Nuclear information systems
Better operations through better integration
The world’s nuclear fleet is aging.

The nuclear industry has faced its share of challenges in recent years. Accidents like Fukushima Daiichi have led to increased regulation and business constraints. Financial stresses are coming from all sides – new construction delays with escalating costs are looking unattractive to investors amid falling energy prices and the increasing competitiveness of renewable generation. Negative public perception has also contributed to the absence of governmental policies that support and value nuclear power as critical infrastructure for meeting the world’s energy needs.

Due to the lack of new-builds from the 1990s to the mid-2000s, the average age of nuclear power plants in operation today has been increasing, with more than 60% of all reactors over 30 years old. Nuclear power plants are typically designed and licensed to operate for 40 years, but some nuclear utilities are extending the operating lifetime of reactors to 60 and even 80 years. To be able to successfully operate plants on this time scale, operators need to take a holistic and long-term view of data management and information organisation.

Age of the world nuclear fleet as of 1 July 2018

- 413 reactors
- Mean age: 29.9 years

The need for nuclear information systems.

Nuclear regulators require owners and operators to not only maintain the physical plant during its entire life, but also the plant’s information: documents and data. The set of business processes dedicated to track configuration changes and document gaps from the reference configuration are part of the asset management business processes. An enterprise asset management (EAM) system can track all changes in configuration that may have an impact on safety, allowing nuclear operators to comply with their license obligations.

In addition to the EAM system, plant lifecycle management (PLM) is widely adopted in the nuclear industry to manage and share information with all stakeholders involved in the design to delivery to decommissioning process (engineering, procurement, construction, owner, operator, etc.). Data and information is captured and managed in an integrated manner and is available to everyone when they need it to perform their work.

Extensive records are kept, ranging from design specifications, operating instructions, testing procedures and maintenance strategies, to 3D digital models, bills of material and lists of spare parts. All information is accessible based on the user’s profile, role, responsibility and authority. This approach of centralising data and information workflow allows the organisation to efficiently construct and deliver the nuclear plant, and to continually improve when implementing uprate projects or other design changes.
The trouble with legacy information systems.

The information systems in older nuclear power plants were often built piecemeal, starting with finance, then procurement and inventory and then, over time, adding other applications covering maintenance, operation, clearance, document management, waste, radioprotection, and other nuclear requirements. The result is a fragmented system, with multiple domain owners responsible for collecting and using data in their own domains.

Since these systems were not built with collaboration in mind, some of the information remains inaccessible to other stakeholders unless they duplicate the data or else build complex integrations. When data is organised this way, there is no longer a ‘single source of truth’, which can result in business process inefficiencies due to missing or inaccurate information.

Disparate information leads to inefficient business processes.
A modern approach to NIS design.

A better approach is to integrate the two largest components of the NIS: the PLM and the EAM. PLM-EAM integration ensures continuity of workflow across the organisation. The most important benefit of PLM-EAM integration is that it fosters communication between engineering, construction and maintenance. It improves transparency of activities for all key players, reduces data maintenance and improves data quality. Information traceability is improved, meaning better data and fewer errors. Users can access data according to their profile at any time, enabling them to do their job right the first time.

PLM-EAM integration = simplicity and efficiency.

**Documentation management**
- Document management
- Configuration management
- Workflow management

**Plant design management**
- Plant design
- Systems design
- I&C design
- Electrical design
- Piping design
- 3D design
- Flow diagrams

**Asset & work management**
- Work management
- Project management
- Controlled documents
- Labour entry reporting
- Records management
- Engineering change

**Materials & procurement management**
- Purchasing
- Accounts payable
- Contracts management
- Inventory management
- Procurement engineering

**Safety & compliance management**
- Action tracking
- Total exposure
- Equipment tagout
- Personnel qualification
- Safety data sheets
Maintain data quality.

In nuclear power plants, capturing equipment and configuration data is not a one-off activity. It is an ongoing process, starting with an approved set of data from Engineering, followed by continuous updates by Operations and Maintenance (O&M) personnel with operational data. After a few years of operation, the most accurate equipment data will be in the EAM, not the original specifications stored in the PLM.

PLM-EAM integration ensures consistent and automatic transfer of operational data to supplement the original design data. It precludes additional manual work to document, review and validate data when justifying requests for design changes or other requirements.

Leverage advanced digital twin features.

The PLM system is able to provide rich 3D modelling and detailed design data on all equipment and plant structures. PLM and EAM data can be integrated to create a master data management (MDM) modelling environment or ‘digital twin’.

The 3D digital twin and virtual navigation enables virtual training or staff qualification. It gives operators the opportunity to demo or practice their operations before going on site, greatly reducing risk and increasing worker safety. All interactions can be tracked and recorded for review and determining pass/fail when conducting staff training. Training certification is automatically sent to the EAM system for qualification tracking.

Work activities such as heavy lifts and major complex activities requiring close modelling of physical distance clearances can be virtually rehearsed to ensure that the plan is safe and efficient. Interactive virtual navigation in a 3D view of the equipment area can be used to verify conditions for work order execution. It can also be used to perform risk assessments, reducing the number of times that a worker needs to physically go into an affected area or containment zone.

PLM-EAM integration enables:
- 3D virtual training and certification
- 3D work understanding and familiarisation
- 4D maintenance simulation
- 3D work assessment

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Physical asset

3D/4D model in PLM

3D model in PLM

Asset data in PLM

Asset data in EAM
Digital transformation is now a necessity.

PLM-EAM integration is a proven approach to designing an NIS that is sustainable, scalable, maintainable, and delivers numerous benefits to owners and operators. It is supported by leading industry experts and in compliance with the Standard Nuclear Process Model, IAEA TecDocs and INPO guidelines for establishing a programmatic governance structure and culture focused on nuclear safety.

In today’s nuclear operating environment, it is more crucial than ever to increase operational efficiency and reduce costs without sacrificing safety. The value of investing in a modern NIS is immense, given that the operating horizon of a plant is in the decades, and continues to be extended. Whether you are planning a new-build or have been operating for years, a well-designed NIS will provide immediate and long-term benefits to your plant operations.