Construction Experience Feedback Lessons Learned

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Experience Feedback within AREVA
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Experience Feedback within AREVA - Overview

Objectives of Construction Experience Feedback within AREVA

- Learn from experience on ongoing activities in order to:
  - Optimize cost
  - Improve time-schedule and certainty on project execution
- Therefore, starting today, it is mandatory to:
  - Capitalize on best practices
  - Prevent and eliminate possible errors

Experience Feedback Process within AREVA

- Within AREVA, experience feedback is an ongoing process
  - As site activities progress, Lessons Learned are emitted by the projects through a dedicated database and following a specific process.
  - Consecutively, the Lessons Learned are analyzed at the head office:
    - The issues encountered on site are analyzed and appropriate improvements are proposed;
    - The good practices are capitalized and implemented in ongoing and future projects.
Detailed Process within AREVA

- A well defined and continuous process
  - Over 1.000 Lessons Learned gathered so far (captured, analyzed, distributed), mostly from OL3 Construction Site
  - Benchmark with construction of other nuclear facilities (GB2, Comhurex…)

- A valuable input towards future projects
  - Standard EPR™, Project Management, Procurement, Construction and Engineering Methods
  - Enlargement to new models

- A common and simple tool accessible to all project teams
Lessons Learned Process within AREVA

Capture

LL Contributors (LLC)
(all AREVA Plants employees)

LL master Delegates (LLmD)

Communicate/Close

LL Pilots (LLP)

Analyze

LL Delegates (LLD)

LL master Delegates (LLmD)

Improve

LL Operational Committee (LLOC)
Lessons Learned Tool in AREVA

- Dedicated database

Capture (Contributor)
Analysis / Filter (Delegate)
Publication (Master Delegate)
Improvement actions (Pilot)

Example of LL sheet

Improvement actions

Ongoing process

Draft
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Experience Feedback within EDF

Goal

- Avoid repetition of problems encountered on in-progress EPR Projects
- Inform about good practices and engineering choices

Method

- Establish a continuous improvement culture across organizations
- Implement a process which quickly defines, assesses applicability and implements Construction Lessons learned

Targeted users

- All EPR Projects

Sharing for mutual benefit
EPR Experience Feedback Project should produce the following results:

- contribute directly to the project efficiency (Performance, Cost, Schedule) of all operational EPR projects through a process of systematic analysis and systematic results delivery consistent with the projects milestones;
- contribute to the overall consistency in capitalizing the information on main evolutions from projects;
- feed the optimization work that will help to establish the reference “EPRRef”, for the future projects.
Experience Feedback Process within EDF

EPR Projects

OL3

Working Group
EDF/AREVA:
• Design update
• Construction
• Methods
• Schedule

“Experience feedback reports”, as far as it is the best way to ensure a good traceability of “field feedback” from all entities within EPR projects.

FA3

Feedback Data Base
• Experience feedback reports
• Thematic synthesis

TSN 1&2

Beyond the establishment by all the parties of feedback sheets, transverse or thematic analyses and syntheses are performed by members of the Project team, to be delivered to the EPR Project Directors and teams according to their needs.

Seminars are organized, to share subjects which may involve multiple projects.
Technical Exchanges between AREVA and EDF

- AREVA and EDF have joined forces to optimize experience feedback and continuous improvements

- Regular technical meetings are organized
  - Topics are defined in advance (ex: liner, pools, pre-stressing,...)
  - Design, Construction, and Time-Schedule aspects are discussed

- The goal is to improve the overall performance of nuclear new builds
Workforce Exchanges between EDF / AREVA / Taïshan Customer

Workforce exchange

- Chinese construction manager on Taishan spent 1 year within AREVA.
- Chinese delegations regularly visit OL3 site and several groups of Chinese engineers have spent 3 months on OL3 site.
- EDF organizes similar exchanges between TSN and FA3,
- 5 EDF experts assigned in OL3 commissioning team.
Experience Feedback
Construction Examples
Lessons Learned
Construction Examples

- Reactor Building (RB) raft: Taishan experience feedback
  - Massive concrete pour (4m thickness at FA3 and TSN)
  - One-step pouring is challenging, but has been mastered on Taishan:
    - Use of ice, integrated piping, heating cover.
    - 1 concrete step => 1 month saved compared to a 2-lift sequence
Lessons Learned
Construction Examples

- Reactor Building (RB) - Liner Cup
  - Delivery of the L-Shaped Liner Cup on site in two parts assembled together
  - Installation of liner Cup in one element on the Base Slab
  - No welding and inspection in situ
  - Support frame to avoid unacceptable deformations of the Liner Cup during lifting

Total prefabrication of the liner cup
Capitalization of OL3 good practice
Lessons Learned

Construction Examples

- Reactor Building (RB) - Gusset area
  - No alternate concreting
  - Optimization of reinforcement and concrete pouring to reduce schedule sequence and inter-dependence with internal construction activities and containment walls start

One single pour
Avoid numerous interfaces with internal construction activities
Lessons Learned
Construction Examples

- Reactor Building (RB) - Inner structures
  - Internal structures divided in 4 zones
  - Detailed and optimized construction sequence
  - Option: prefabrication of SG walls above +19.50m

**Improved construction sequence for the RB internal structures**
Lessons Learned

Construction Examples

- Fuel Building (FB) - Civil Works sequence
  - Construction in zones to avoid critical interface with Outer Containment
  - Priority to pools & level +19.50m
  - Detailed and optimized construction sequence

Reduce the impact of FB construction on critical path
Lessons Learned

Construction Examples

- Pools’ construction method: liner as lost formwork
  - Use of the pools’ wall structure (with liner sheets on) as lost formwork;
  - Preassembly of large modules outside Nuclear Island (OL3 good practice);
  - In line with ETC-C latest evolutions;
  - Drastic time-schedule reduction thanks to maximized prefabrication.
Lessons Learned
Construction Examples

Fuel Building (FB) & Safeguard Buildings (SAB) 2&3 - Roof construction methods

- Avoid the use of propping towers inside pool hall (FB)
- 2 layers of concrete of 1m and 0.8m thickness respectively for the APC Roof
- Temporary supporting structure composed of steel beams (FB)
- Providing a counter deflection by using different columns (SAB 2&3)
Lessons Learned
Construction Examples

- Galleries & Access Building
  - Optimization of construction sequence
  - Anticipation of connected buildings
  - Under study: use of prefabrication for galleries
  - No intermediate layer of reinforcement for Reactor Building Base Slab

Anticipation of galleries’ construction
Lessons Learned
Construction Examples

- Reactor Building (RB) Polar Crane
  - Use an already available hanging scaffolding for Polar Crane installation
  - Use two main preassembly areas instead of one
  - Early installation of the Runway through the use of temporary shimming
  - TLDs installation before Dome Closure
  - Installation activities carried out during Dome Closure
  - 5/35t trolley reeving in factory (320t also as additional key element)

Optimized sequence for Polar Crane installation
Lessons Learned
Construction Examples

Primary Components Installation

OL3 successful sequence capitalized
Lessons Learned
Construction Examples

Main Control Room prefabrication
- The OL3 MCR is base on a “box-in-a-box” concept
- To limit noise levels and increase worker’s comfort
- The steel box for the MCR has been fully prefabricated and lifted onto its final location with the heavy-load crane
Lessons Learned

Conclusion

- Clear & Efficient Lessons Learned Process set-up in place:
  - Joint involvement of EDF and AREVA on this Process
  - Formal Process set-up in AREVA involving various Engineering Departments
  - Efficient and visible results of this Process, especially for topics related to Construction matters – Direct application on
    - Standard Construction Methods
    - Constructability analysis for new models
    - Applicability to Request for Quotation for Construction & Installation Contractors
    - Construction Schedule mastering

- Key of Success of this Process and its results:
  - Dedicated Organization: Investment in a specific structure dedicated to Lessons Learned included delegates in various projects
  - Dedicated Process: Formal Process set-up in place with an efficient procedure
THANK YOU FOR YOUR ATTENTION