Lessons learnt:
The value of experience

October 5th 2012
Project status

The value of experience

South African Context
4 EPR™ Reactor Units Under Construction

Olkiluoto 3

Taishan 1&2

Flamanville 3

The World’s First Advanced Fleet to be deployed
Olkiluoto 3
Major Milestones

- Reactor Building
- Containment Line -7 m to +16 m
- Delivery of the Reactor Pressure Vessel
- Lifting of the Reactor Dome
- Reactor Pressure Vessel introduced
- All primary loop components installed
- Fuel handling equipment installed

2007 2008 2009 2010 2011 2012
Flamanville 3
Major Milestones

- **Signature of the contract:** 2007
- **First concrete pouring:** 2008
- **Installation of Safeguard system piping:** 2009
- **Installation of the pressurizer relief tank:** 2009
- **Delivery of the first embedded tank (RPE):** 2010
- **First safety pump in the safeguard building:** 2010
- **Welding of first supports in safeguard buildings:** 2010
- **Start of Piping Erection:** 2011
- **EBS pumps installed:** 2012
Taishan 1&2 EPR™ Project
Major Milestones

- **Signature of the Contract**
- **Excavation Ceremony**
- **First Concrete TS1**
- **TS1 1st liner lifted**
- **TS2 1st liner lifted**
- **TS1: polar crane delivered**
- **TS1: RPV installed**

- **Start of the Self Reliance program**
- **LOI to create a JV in Nuclear Reactor Engineering**
- **First Concrete TS2**
- **TS1: Dome lifted**
- **TS2: Dome lifted**

2007 - 2008 - 2009 - 2010 - 2011 - 2012
Project status

The value of experience

South African Context
The value of Experience: Licensing
Reviewed by reference Safety Authorities

The EPR™ reactor
- Construction license granted by Finnish, French and Chinese Safety Authorities
- Design Certification by US NRC expected by 1st quarter 2013, GDA by HSE end 2012/beg. 2013 (interim DAC has already been issued)

First reactor subjected to the Multinational Design Evaluation Program (MDEP)

The EPR™ Reactor fully complies with WENRA objectives for New Power Reactors and is ready to comply with post-Fukushima requirements

This unique breadth and depth of design review strongly mitigates the licensing risk related to nuclear new build
The value of Experience: Project organization

Generic organization leveraging experienced teams

**Organization**

- **Worldwide PM support organization**
  - Project Management Office
  - Risk & Opportunity Management
  - Contract Management
  - Schedule Management
  - Estimating
  - Lessons Learned

- **COMPETENT RESOURCES**

- **STANDARDS, METHODS, TOOLS**

- **CROSS-FERTILIZATION**

**Experienced teams**

For the Taishan projects:
- 50% Management Directors & Managers,
- 50% Engineering staff,
- 90% Procurement workforce,

have worked on the OL3 or FA3 projects

Worlwide project support organization
The value of Experience: Engineering
Standardization of early engineering activities

- P&ID: Important input for layout in order to validate Civil Works (CW) interfaces
- DSE stage 2: important input for I&C

<table>
<thead>
<tr>
<th>System activities: Input data for other disciplines ready earlier and better defined</th>
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<tbody>
<tr>
<td>P&amp;ID First issue (months)</td>
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<tr>
<td>System Description Stage 2 - First issue (months)</td>
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<td>Piping isometrics Nb of revisions</td>
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NSSS engineering standardized and streamlined

Number of engineering hours for NSSS completion (for Taishan: estimate)
### The Value of Experience: Supply chain

Manufacturing of heavy components

<table>
<thead>
<tr>
<th>Unit</th>
<th>Year</th>
<th>Tube Sheet and Lower Shell</th>
<th>Shells Subassembly</th>
<th>Pressure Boundary &amp; Lower Part Sub-Assembly</th>
<th>Hydraulic Tests &amp; Preparation</th>
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<td><strong>OL3</strong></td>
<td><strong>Y1</strong></td>
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<td><strong>TS1</strong></td>
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Source: AREVA, average of the four Steam Generators for each unit

**Apr '12**

First two steam generators delivered on Taishan site
The value of experience: Procurement
Illustration: Core catcher

Delivery time core catcher protection layer\(^1\)

\[\begin{align*}
\text{(# months)} & & \text{OL3} & & \text{FA3} & & \text{TSN} \\
0 & & 28 & & 10 & & 5 \\
5 & & 25 & & 15 & & 10 \\
10 & & 20 & & 15 & & 10 \\
15 & & 15 & & 10 & & 5 \\
20 & & 10 & & 10 & & 5 \\
25 & & 5 & & 5 & & 5 \\
30 & & 0 & & 0 & & 0
\end{align*}\]

-68%

Included >1 year discussions about docs & construction plans

<9

Delivery time core catcher cooling structure\(^1\)

\[\begin{align*}
\text{(# months)} & & \text{OL3} & & \text{FA3} & & \text{TSN} \\
0 & & 26 & & 13 & & 6 \\
5 & & 25 & & 12 & & 5 \\
10 & & 20 & & 10 & & 0 \\
15 & & 15 & & 10 & & 0 \\
20 & & 10 & & 5 & & 0 \\
25 & & 5 & & 5 & & 0 \\
30 & & 0 & & 0 & & 0
\end{align*}\]

-50%

<13

Ceramic elements

1- Delivery time: from contract to delivery
The value of experience: Construction Illustration, from OL3 to TSN: first main milestones

**Construction duration (# months)**

- **Dome lifting**: 47 months
- **Slab +1,5m**: 16 months
- **Start of inner containment**: 10 months
- **Gusset pouring**: 9 months
- **1st concrete**: 12 months

Diagram showing the construction timeline from OL3 to TSN1.
The EPR™ reactor series effect: On-budget & faster project delivery

Planned construction time have been reduced significantly…

For reference: US Gen2 average

\[ \begin{array}{c|c|c|c}
\text{FOAK average}^1 & \text{OL3} & \text{FA3} & \text{TSN1&2} \\
\hline
\sim 95 & \sim 90 & < 50 & < 50 \\
\end{array} \]

Construction duration: 1st concrete to start of nuclear operation (# months)

1- FOAK average duration for AREVA previous reactor series

… and costs are well under control: Taishan on budget with already more than 85% costs committed on AREVA’s scope

Reference budget

Estimated cost at completion

Contingency

Fuel procurement

Equipment

Engineering & project management

\[ \begin{array}{c|c|c|c|c}
\text{Contingency} & \text{Fuel procurement} & \text{Equipment} & \text{Engineering & project management} \\
\hline
\text{Reference budget} & \text{Estimated cost at completion} \\
\end{array} \]

Nuclear Empowerment Conference – October 5th 2012
Project status

The value of experience

South African Context
From the report prepared for the DTI in 2011, Figure 1 shows the potential range of localization for the first NPP (assumed to be 3000MW). This figure shows a probable range of local content from 27% to 54%. The curve represents the total NPP CAPEX, including engineering, procurement (materials and equipment) and construction costs (the curve excludes specific specialty equipment including the reactor, stream generators and the turbine/generator package – which can amount to approximately 20% of the total CAPEX).
Using these ranges as a basis, the following figure shows the local content as it could increase through a fleet program (the IRP basis of 9600MW). The progression from the first NPP to the final shows the increase in local content based on the starting points shown in Figure 1 for minimum, mean and maximum. The increase of local content for each NPP is the same, only the starting points are different.
The Challenges

► Governmental request on localization:
  • A necessity for the development of the Country
  • But no anticipation

► Education and skill development:
  • A key point for the success of any infrastructure project
  • But too often a focalization by the elite on the wrong urgent needs

► Industrialization of the country
  • Existing in some activities and to be created
  • But to be upgraded for Nuclear requirements
  • But very often too expensive

► Wages versus Productivity
  • Not at the international standard but in total more expensive than Europe
The Challenges

► Localization

• A necessity if the Government wants to build a fleet and to create a local nuclear industry
• But this need a long anticipation impossible with the NO announcement

► Local localization

• Understandable for political reasons and acceptable for semi-skilled
• But counterproductive for high level skill in particular Artisans, Technician and Engineer

► Just an example of misunderstanding of the nuclear needs

• OL3: a peak of 4200 employees was reached in 2011
• FA3: 3600 employees on site (26% are foreigner)
• Taishan 1&2: more than 15000 people on site
The Challenges

To succeed we all need to start now

and thank you to be there today

now convey the message

at the Top Level

Merci