Application of the Multi-D technology for knowledge management throughout NPP life cycle

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- About NIAEP-ASE Integrated company
- Knowledge Management. Issues and approaches
- Why design knowledge management is important?
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- Multi-D Technology components
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Integrated company NIAEP-ASE is the leading engineering company of the State Corporation "Rosatom"
NIAEP-ASE in figures

Share of NIAEP-ASE in the world market of high power NPPs*

- NIAEP-ASE Integrated Company: 25%
- Westinghouse: 19%
- AREVA (including Atmea): 11%
- GE Hitachi: 11%
- KEPCO: 1%
- AECL: 2%
- Chinese manufacturers: 31%

* by power parameter

Share of NIAEP-ASE in the NPP construction market of Russia

- 53%

19 countries
current business presence

7 400 people
number of employees

$ 1.1 bln
revenue

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2013 Annual Report figures
NPP construction projects in Russia

4 Sites
8 Power Units

Baltic NPP
PU No. 1 • PU No. 2

Kursk NPP-2
PU No. 1 • PU No. 2

Nizhny Novgorod NPP
PU No. 1 • PU No. 2

Rostov NPP
PU No. 3 • PU No. 4

CONSTRUCTION
DESIGN AND SURVEY WORK
WORKS OF PREPARATORY PERIOD BEGAN
NPP construction projects worldwide

9 Countries  10 Sites  22 Power Units

Belarus: Belarus NPP
PU No. 1  PU No. 2

Hungary: Paks NPP
PU No. 5  PU No. 6

Turkey: Akkuyu NPP
PU No. 1  PU No. 2
PU No. 3  PU No. 4

Jordan: Mazhdal NPP
PU No. 2  PU No. 1

India: Kudankulam NPP
PU No. 1  PU No. 2
PU No. 3  PU No. 4

China: Tianwan NPP
PU No. 3  PU No. 4

China: Power Unit BN-800

Bangladesh: Rooppur NPP
PU No. 1  PU No. 2

Vietnam: Ninh Thuan-1 NPP
PU No. 1  PU No. 2

Armenia: Metsamor NPP
New power unit (NPU)

* INTER-GOVERNMENTAL AGREEMENT ON CONSTRUCTION OF NPP FACILITY WAS SIGNED
** TENDER FOR CONSTRUCTION NPP WAS WON

INITIAL PROJECT PREPARATION
DESIGN AND SURVEY WORK
CONSTRUCTION
LOW POWER TESTING

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2013 Annual Report figures
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Knowledge Management

Issues

We expect Structure

But usually Chaos
Knowledge Management

What we want

Why so?

We want **quickly** and **conveniently**

*find* and *apply* the needed knowledge
Knowledge Management
NIAEP-ASE concept of classification

- Lists
  - Requirements
  - Check lists
  - Classifiers
  - PBS, WBS и т.д.
  ...

- Schemas
  - Architecture diagrams
  - Business process diagrams
  - Mind maps
  ...

- Templates
  - Reports
  - Sequence of works
  - Letters
  ...

Knowledge repositories

References to Knowledge libraries are optional
Suggested Knowledge Management focus area
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Project management triangle for construction of large capital projects

- Cost
- Schedule
- Quality and Safety
How to manage triangle elements?

Decompose into single elements having cost and manage them, tracing the limit of elements, groups and in general.

Decompose into single elements having duration and manage them, tracing on control points.

Decompose **WHAT?** Manage **WHAT?**
Want to manage Safety and Quality?
Requirements and Configuration Management are the keys

Requirements  ➔  Documents and models  ➔  NPP

Decompose and manage

Configuration Management
IAEA-TECDOC-1335
Configuration management in nuclear power plants
Configuration Management principles (1/3)

IAEA-TECDOC-1335 Configuration management in nuclear power plants

"Configuration management (CM) The process of identifying and documenting the characteristics of a facility’s structures, systems and components (including computer systems and software), and of ensuring that changes to these characteristics are properly developed, assessed, approved, issued, implemented, verified, recorded and incorporated into the facility documentation."

CM equilibrium
Configuration Management principles (2/3)

IAEA-TECDOC-1651 Information Technology for Nuclear Power Plant Configuration Management

"Configuration management (CM) The process of identifying and documenting the characteristics of a facility’s structures, systems and components (including computer systems and software), and of ensuring that changes to these characteristics are properly incorporated into the facility documentation."

"in addition to the supporting facility configuration information programmes depicted in Figure 1, operational configuration, maintenance, and training information are also important components."
IAEA-TECDOC-1651 Information Technology for Nuclear Power Plant Configuration Management

"The CM IT solution, when complete, should meet the following general functional attributes in order to fully support the CM mission:

...  
-CM is identified as the integrating methodology for creating, maintaining, publishing and recording the nuclear power plant design basis"

"An important objective of a configuration management programme is to ensure that accurate information consistent with the physical and operational characteristics of the power plant is available in a timely manner for making safe, knowledgeable, and cost effective decisions with confidence."

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Knowledge Management - the key element to «enrich» Configuration management for future right decision-making

DATA are a set of the facts recorded on a certain carrier in the form suitable for continuous storage, transmission and processing.

INFORMATION is a result of data conversion and data analysis.

KNOWLEDGE is a recorded and processed information checked by practice, which can be used for decision-making.

WISDOM is a selection of the best (in some aspect) solution based on data, information, knowledge.

CM is usually focused on data and information. To support the right decision-making in the future it is also absolutely necessary to consider knowledge.
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Multi-D Technology – the project management methodology implemented in tools

Multi-D Technology to support life cycle management of large capital projects

Initial focus
Development of NPP construction project management technology based on construction process simulation using intelligent 3D models

Evolutionary focus
A set of UNIVERSAL approaches and tools has been created during development
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Requirements Management
Additional capabilities

IAEA, EUR are given for example. Is true for all types of high-level tasks

"Action" - for example, similar answer of requirement during tender documentation preparation
**Requirements management**

**KEY FEATURES**
- Management of individual requirements and links between them
- Requirements classification
- Traceability of requirements of different levels (regulatory requirements, customer requirements, internal requirements of the company) and at different stage (legal requirements, design task, requirements specification)
- Requirements change management and gap analysis

**DKM CONTRIBUTION**
- The best practices of the company are fixed in the form of internal requirements of the company
- Answers to requirements can be used on other projects of the company
The chain of help

Concept

Manager level

Head of the company

Chain depends on Issues type

Not solved in type? Auto escalation

1 day

2 days

1 day

INITIATOR
all requests via Operator only

OPERATOR
makes initial decision to start the chain classifies the problem and register it in the system concludes whether the issue is solved, or not

Low-level manager
The chain of help

KEY FEATURES

- Allows you to create a list of problem situations, controversial issues, nonconformities and automatically transfer the responsibility for resolving the problem of the hierarchical chain from the bottom up.

DKM CONTRIBUTION

- One of the elements of converting implicit knowledge into explicit.
- Issue-solution pair is a part of organization knowledge base itself.
- In addition there's a possibility to convert records of The chain of help in requirements of the organization. Two ways: identification in the accumulated knowledge base of the repeating problems during periodic reviews, or decision of the expert (just after solving the issue) that issue significantly affected (or may affect, if repeated) the project.

RMS – requirement management system
Catalogue of equipment and materials

Concept
Catalogue of equipment and materials

KEY FEATURES

- Catalog positions are added directly by manufacturers and suppliers. NIAEP-ASE is a verification center
  - More than 750 companies
  - More than 2,500 types of products
- Contains 3D models and required set of attributes
  - More than 25,000 unique 3D models
  - Some products have more than 150 attributes
- Integration with 2D/3D CAD systems
  - Adaptors for Intergraph SPPID, SPEL, SPI, SPRD, SP3D

DKM CONTRIBUTION

- Necessary structures to store products, documents, 3D models, equipment, price and suppliers quality data (= templates)
- Manufacturers, Products with related documents and 3D models, database (= knowledge library)

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3D designing

KEY FEATURES

- Creation of layout design
- Identification of spatial collisions
- Automatic generation of the design documentation (drawings, specifications) on the basis of 3D-models, to eliminate manual data entry errors in the documentation
- Provide input for procurement, Multi-D designing and other elements of Multi-D Technology

DKM CONTRIBUTION

- 3D model is a part of knowledge library
- Layout design of one project can be used for another (3D = template)
Unified plant information model
Unified plant information model
Possible software functionality

Detection of collisions and verification of data created in different CAD: 3D and attributes

Consolidated configuration management
Multi-D designing

Elements

3D

4D Schedule

5D Physical volumes

6D Human resources

7D Machines and mechanisms

8D Cost

Multi-D

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Multi-D designing

KEY FEATURES

- On the basis of the unified information model, construction processes are fine-tuned prior to their performance at site
- Allows to define the optimal construction technology and to create the "real" schedule
- Personnel training
- Planning and modeling of processes of technical maintenance and repair, decommissioning

DKM CONTRIBUTION

- Creation of standard fragments of works for application as a template when planning on other projects
- Creation of "real" labor norms on the base of experience coming from different projects
- Creation of various visual materials for personnel
Laser scanning

KEY FEATURES

- As a result of periodic scanning of the constructed object to receive a 3D model corresponding to the current situation and combining it with the 3D model to input the fact and to trace dynamics of events on a site
- When construction is completed, use results of laser scanning for updating 3D model and documentation ("as built") before transferring to operation
- Creation of 3D models ("as built") of objects for maintenance and decommissioning, in case models are absent

DKM CONTRIBUTION

- Data to update the 3D model ("as built")
Visual modeling studio on site

**KEY FEATURES**

- Helps to define the amount of work by a visual analysis of the object
- Helps to work with collisions between different disciplines identified during the construction
- Pre-installation layout of equipment and materials (for open-top method)
- Rigging (moving equipment through the corridors, levels, mounting openings and etc.)

**DKM CONTRIBUTION**

- Means "delivery" of visual materials to end-users on site
- Better mastering of visual materials on site
- Improving feedback quality
Spherical panoramas

**KEY FEATURES**

- Visual navigation between view points on a simplified site general layout from the office and directly at the site
- When combined with 3D model it's possible to perform plan-fact analysis of work in the construction, operation and decommissioning

**DKM CONTRIBUTION**

- Means of "delivery" of visual materials to end-users at the site (including on mobile devices)
- Provide access to knowledge libraries (3D, drawings, maintenance documentation and systems, visualization flush-mounted) by visual navigation and transition via the links (tags) applied on the image
Unified construction schedule

Usually the main difficulties in managing schedules are:

- Different responsible/stakeholders
- Different sources
- Huge amount of items to be analyzed

KEY FEATURES

- Analytics on documentation and equipment availability for upcoming construction & installation works (management of 3 schedules simultaneously based on links between items)
- Automation of collisions search within equipment supply and documentation release schedules
- Automation of collisions search between equipment supply and documentation release schedules
Thank you for your attention!

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