INTRODUCTION TO THE FRENCH NUCLEAR DECOMMISSIONING EXPERIENCE

30th of June 2017 – Workshop – Japan – Tokyo
Overview of the French nuclear sites under decommissioning

AGENDA

1. NUCLEAR PLANTS OWNERS AND RESPONSIBLE FOR DECOMMISSIONING

2. CURRENT FRENCH NUCLEAR FACILITIES UNDER DECOMMISSIONING

3. LESSONS LEARNED

4. STRATEGY FOR SUCCESS
FRENCH NUCLEAR OPERATORS ARE RESPONSIBLE ALL ALONG THE NUCLEAR LIFECYCLE…

- **3 NUCLEAR LICENSEES CEA / AREVA / EDF:**
  - Nuclear plants owners and responsible for plant lifecycle from design, erection, operation to dismantling together with waste management all along plant lifetime,

- **FRENCH REGULATORY FRAMEWORK REQUIRES DECOMMISSIONING TO BE COMPLETED AS SOON AS POSSIBLE WITH 3 PRIORITIES:**
  - Plant safety
  - Workers safety
  - Environmental respect

- **OWNER RESPONSIBLE FOR TECHNICAL AND FINANCIAL DECOMMISSIONING OPERATIONS:**
  - Dedicated fund placed under French State control
DECOMMISSIONING PREPARATION OPERATIONS

- Submission of the Decommissioning file
- Public inquiry
- Publication of the Decommissioning permit
- Application of the Decommissioning permit
- Regular plant inspections performed by the ASN
- Plant declassification permit

WASTE MANAGEMENT SYSTEM

- 20% radioactive waste (metal, etc)
- 80% conventional waste (rubble and metal)

- 19.5% very low and low level waste
  - Treatment (reduction in volume)
  - Surface storage

- 0.5% medium level long-lived waste
  - Conditioning
  - Temporary storage
  - Future disposal underground

0% of high level waste
AREVA HAS A STRONG EXPERIENCE IN D&D ...

- More than 5,000 D&D experts, globally, within the AREVA Group, with D&D and Clean-up skills (engineering, project management, nuclear operations, clean-up and D&D work ...)

- A presence in D&D with 5 major locations (France, Germany, United States, Japan, United Kingdom)

- Both as owner (in France) and contractor
As a responsible nuclear operator, demonstrate our full control along the entire life cycle, by efficiently managing decommissioning projects and waste generated by our power plants in operating or dismantlement phase.

EDF, the efficient and responsible electricity company, the champion in low-carbon growth

EDF NEW ORGANISATION WITH A DEDICATED DIVISION TO DECOMMISSIONING & WASTE MANAGEMENT

- Thermal
- Nuclear
- Renewables
- Grid
- Energy Trading & Supply

77% of the Group's power output

New Build
- 5 EPRs under construction in France, China & UK
- Others in project phase

Operating NPPs
- 58 reactors in France, 15 in the UK
- 73 GW installed capacity
- 478 TWh generated

Decommissioning and Waste Management (DP2D)
- 9 NPPs under decommissioning
- Waste treatment (Cyclife, Socodei)
- Development of solutions for HLW

Generating low-carbon electricity from nuclear power and renewables is a top priority of the CAP 2030 strategy

EDF, the efficient and responsible electricity company, the champion in low-carbon growth

As a responsible nuclear operator, demonstrate our full control along the entire life cycle, by efficiently managing decommissioning projects and waste generated by our power plants in operating or dismantlement phase.
EDF, A EUROPEAN FOOTPRINT WITH MORE THAN 1000 PEOPLE DEDICATED TO DEC. & WASTE MANAGEMENT…

The UK, Workington facility
- 25-staff
- Size-reduction and shot blasting: 3000 t/yr

FRANCE, Centraco facility
- 250-staff
- Melting: 3500 t/yr
- Incineration: 6000 t/yr
- Fabrication of concrete containers for nuclear wastes transportation
- Fabrication and operation of mobile conditioning units

SWEDEN, Nyköping facility
- 75-staff
- Melting: 5000 t/yr
- Incineration: 600 t/yr
- Pyrolysis: 50 t/yr

FRANCE, Paris and Lyon
- 400-staff dedicated to decommissioning
- 100-staff dedicated to characterization and waste management solutions
- 200-staff dedicated to safety and environmental studies

Based on its own experience and its “Architect Integrator Model”, EDF is able to provide a full integrated range of services across all the lifecycle of NPP.
EDF HAS CARRIED OUT PROJECTS IN DECOMMISSIONING AND PROCESSED NUCLEAR WASTE IN:
Austria, Belgium, Czech Republic, Danemark, Finland, France, Germany, Hungary, Italy, Kazakhstan, Netherlands, Norway, Poland, Romania, Slovakia, Sweden, Slovenia, Spain, Switzerland, United Kingdom, Ukraine.

EXAMPLES

FRANCE
9 units under decommissioning and an engineering support centre

KAZAKHSTAN
On site assistance for Aktau plant in the elaboration of their decommissioning plans

SPAIN
Transport and treatment of 15 heat exchangers from Cofrentes NPP

SWEDEN
Treatment of nine steam generators from Ringhals NPP

UNITED KINGDOM
• Treatment of multiple heavily contaminated steel and aluminium pond skips from Sellafield’s First Generation Storage Ponds
• Review of the base-line decommissioning plans for the AGR fleet

UKRAINE
Participation in the Shelter Implantation Plan (SIP) at the Chernobyl plant
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AREVA PROJECTS AND OPERATIONS IN FRANCE FOR D&D NUCLEAR SITES DISMANTLING

50+ Projects ongoing
600 M€ of revenue

4,000 employees

50 years of experience

4 main customers
(CEA, EDF, AREVA, ANDRA)

AREVA has a strong industrial base, thanks to a presence on all French nuclear sites
EDF, MORE THAN 15 YEARS OF EXPERIENCE, 9 WORKSITES, 4 TECHNOLOGIES
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**Description**

A massive Decommissioning & Dismantling program to manage diverse, complex issues (waste retrieval, ponds, silos, concrete buildings, process equipment… in high Rad environment).

**Lessons learned: Post Ops & Close Out preparation**

- Extensive characterization plan: essential to underpin the POCO / decom scenario
- End-state definition has a strong impact on POCO and Decom scenarios
- Waste-driven strategy is essential for the overall program cost & time management
- Safety issues: POCO & decom programs are different from commercial operations
- Securing specific competencies, resources and knowledge management
- Transition from ops to decom’ requires a major change in culture

**The key facts**

- A huge program combining waste retrieval and Decommissioning & Dismantling
- €4Bn of planned expenditures for a project set to last over 25 years
- More than 500 staff at peak
- 50,000 m³ of waste to evacuate
- 6,000,000 working hours
EDF CHOOZ A NPP: FIRST PWR UNDER DECOMMISSIONING IN FRANCE

- **Description**
  
  *The first reactor Chooz A, an early PWR built and exploited by EDF, was shut down in 1991 after an operational life of 22 years. The decommissioning permit has been granted in 2007 and the decommissioning should be done by 2022...*

- **Lessons learned**
  
  - Strategic choice between retrieving special operating tools for dismantling and developing new tools
  - NSSS Decontamination strategy (primary circuit)
  - Waste strategy & large components management

- **Ongoing works**
  
  - Under water vessel internals segmentation *(beginning on August 2017)* before vessel segmentation
  
  - Design of the strategy to optimize & secure the global fleet decommissioning: *58 PWR in Operation across 19 sites (3 NPP models with very closed design: 900MW, 1300MW, 1450MW)*
EDF SUPERPHENIX: THE BIGGEST REACTOR UNDER DECOMMISSIONING IN THE WORLD

- **Description**
  
  *The only fast reactor operated by EDF, Superphenix was a first of kind design based on high and complex innovative technology. Start up in 1986 with a unique Power of 1 240MW and shut down in 1998, the decommissioning permit has been granted in 2006 and the decommissioning should be done by 2030…*

- **Lessons learned**
  
  - Close work with the reactor designer (alliance type contract)
  - Definition of the methodology, in close relationship with the Safety Authority, for the defueling operations and the progressive shutdown of systems
  - Management of the socio economic aspects during the transition period
  - Design & successful operation of innovative waste treatment installations for Na treatment and internals penetration cutting by laser

- **Ongoing works**
  
  - Water filling of the vessel has been started on June 1017
  - All vessel plugs removal and vessel internal structure dismantling to start in 2018
  - Remote operations for vessel segmentation
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Nuclear decommissioning operations, compliant with the safety framework when …

✓ Driven by waste management from inventory, characterisation, off site evacuation to final disposal,

✓ Secured with proper and safe Primary Circuit dismantling, whenever done,

✓ Efficient and continuously optimized using the digital transition and in implementing innovative solutions, treatment processes and tools.

… managing the complexity and gathering experience is the key!
THANK YOU FOR YOUR ATTENTION

どうもありがとうございました