

# Nuclear Energy in France Current Trends and Impact on the Bilateral Ties with Japan

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## 1. Current trends in France

- 1.1 The Past: Dismantling / Decommissioning
- 1.2 The Present: Gen III reactors
- 1.3 The Future: Generation IV reactors
- 1.4 The restructuring of the French nuclear industry

## 2. Impact on bilateral ties with Japan

### 2.1 Dismantling / Decommissioning

- 2.1.1 Fukushima
- 2.1.2 Monju

### 2.2 Generation III Reactors

- 2.2.1 ATMEA-1 reactor

### 2.3 Generation IV Reactors

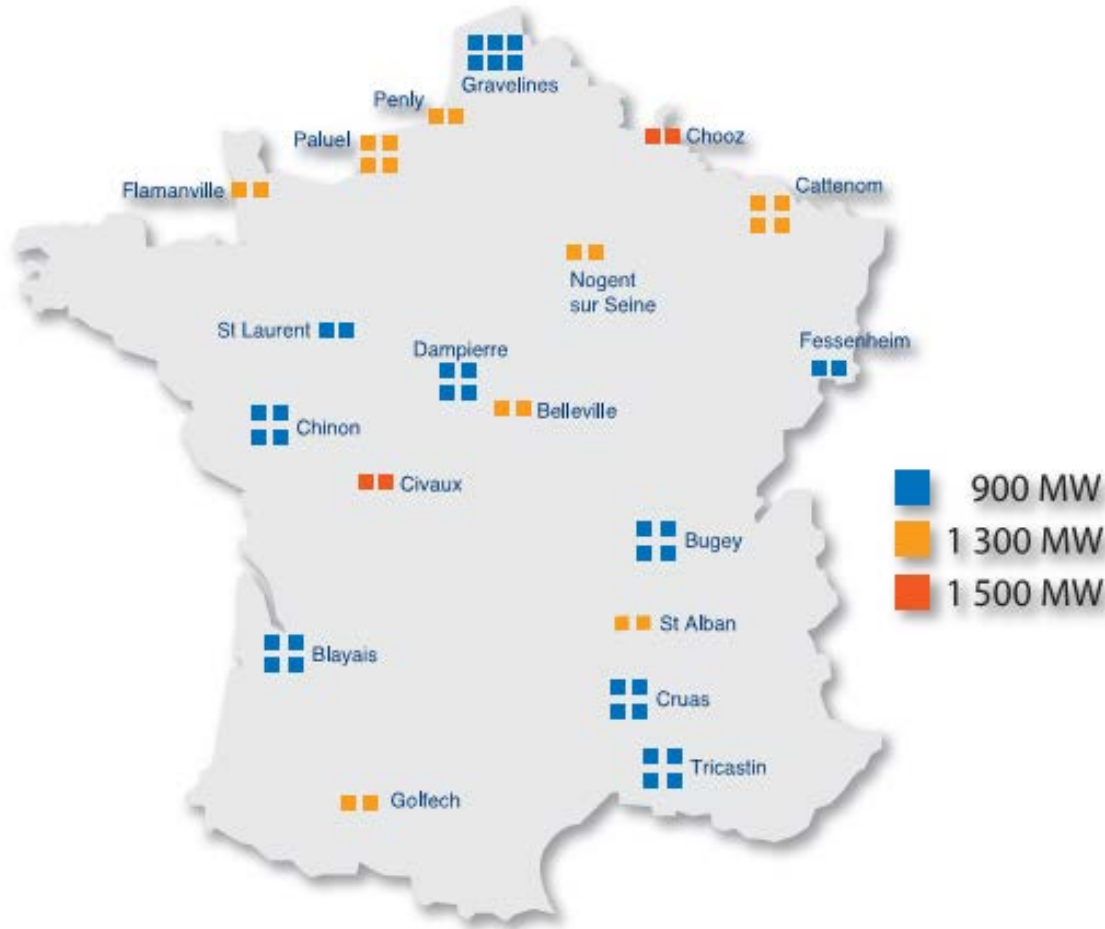
- 2.3.1 Fast Breeder Reactors: ASTRID

### 2.4 Japanese participation in the new structure of the French nuclear industry

## 3. Conclusion

# Today's Nuclear Fleet

One operator  EDF



19 stations

58 PWRs

+ 1 under  
construction

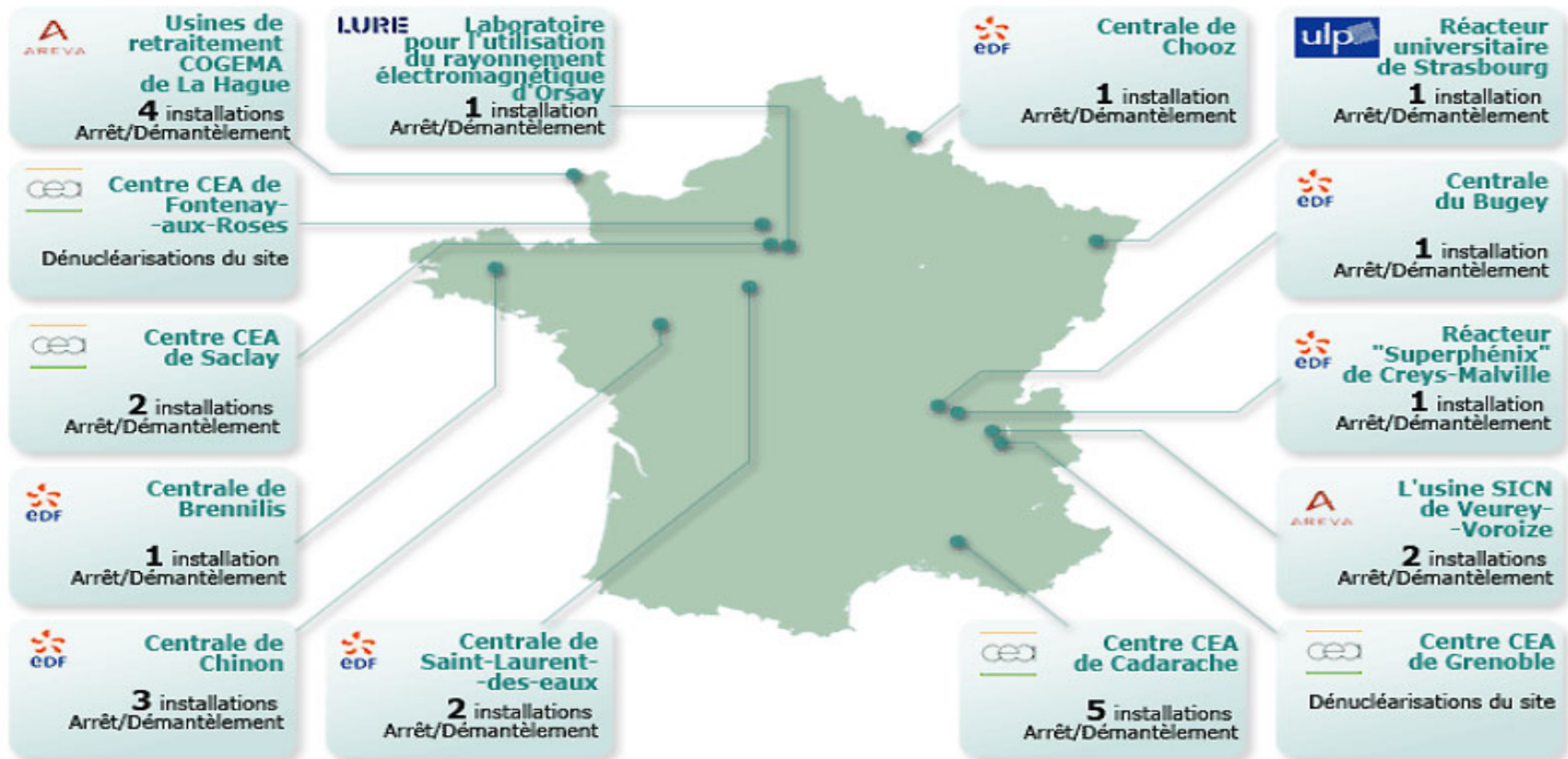
63 GWe

406  
TWh/year\*

# The Past: Nuclear sites currently being dismantled

4

## Les installations en cours de démantèlement



**Les réacteurs de première génération d'EDF (UNGG) :** les réacteurs A1, A2 et A3 sur le site de Chinon, le réacteur de la filière graphite-gaz du Bugey et les réacteurs A1 et A2 de Saint-Laurent-des-Eaux.

**Les autres réacteurs d'EDF :** le réacteur Superphénix sur le site de Creys-Malville, le réacteur à eau sous pression sur le site de Chooz, la centrale de Brennilis (EL4).

**Les installations en démantèlement sur les centres du CEA :** le centre CEA de Saclay et de Cadarache.

**Les centres du CEA en démantèlement :** le centre CEA de Fontenay-aux-Roses et le centre CEA de Grenoble.

**Les autres installations en démantèlement :** le Laboratoire pour l'utilisation du rayonnement électromagnétique (LURE) d'Orsay, le réacteur universitaire de Strasbourg, les usines de retraitement COGEMA de La Hague, l'usine SICN de Veurey-Voroize.

## Dismantling / Decommissioning

### **Fukushima**

With JAEA, MEXT, NDF, TEPCO

For e.g.:

- conditioning of slugs resulting from contaminated water
- decontamination of sites
- retrieval of fuel debris
- soil decontamination

### **MONJU**

**Non accidented plants : post-Fukushima**

## EDF plants under decommissioning

1 Pressurized Water Reactor (PWR)

1 Heavy Water Reactor (HWR)

6 Natural Uranium Graphite Gas reactors (UNGG)

1 Fast Neutron Reactor (RNR)

EDF Main storage facilities



→ More than 15 years experience on its own fleet decommissioning

→ EDF has taken 9 units from operating to decommissioning

→ More than 15 years in waste treatment through Socodei : melting, incineration, onsite waste treatment operations

→ EDF is also preparing AGR decommissioning in the UK that will begin by mid 2020s



*Through the French regulation context, EDF is the owner and the operator of its own fleet. Moreover, EDF is also in charge of the decommissioning with the dedicated funds (~23Mds€). EDF applies its “architect integrator model” across the entire lifecycle units: mastering technical competencies (with some contractors/partners), costs, planning and risks.*

## The Generation III+ **EPR™** Reactor : Key Assets

- offered by AREVA
- the product of R&D programs spanning several decades in France and Germany
- the most powerful reactor system, capable of generating more than 1600 MWe of electricity
- certified by several leading nuclear regulator authorities
- under construction in Finland, China, France
- in project discussion in other areas: UK, India

## The mid-sized Generation III+ **ATMEA 1** Reactor :

- The ATMEA company, a AREVA /MHI JV, sells the ATMEA1 reactor
- a 1,100 MWe Generation III+ PWR that brings together innovative and proven nuclear technologies from both AREVA and MHI
- a mid-sized PWR offering solid Gen III+ safety features
- in discussion in Turkey

## **Mitsubishi Heavy Industries and EDF Sign MoU on Collaboration in Civil Nuclear Power Businesses (Paris – June 28, 2016)**

EDF and MHI intend to enhance their strategic cooperation by establishing general objectives and principles related to:

- an updated cooperation framework regarding the ATMEA joint venture, including the involvement of EDF in ATMEA's business operations,
- with mutual support to be brought for the smooth execution of ATMEA1 projects, in particular in Turkey and Vietnam,
- the potential participation of MHI as a partner in the French nuclear landscape reorganization with the acquisition of a minority equity interest in AREVA NP,
- potential broader range of collaborative ties leveraging the respective technologies and special expertise in the global market.

## **Restructuring of the French Nuclear industry**

**1/ Participation of JNFL and MHI in the capital of New Co  
March 2017**

**2/ On-going discussions for the participation of MHI on  
the capital of AREVA-NP**



# THE FUTURE : GENERATION IV REACTORS THE RATIONALE FOR A CLOSE CYCLE AND ITS EVOLUTION TOWARDS MORE SUSTAINABILITY

1980      2000      2020      2040      2060      2080      2100

*Dates are purely indicative*

**TOWARDS INCREASING SUSTAINABILITY**



**Gen. II & III *Pu-monorecycling***



**GenIV : *Pu + Minor Actinides multi-recycling***



**Pu mono-recycling**

- LWR reactors
- Pu-recycling in MOX fuel

**Pu multi-recycling**

- Multi-Through Cycle
- Fast-Reactors (FR)

**Breakthroughs on cycle  
and fast reactors are needed**

**Main incentives for Gen IV development**

- Major resource saving
- Pu stockpile minimization
- Energetic independence and economic stability
- Decrease of waste burden and optimization of the disposal
- Public acceptance

**Current close  
fuel cycle**

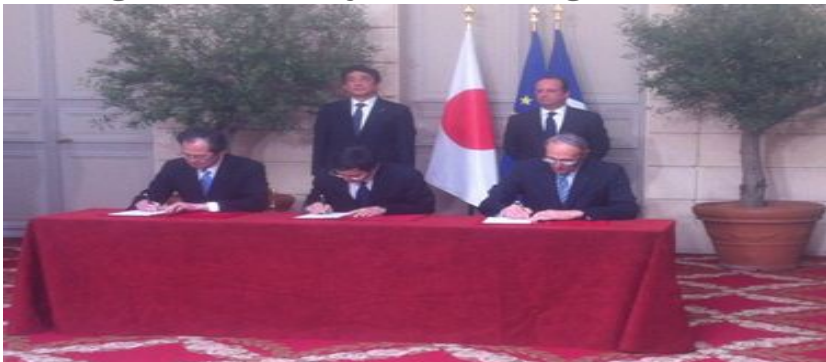
**Future close  
fuel cycle**

**ASTRID will validate breakthroughs on cycle and sodium-cooled fast reactors**

# ASTRID : A STRONG PARTNERSHIP WITH JAPAN TO WORK ON SUSTAINABLE NUCLEAR ENERGY

## The General Arrangement

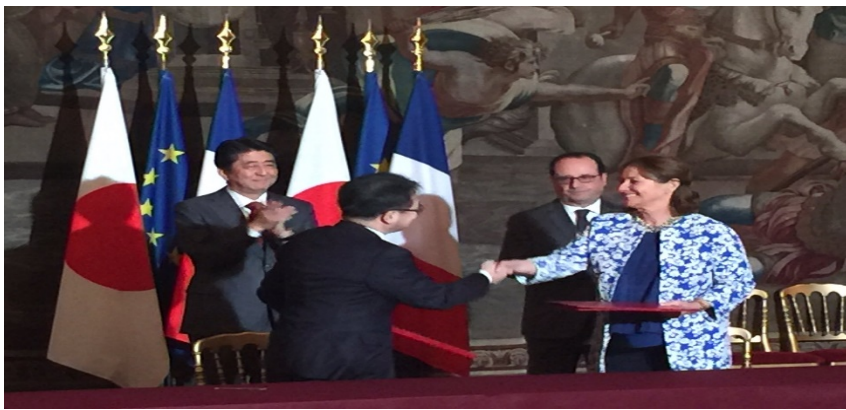
- *Defining the main principles of the collaboration*
- *Between the METI, the MEXT and France's CEA*
- *Signed on 5 May 2014 during the visit of Japan's Prime Minister to Paris*



*Signature collaboration agreement on Astrid in the presence of Shinzo Abe and François Hollande*

## The Declaration of Intent

- *Extending the scope of collaboration*
- *Between the METI and France's Energy Ministry*
- *Signed on 20 March 2017 during the visit of Japan's Prime Minister to Paris*



# CONCLUSION

NUCLEAR ENERGY

A PILLAR OF THE BILATERAL

STRATEGIC PARTNERSHIP