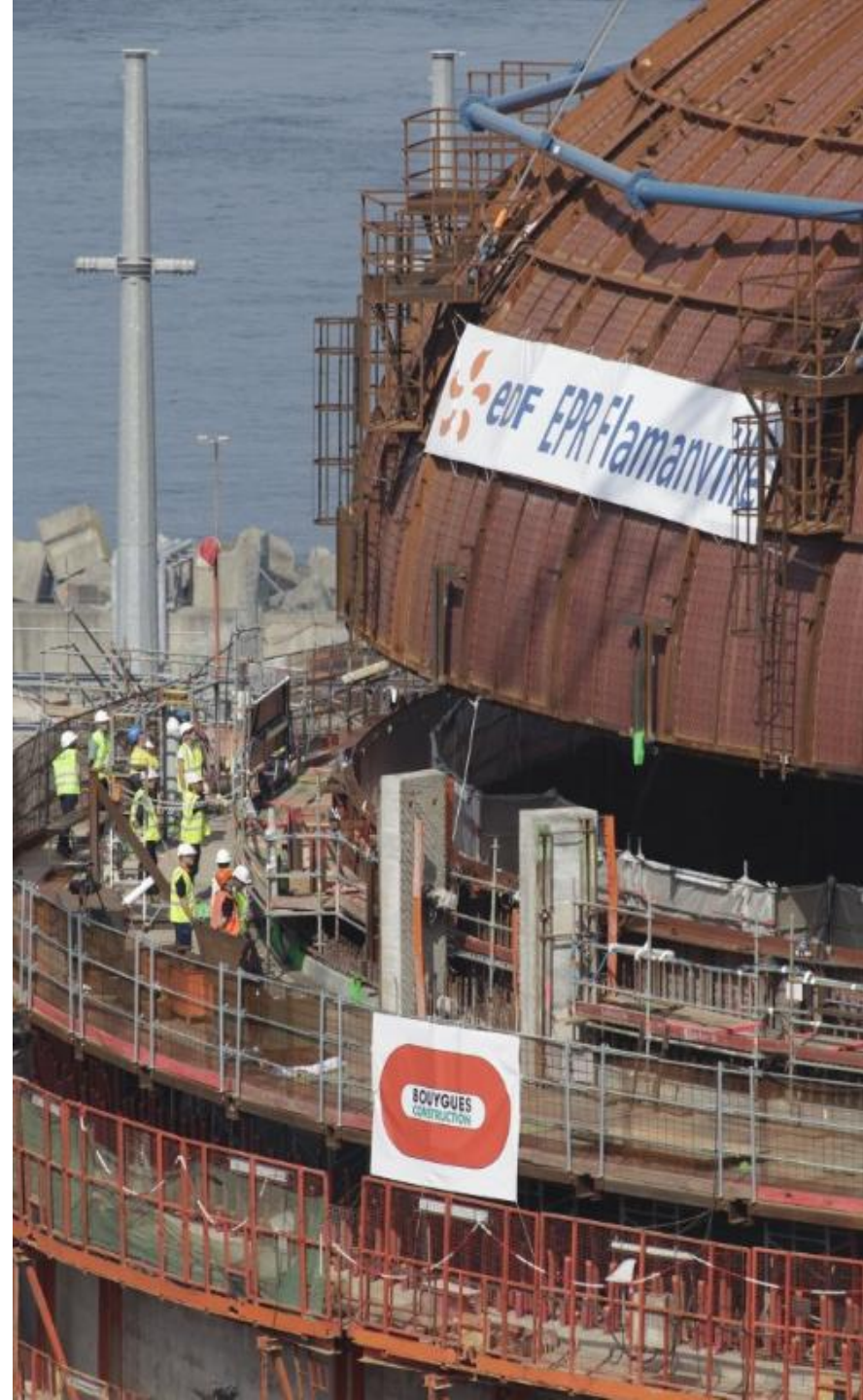


Nuclear development and safety evolutions post Fukushima

EDF experience

Perspectivas da Energia Nuclear no Brasil
Rio de Janeiro – 12 September 2014

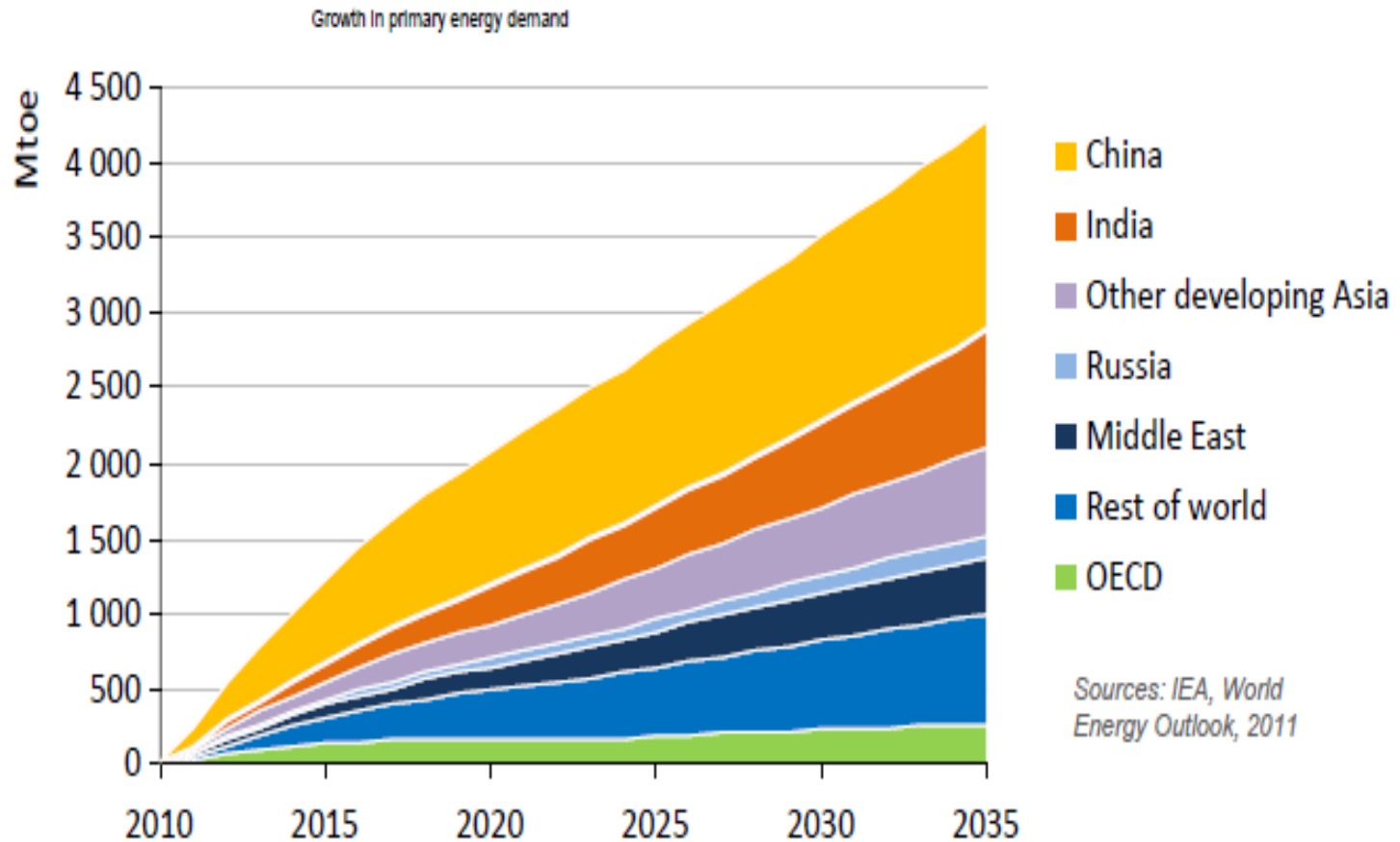
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NUCLEAR DEVELOPMENT PERSPECTIVES

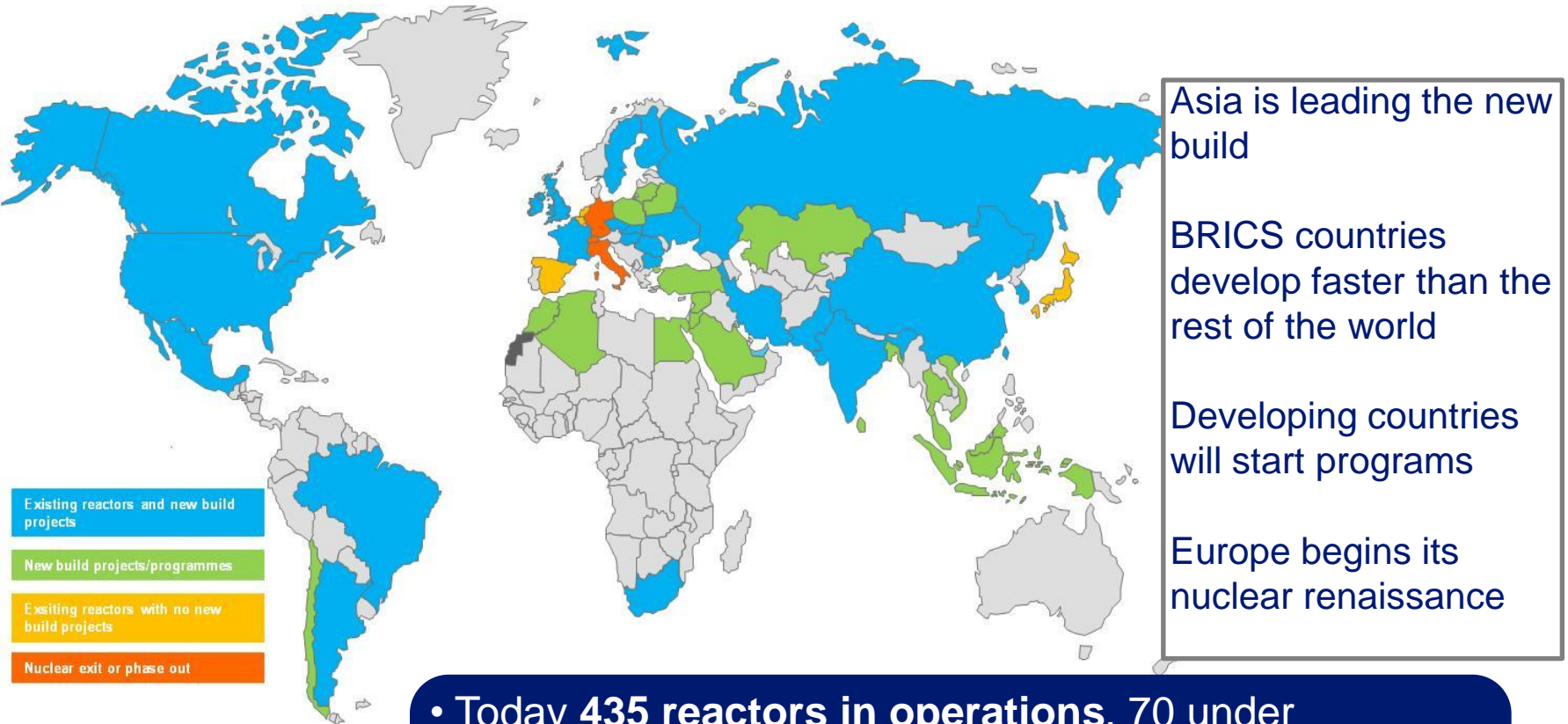


GLOBAL ENERGY DEMAND WILL GROW...



- Global energy demand increases by one-third from 2010 to 2035, with China & India accounting for 50% of the growth

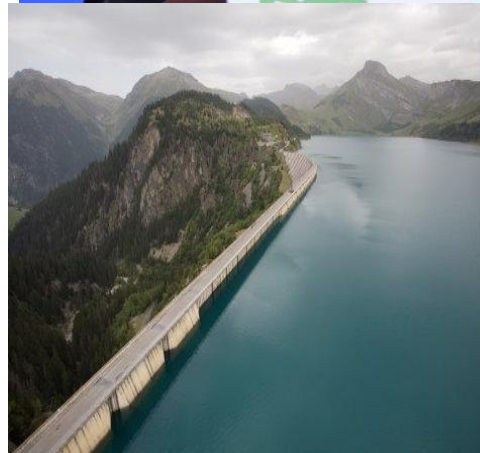
...AND NUCLEAR IS PART OF THE ANSWER



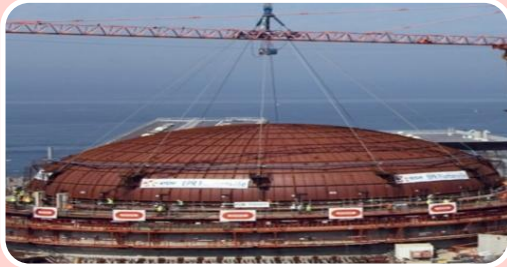
- Today **435 reactors in operations**, 70 under construction
- IAE World Energy Outlook 2013 : **Forecast of 578 to 792 GW of nuclear capacity installed**

COMING YEARS ARE KEY

- **Fukushima accident impacts start to fade worldwide**
 - Nuclear energy stays part of the energy mix in most of the countries
 - European debates on the part of renewable energies in the mix are growing (Germany, Spain...)
- **France: towards a rebalanced electricity mix... but still with a strong nuclear base**
 - “50% reduction in energy consumption by 2050, but this is not a dogma”
 - “ 30% reduction in fossil consumption by 2030”
 - “No growth in nuclear capacity”
- **The Nuclear industry must be exemplary**
 - Maintain a high level of competencies
 - Be at the state of the art in performance (economical and safety)
 - Be transparent for public information and acceptance



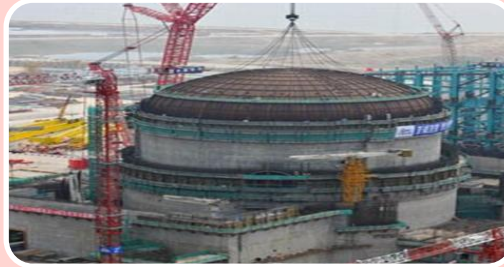
EDF NEW BUILD : BENEFIT FROM LESSONS LEARNT TO WRITE A NEW INDUSTRIAL STORY



Flamanville 3



Commercial operation
en of 2016



Taishan 1 & 2
(CGN + EDF)



Unit one : connection to the
grid end of 2015



Hinkley Point C 1&2
(EDF + CGN + CNNC)



Planned end of construction
2023 - 2025

EDF New Build perspectives integrate industrial partnership

NUCLEAR SAFETY POST FUKUSHIMA



FUKUJHIMA ACCIDENT – LESSONS LEARNT

- Nuclear is a nationwide concern
- Safety is not only technology
- The operator is at the heart of nuclear safety
- A strong crisis organisation involving the operator and all the services of the state is needed
- A new era has begun : severe accident analysis must take into account events or situations that may have not been considered before

Concept of “*what if?*” ...



beyond the design analysis , permanent enhancement , questioning attitude

THE FRENCH REGULATORY CONTEXT BEFORE FUKUSHIMA

General policy : continuous improvement of nuclear safety, with regard to the state-of-the art of scientific knowledge, to the worldwide operation feedback, and to the safety improvements of new reactors

Periodic safety review (PSR) every ten years for each unit

No limited licensing life time but advice by the French Nuclear Safety Authority, on a case by case analysis for each unit, to operate for another ten year period

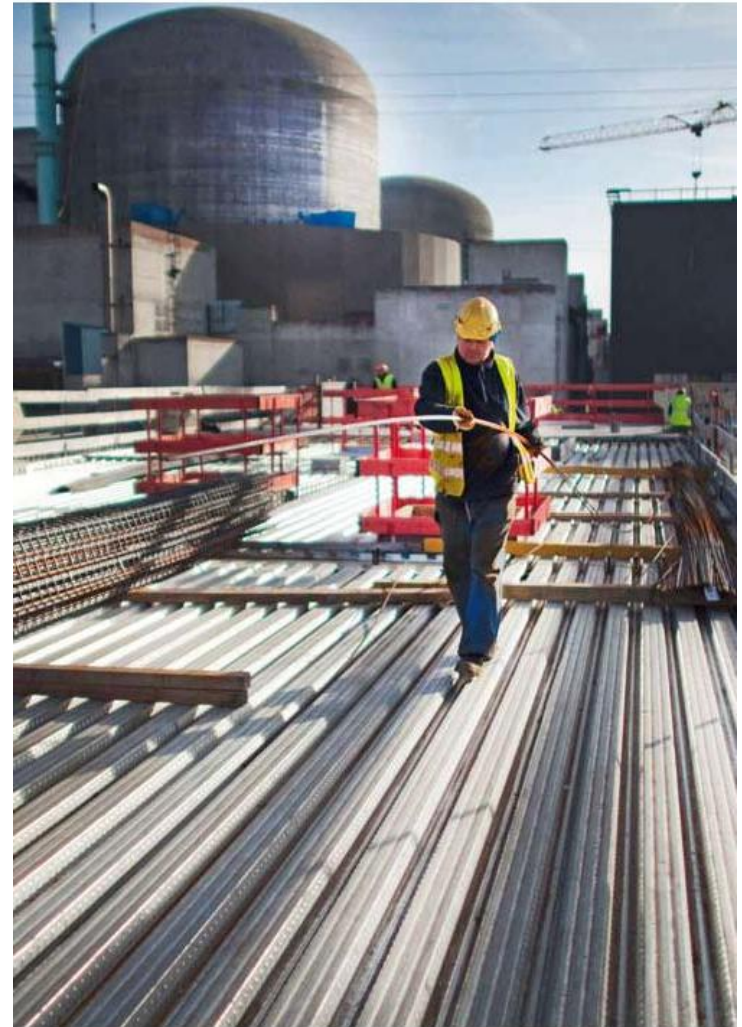
Numerous modifications already implemented on the plants (after TMI, Tchernobyl, Blayais site storm in 1999, summer heat wave in 2003, ...). Among them : sand filters on containment (1986), Hydrogen recombinors , new concept of emergency procedures, man-machine interface (N4 series), etc...

SAFETY IS A CORE CONCERN FOR EDF NUCLEAR ACTIVITY

The two drivers towards excellence for EDF in nuclear are **safety and competitiveness of electricity**

EDF believes that a strong **operator mastering its technology from design to operation and decommissioning** is the base of safety

Lessons learnt from the French nuclear fleet and international benchmark are integrated modifications and new build activities



POST FUKUSHIMA CHRONOLOGY IN FRANCE

→ Fukushima accident on **March 11, 2011**

→ Additional safety assessment report submitted by EDF to the Nuclear Safety Authority on **September 2011**

→ Statement of the French Nuclear Safety Authority (ASN) on **January 2012**

◆ *“the ASN considers that the plants show a level of safety sufficient that enables her not to ask the immediate shutdown of any of them.*

◆ *At the same time, the ASN considers that it is necessary to increase, in a time as short as possible, beyond the safety margins already in place, the robustness of the plants to cope with extreme situations.”*

→ The ASN issued 600 technical requirements on **June 2012**, with deadlines for implementation of the first ones by the end of 2012 and mid-2013, all of which have been met.

REGULATORY SITUATION TODAY

→ The ASN issued in 2014 a **supplementary set of requirements** (hardened core concept)

→ Extensive action by EDF to embed the safety objective **of no significant radioactive release with lasting effect on the environment.**

The next IAEA Safety Convention (2014) is being prepared based on this principle.

→ The association of the **main European nuclear regulators**, the Western European Nuclear Regulators Association (WENRA), is revising the Safety Reference Levels (for NPPs in operation) and Safety Objectives (for new reactors) incorporating **requirements based on the lessons learned from Fukushima.**

EDF SAFETY GOALS FOR LONG TERM OPERATION

Continuing to **reduce the risk of core melt**, already divided by ten since the commissioning of the plants in case of internal events

Significantly **enhancing plant resistance to hazards**

Minimizing time and space-related countermeasures in the event of a severe accident

Continuing the development of **competences**



EDF POST FUKUSHIMA PROJECT – 3 STEPS APPROACH

→ **Step 1:** Fast emergency response organisations and related resources to manage an accident affecting all reactors on the same site.

Started in 2012 – 100% operational in 2015

→ **Step 2:** Set up robust means of water makeup and back-up electricity supply to safeguard the core in the event of loss of the current means (target: 2018). Set up robust emergency response centres to manage an emergency for all the reactors on the same site (target: first site 2016).



EDF POST FUKUHIMA PROJECT – 3 STEPS APPROACH

→ **Step 3:** Supplement the current means in place to achieve the **safety aim no significant radioactive release with lasting effect on the environment** by deploying the hardened core. Target: as from 2019 (in keeping with the fourth ten-yearly outages)

Aiming at reaching the safety objective of 3rd generation reactors for existing NPP

This is required by the ASN so that the existing NPPs can operate for more than 40 years.



Conclusions



- **Nuclear provides competitive carbon-free electricity, available when needed, and stable electricity prices; It will remain part of the world energy mix in the next decades**
- **Fukushima accident has highlighted the utmost importance of the operator; EDF industrial model rely on a strong technical in-house capability**
- **The feedback from experience is key to improve the control on construction and operation risks; Constant enhancement of technology and training people allows to address post Fukushima action plan**
- **Post Fukushima, public acceptance for nuclear need transparency and communication.**

**Obrigado por
sua atenção**



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