1. FEEDBACK EXPERIENCE OF THE FRENCH NUCLEAR INDUSTRY AS A WHOLE
2. EPR DESIGN AND KEY FIGURES
3. EPR PROJECT LESSONS LEARNED
4. TAKEAWAYS
FEEDBACK EXPERIENCE OF THE FRENCH NUCLEAR INDUSTRY AS A WHOLE

D&D Solid experience in decommissioning
9 units taken from operation to decommissioning

Unique experience across the entire fuel life cycle with French industry

A unique experience of nuclear services provided to more than 360 reactors all over the world (80% of capacity installed)

European and world scale feedback in operation
2,000 reactor-year of operation feedback
73 reactors operated by the Group

A strong and qualified nuclear workforce
more than 75,000 employees capable to manage all the steps of NPP construction

More than 100 NPPs built

Recent experience of construction
2 EPR in operation
2 EPR under final commissioning
2 EPR under construction

40 years of inhouse architect engineer experience
EPR : A POWERFUL & ROBUST DESIGN

The highest safety standard

- Safe by design
- Compliant with IAEA, WENRA, EUR standards
- Licensing experience
- Operational experience

A proven technology

- Evolutionary design derived from the best proven features from French and German PWR fleets
- 106 reactors built or under construction across the world
- More than 2,000 reactor-years of cumulated operating experience feedback

Performance improvements and efficiencies

- 37% overall efficiency depending on site conditions
- ~15% savings on uranium consumption per produced MWh
- >91% availability

Benefits from high power output (1,650 – 1,770 MWe)

- Compact Design: Size effect & Limited footprint
- with low carbon generation performance

DESIGNED FOR SUSTAINABLY REDUCING O&M COSTS
## EPR Reactor Main Design Characteristics

<table>
<thead>
<tr>
<th>Category</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermal Power</strong></td>
<td>4,300 MWth – 4,590 MWth</td>
</tr>
<tr>
<td><strong>Electrical power output</strong></td>
<td>1,650 MWe – 1770 MWe</td>
</tr>
<tr>
<td><strong>Thermal efficiency</strong></td>
<td>37 %</td>
</tr>
<tr>
<td><strong>Plant design availability</strong></td>
<td>91 %</td>
</tr>
<tr>
<td><strong>Primary system</strong></td>
<td>4-loops configuration</td>
</tr>
<tr>
<td><strong>Operation cycle length</strong></td>
<td>Up to 24 months</td>
</tr>
<tr>
<td><strong>Design service life</strong></td>
<td>60 years</td>
</tr>
<tr>
<td><strong>I&amp;C</strong></td>
<td>Full digital</td>
</tr>
<tr>
<td><strong>Fuel assemblies in core</strong></td>
<td>241 with 17x17 arrangement</td>
</tr>
<tr>
<td><strong>Radiation Protection</strong></td>
<td>collective dose &lt; 0.5 man.Sv/y</td>
</tr>
</tbody>
</table>

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**Designed for Sustainably Reducing O&M Costs**
EPR DESIGN : A WIDE LICENSING EXPERIENCE

- Construction license granted
- Design license initiated

A ROBUST DESIGN ALREADY LICENSED IN 4 DIFFERENT COUNTRIES
EDF EPR PROJECTS WORLDWIDE

UNDER OPERATION

EPR TAISHAN
The 2 first EPR units in operation worldwide

UNDER COMMISSIONING OR CONSTRUCTION

EPR FLAMANVILLE 3
The first EPR unit built in France

EPR HINKLEY POINT C
First nuclear construction project in the UK since 30 years

UNDER DEVELOPMENT

EPR JAITAPUR
The world largest nuclear power plant
6 units, 9.9 GWe

EPR SIZEWELL C
A replication of EPR Hinkley Point C

EPR KSA PROJECT
2 EPR Units
GENERAL INFORMATION

- First EPR reactor built in France
- Power output: 1,650 MW
- EDF combining its skills and responsibilities of Owner & Operator and Architect Engineer
- 100% EDF ownership

MAIN LESSONS LEARNED

- Management of regulatory changes
- Quality and safety culture as an overriding priority
- Building trust through dialog with stakeholders
- FOAK effects

CURRENT STATUS

- August 2017: Nuclear circuit cleaning
- August 2018: Functional tests vessel open successfully completed
- September 2019: Start of hot functional tests
- January 2018: Cold tests carried out

NEXT

- Fuel loading and start-up operation
EPR TAIHSAN 1 & 2: FIRST EPR UNIT IN COMMERCIAL OPERATION

**GENERAL INFORMATION**

- The first two EPR reactors in China
- Power Output: 1,750 MW each
- EDF as co-owner and co-operator – 30% EDF ownership

**MAIN LESSONS LEARNED**

- EPR design adaptability to tropical conditions
- Twin effects and benefits of lessons learned on EPC performance
- Deep localization based on robust qualification processes and partnership
- Early training and setting of a pre-operation team for smooth commissioning and operation readiness

**STATUS**

- **6 June 2018**
  - Unit #1: 1st criticality
- **10 December 2018**
  - Unit #2: Start of hot functional tests
- **13 December 2018**
  - Unit #1 in Commercial Operation
- **29 May 2019**
  - Unit #2: 1st criticality
- **29 June 2018**
  - Unit #1: grid connection
- **24 TWh**
  - nominal power
- **7 September 2019**
  - Unit #2: in Commercial Operation

**EDF Lessons Learned | ANBP Nairobi, Kenya | 16 October 2019 | EDF Copyright 2019**
EPR HINKLEY POINT C: A NEW BUSINESS MODEL FOR NEW NUCLEAR THAT INSPIRES OTHER COUNTRIES

GENERAL INFORMATION
- First nuclear construction project in the UK since 30 years
- 2 EPR units, 1,638 MW each
- A successful certification process: Generic Design Assessment (GDA)
- Contract For Difference (CFD) guarantying a fixed price of electricity for 35 years
- 66.5% EDF ownership

MAIN LESSONS LEARNED
- Early contractors involvement
- Increased level of design maturity at FCD
- Use of digital tools (design, schedule)
- Industrial and contractual schemes aligned to focus on delivery and project performance

CURRENT STATUS
- September 2016: Final Investment decision
- October 2013: UK Governments agrees Contract For Difference for HPC
- June 2019: Unit #1 « J0 » achieved Completion of Nuclear Island common raft
- March 2017: Reactor common raft first concrete successfully poured for power station galleries

NEXT
- 2025: COD Unit #1
- 2026: COD Unit #2
EPR SIZEWELL C: THE NEXT NEW BUILD IN THE UK

GENERAL INFORMATION

- 2 EPR units on the site of Sizewell totalizing 3,200 MW of capacity installed
- Project developed by EDF Energy together with CGN
- Replication of Hinkley Point C design

LESSONS LEARNED TO BE IMPLEMENTED

- Maximizing replication benefits (design, project management, industrial scheme)
- Adapting financing solutions to replication

SCHEDULE

- Stage 2 Public consultation
- Stage 3 Public consultation
- Nuclear Site Licence Application
- Generic Design Assessment
JAITAPUR PROJECT – THE MOST POWERFUL NUCLEAR SITE

GENERAL INFORMATION

- 6 EPR units on the site of Jaitapur totalizing 9,900 MWe of installed capacity
- First EPR reactors in India
- Works shared with NPCIL, Nuclear Power Corporation of India Limited and other international partners

LESSONS LEARNED TO BE IMPLEMENTED

- Deep localization through strong partnerships
- Anticipation of qualification and training processes
- A robust industrial scheme as a pillar of contractual arrangements

CURRENT STATUS

March 2018
India and France inked an agreement to expedite the JNPP project

May 2018
Submission of Preliminary Commercial Proposal to NPCIL

SCHEDULE

Commercial & Technical offer by EDF to NPCIL, scheduled by end 2019
Collectively address evolving safety requirements and strategies to meet them: an overriding priority.

Promote good practices and lessons learned for efficient EPR implementation: engineering, construction, commissioning, pre-operation.

Forge robust relationships foreseeing partnership opportunities in co-development projects.

Share operators’ knowledge and experience for boosted EPR operating performance.
KEY TAKEAWAYS

1. EPR is a safe, robust and adaptable product meeting its promises with its first operational track record

2. Success factors for project performance and long term safe operation are:
   - A stable and comprehensive regulatory framework
   - A strong control of the design (early design freeze, changes management, system engineering) and of the project performance
   - The early preparation and commitment of a knowledgeable Owner-Operator
   - The anticipation of supply chain development and strategic alliances (specially for deep localization ambitions)
   - Robust industrial and contractual schemes to align and incentivize projects participants with project objectives
   - A clear definition and allocation of risks among stakeholders

3. Most of all, quality and safety culture should always be maintained and continuous improvement

ALL LESSONS LEARNED ARE MANAGED TO BENEFIT TO CURRENT AND FUTURE EPR PROJECTS