Plant Engineering and Construction System with Knowledge Management

A case study in NPP construction in Hitachi-GE NE

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1. Outline --- Way to success in NPP Construction

Challenges for New build projects

- Cost overrun
- Delay in schedule & commissioning

Hitachi-GE’s Approach

- Advanced Plant Integrated CAE system
- Front-loaded construction engineering
- Integrated construction management
- IT tools to improve site work efficiency

On-schedule & On-budget construction
2. Hitachi BWR Construction Experience

- Over 40 years and more than 20 BWR units construction experience
- Continuous construction provides a knowledge basis of improvement for next construction

- ‘60
  - Tokyo Electric Power CO.
  - Kashiwazaki-Kariwa-6/7 (1996/1997 C/O)

- 1970
  - Chubu Electric Power CO.
  - Hamaoka-5 (2005 C/O)

- 1980
  - Hokuriku Electric Power CO.
  - Shika-2 (2006 C/O)

- 1990
  - Electric Power Development CO.
  - Ohma-1 (Under Construction)
    (Full MOX ABWR)

- 2000
  - Chugoku Electric Power CO.
  - Shimane-3 (Under construction)

- 2010
  - ABWR (Advanced Boiling Water Reactor)
  - Other BWRs
Evolution of Engineering method

3. Advanced Plant Integrated CAE System with KM

Entire Engineering Process is based on Hitachi NPP Experience & Know-How with the support by Integrated IT tools.

- Conceptual & Basic Design
- 3D Modeling & Detail Design
- Production Design & Manufacturing
- Construction Planning & Site Work
- Operation & Maintenance

Integrated IT Tools

- Plant Engineering Database
- Integrated 3D-CAD Database
- Integrated Construction Management Database

NPP Experience & Know-How

Project Management  Engineering  Site Construction
4. Front Loaded Construction Engineering

Previous Design Process

- Basic Design
- Detailed Design
- Construction

Construction Engineering

Front-Loaded Construction Engineering
(Integrated CAE System Application)

Basic Design

Requirements from Construction Engineering

Detailed Design

- Inputs from Plant Design (BOQ, Composite Design, etc.)

Construction Engineering

-Just Do It As Planned –
-Quality Const. Eng’g-

Detailed Construction Management
5. Front Loaded Construction Engineering Examples (1 of 3)

- 21M (21 Month before Rock Inspection)

Optimization of construction method and construction schedule in master / sub-master planning

- Visualization of overall construction plan
- Combine 3D model with schedule data
Visualization of schedule by 4D (3D+ time)

6. Front Loaded Construction Engineering Examples (2 of 3)

Schedule

4D Simulation (Civil/Mechanical Coordination)

Construction schedule has millions activities in detail level. Therefore, it is necessary to visualize the work sequence on 3D-CAD in order to let the workers understand the image of their work.
For detail schedule planning, it is essential to consider actual construction work and the workface conditions because there will be some interferences by other contractors’ work and buildings and temporary materials, etc.

This simulation shows the sequence with 3D Modeling in order to share the sequence in each stakeholders (workers, supervisors, etc).

Schedule is basically categorized into 5 levels as followings;

1) Level1: master schedule
2) Level2: sub-master schedule
3) Level3: Area-by-Area Schedule
4) Level4: Monthly Schedule
5) Level5: Weekly Schedule
8. Integrated Construction Management Scheme

It is one of the most important issues how to manage the site work and what IT tools are to be developed!!

- Synchronize latest design information consistently
- Support an enormous Administrative Work at Site
- Control tight construction work processes

From Office Engineering To Site Work!
9. IT System Examples  (1 of 5) - Work Instruction & Record & Progress Control -

For nuclear power plant construction, it is necessary to make so much construction records. Therefore, it is essential to use advanced IT systems to manage these records efficiently. The IT System Examples section illustrates how to use these systems to ensure that all necessary records are managed effectively.

The IT System Examples section comprises several parts, each focusing on a different aspect of the IT system. These parts are:

1. **Work Instruction & Record & Progress Control**
   - The system is designed to manage work instructions, records, and progress control for the construction process.
   - It is based on the idea of linking all necessary database and IT systems to ensure that construction is managed totally and efficiently.

2. **Work Instruction & Record**
   - This part of the IT system manages work instructions and records, ensuring accuracy and completeness.
   - It streamlines the process of creating and maintaining detailed records for each construction point.

3. **Progress Control**
   - The system controls the progress of the construction process, ensuring that deadlines are met and that the project stays on track.
   - It provides a comprehensive view of the current status of the construction, allowing for prompt adjustments and improvements.

The IT System Examples section emphasizes the importance of using advanced IT systems in managing construction projects, particularly in the nuclear power plant sector. The system examples demonstrate how these IT systems can be utilized to achieve efficient and effective construction management.
For global project, it is important to easily take the information necessary for workers to do the work. This type of instruction method is important idea for unexperienced country of nuclear power plant construction.
This example shows how easily the worker can take the work instruction information by portable IT tools (in this case, portable tablet) at workface. It is important to let the Workers NOT to think over how to take their necessary information. "Make it simple" and "Make it Clear" is most important method.
12. IT System Examples (4 of 5) – Electronic Installation Manual (Animation Version) -

Installation for RCCV 2\textsuperscript{nd} Liners on the 1\textsuperscript{st} Layer

Lifting-up installation

<table>
<thead>
<tr>
<th>Work</th>
<th>Installation for RCCV 2\textsuperscript{nd} Liners on the 1\textsuperscript{st} Layer Lifting-up installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comment</td>
<td>safety precaution</td>
</tr>
</tbody>
</table>

Detail information

- Construction Manual
- Reference Documents
- Safety precaution
- Work precaution
- Quality precaution
- Others

Display

- Play Video

Movies list
13. IT System Examples (5 of 5) – Electronic Installation Manual (Actual Movie Version)
Lessens learned & Improvement items are to be reported and reviewed for next Project.

Our ABWR projects refer to the previous engineering legacy in all phases for basic/detail design, manufacturing design, construction engineering, as well as construction work procedure etc. Also, the improvement activities are to be implemented in the construction phases for next projects.

- “Kaizen” activity with incentive in construction phase
- Rationalization activities coordinated with Subcontractors
- Lesson Learned Report
- etc.

Design Coordination about “Kaizen” proposal
Master / Sub-Master construction schedule planning
Transportation Basic Planning
Temporary Facility Basic Planning
Installation In-Process Control and Procedure Review
etc.
15. Solution for “On Schedule, On Budget”

- Integrated **knowledge management** through total plant life (4D-CAE)
- Integrated **plant construction methodologies and management**
- Matured **engineering before starting construction** makes less rework

3D design output of reactor area  Actual installation work of reactor area

- **Realization of “On Schedule, On Budget”** NPP construction
- **Knowledge Management** based on abundant experience
Hitachi GE Nuclear Energy, Ltd has:
Exhibition Booth at M01 No.14

Please visit us to see more examples of
Plant Engineering and Construction
Management System !!