

Solving the Brain Drain of the Nuclear Industry: How to capture and manage your company's institutional knowledge for immediate action.



The ups and downs of nuclear knowledge

As the Nuclear renaissance is taking shape, more and more organizations realize that the knowledge and skills being lost due to baby boomer retirements are threatening the bottom line by compromising the safe and reliable operation of plants.

In the heyday of global nuclear development, nuclear plants drew the best of the best from universities and an abundant engineering and nuclear knowledge worker pool. But in the United States the newest nuclear power plants started contributing to the energy grid in the mid-1980s, resulting in a significant time gap in the development of new nuclear plants.

This latency in the evolution of nuclear power has affected the industry by reducing the number of nuclear university programs and discouraging new engineers from pursuing disciplines in the nuclear field. During this period a global freeze on new nuclear plant development magnified the problem. The amount of new talent entering the industry became stagnant for decades.

With the new emphasis on green energy, smaller carbon footprints and the ecological impact and cost of fossil fuels, the nuclear industry is once again growing, producing a rising market demand for nuclear professionals and an increased awareness of the need to maintain, sustain and grow the nuclear knowledgebase. The growth of the industry will be impeded unless viable solutions are implemented to capture and apply the knowledge of workers.

In 2006, the IAEA's (International Atomic Energy Agency) report titled *Risk Management of Knowledge Loss in Nuclear Industry Organizations* stated "There are two other complicating factors. The USA faces the issue of a 'greying' workforce where literally half the current workers will be eligible to retire within the next five years.



Secondly, the lead time required to produce an individual capable of safely operating the complex nuclear systems and technologies may exceed the time frame available until substantial retirement of the existing workforce begins.”

According to the IAEA it is critical to establish knowledge management programs to “maximize the flow of nuclear knowledge from one generation to the next and attract, maintain and further develop a dedicated cadre of highly competent professional staff to sustain nuclear competence.¹”

Throughout the career of a nuclear professional knowledge is accumulated not only through direct experience but also from the intangible experience gained from being a part of a complex operational environment. This cumulative knowledge is impossible to quantify. However, the potential impact of this lost knowledge can increase costs through:

- ◆ Increased CAQs (Conditions Adverse to Quality)
- ◆ Potential safety risks
- ◆ Reduced productivity
- ◆ Slower technology advancements

Managing knowledge is a multi-step process which includes the capture, dissemination and utilization of information. The benefits of effective knowledge management are numerous:

- ◆ Capture and identify tribal and institutional knowledge
- ◆ Increase productivity through easy access to information and reduced impact on work schedules caused by rework and repeatable errors
- ◆ Increase safety levels
- ◆ Improve/maintain competitive advantage through operational efficiencies
- ◆ Minimize the impact of worker mobility
- ◆ Maintain high levels of information integrity

And so the race is on to create effective knowledge management programs that the next generation of nuclear workers can leverage to improve their knowledge and contribute to the success of their organizations.

Explicit vs. Tacit Knowledge

Knowledge is broadly defined in two ways – explicit knowledge and tacit knowledge. Explicit nuclear knowledge is gained by attending engineering schools, training programs and certification classes. It can also be gained through visibility to documented best practices and lessons learned within the workers’ fields of expertise.

Tacit knowledge, also known as tribal or institutional knowledge, is built up over years on the job through experience and lessons learned. The individuals with this kind of knowledge often don’t realize the extent and value of that knowledge and typically don’t have a system to document it. It is this tacit knowledge that is “walking out the door” as a result of plant worker age, attrition, lack of mentorship programs, and adequate knowledge management systems. Once captured, tacit knowledge must be converted into explicit knowledge.

The key to a successful knowledge management program is to streamline and integrate capture and dissemination in such a way that utilization becomes efficient. In other words, captured knowledge must be actionable.

Developing a plan to capture tacit knowledge and make it actionable

As the nuclear industry has recognized and watched this disturbing trend of knowledge loss a number of organizations have launched efforts and strategies to try to capture the knowledge of experienced nuclear workers. These include document management, analyzing and discussing lessons learned, problem identification, corrective action, operating experience programs, and maintaining training and qualification records.

In most cases the information retrieved from departing knowledge workers is captured in one or more documents and then buried in a document management system. Or even worse, these documents disappear into desk drawers or personal filing systems. While document management systems have various degrees of success in making this information available through advanced searches, text retrieval methods and OCR, the information is still static and becomes stale almost as soon as it is archived.

¹IAEA Nuclear Energy Series No. NG-T-6.2, *Development of Knowledge Portals for Nuclear Power Plants*

Capturing the knowledge is only part of the challenge, and historically, it has been the lesser part of the challenge. What always seems to haunt these programs is the inability to make this information part of the organizational structure and daily business processes. In order for this information to benefit the plant and its workers, this is essential, it is what makes the information actionable.

The creation and refinement of knowledge is continuous, so the solution must be dynamic, and managed through change, while also being timely. The solution must be able to identify, manage and bridge the critical knowledge, while making it easy to find, easy to understand the context, and easy to access. And, due to its sensitivity, the information must be kept secure.

Rather than bury information in a static document, a better approach for managing institutional knowledge is to integrate it with accessible operational processes such as records management activities, master data list management (including MEL), modification packages, procedure and drawing updates, and corrective action. An additional benefit to this approach is that it allows and encourages current employees to contribute additional knowledge items. This is the foundation of a “living” knowledge management system that employees can continuously learn from and contribute to, diminishing the fear of information loss and obsolescence and providing an encyclopedia of tribal knowledge from which to draw on.

So much information. So much change.

From the very beginning of the life cycle of a nuclear facility there is information. Permit and license applications, engineering and architectural designs – owner/operators, AECs, EPCs all working simultaneously to get the nuclear facility built. Then the operations and maintenance phase begins, when the objective of a nuclear plant is, of course, to generate electricity. To reach this objective numerous departments handle many types of information items relating to design engineering, performance improvement, compliance, information management, and training.

There are many software applications available to nuclear facilities that manage portions of their complex and integrated closed loop processes, such as document management, or work management. But in order to effectively manage knowledge as it flows through these processes what is needed is an enterprise information management solution that establishes relationships between relevant information objects and manages the information and relationships through the life cycle of change.

Knowledge Management requires an information management platform that identifies all enterprise information associated with business processes, and the people that impact, participate or have responsibility for these processes. The nuclear plant is in a state of constant change, driven by regulatory requirements, lessons learned from communities of practice, equipment maintenance requirements, incidents and human behavior. Effective Knowledge Management requires the ability to transfer knowledge over time through the capture, analysis, auditing and management of changing information assets.

Knowledge Management through Enterprise Information Management (EIM)

With a true enterprise information management system, information objects are modeled and linked through relationships across processes and categories and managed through change. This is best described through a real world example.

Replacing a corroded pipe – a comparison of systems

An engineer is assigned to install a new pipe, to replace an existing pipe that is corroded. He will be using a pipe made from a different material than the original. As an experienced engineer, he knows that he will probably have to change the isometric drawing, perhaps one or two calculations, and confirm that the new pipe complies with the plant's design basis.

Without EIM:

Without a proper EIM system, the engineer will have to manually research, in a paper-based document vault or document management system, if changes to the ISO drawing will affect other related documents, equipment or business processes. In addition he will need to determine whether new operator training will be needed and specifically which training programs will be affected. Impact studies are compiled through brute force research, data mining and experience.

With EIM:

With an EIM system in place and fully populated and maintained, all the information listed above is available to the engineer "at a click of a button." The EIM system will also know if the engineer is properly certified to do the work and will track relationships between the pipe that is being replaced, related equipment, documents, processes, training programs, licensing impact, affects to the technical specifications and design basis. The EIM system compiles the impact analysis report proactively using information objects, including knowledge items, that have been contributed by multiple employees, using their experience and supported/enhanced by an ever growing and maturing knowledge database. The engineer will then be notified of any additional tasks that need to be completed based on the change he is making.

An Enterprise Information Management system improves information integrity and operational efficiency, thereby reducing costs and improving plant safety.

The effect of a living knowledge library is most obvious when change is introduced. Change may be prompted by various methods ranging from process improvement and corrective action to equipment obsolescence and new technology advancements. With a living knowledge base built within an enterprise information management system, change agents have the opportunity to report on the effect of change by simply drawing on the collective knowledge of the organization, as it was added into the integrated knowledge library, thereby providing the means to produce a change effects analysis.

A true EIM system provides an efficient and effective means to capture knowledge because tacit knowledge can be captured as workers go about their daily routines and converted to explicit knowledge, or knowledge items. This explicit knowledge is then automatically linked to relevant information objects so that it is visible as others access the system. The business owner or knowledge worker has thus contributed to the knowledge around a certain business process, without explicitly being aware of it.

For these reasons the most effective approach to Knowledge Management is through Enterprise Information Management. EIM provides the benefits not just for knowledge management, but for all operational processes throughout a nuclear plant:

- ◆ See and evaluate the impact of change before it happens so you can make better, more informed decisions
- ◆ Manage change efficiently and reliably
- ◆ Reduce time and effort necessary to fully comply with regulatory requirements
- ◆ Incorporate an effective Configuration Control Information System (CCIS)
- ◆ Manage and control all documents and records
- ◆ Improve safety and security
- ◆ Reduce costs and increase profitability
- ◆ Capture and retain operating experience and knowledge
- ◆ Reduce enterprise risk

What to look for in an Enterprise Information Management Solution

Gartner describes EIM as “an integrative discipline for structuring, describing and governing information assets, regardless of organizational and technological boundaries, to improve operational efficiency, promote transparency and enable business insight.”²

As the term has matured, they have added the following³:

- ◆ EIM brings together technology, business and organizational disciplines to exploit information as a strategic asset and to overcome existing information “silos.”
- ◆ EIM provides organized, consistent, secure and accessible content to those individuals who are empowered with the authority, accountability and decision rights for the proper control and oversight of enterprise assets.
- ◆ EIM spans described (also known as structured) and undescribed (also known as semi-structured or unstructured) content sources, inside and outside the organization
- ◆ EIM eliminates redundancy in data and processes, enables the lineage of information assets across the applications portfolio and establishes the common information infrastructure required to support business intelligence and performance management initiatives in using and analyzing information assets and metrics.

With this in mind, here are some critical features of an EIM system that you should look for:

- ◆ A unified solution where all components are designed to work together (as opposed to solutions that are touted to be “integrated” that patch information together between disparate information silos).
- ◆ A solution that connects all relevant information, including structured and unstructured, and connects all types of information objects, including documents, records, assets, people, processes and projects.

²Gartner, ID No. G00148273, *Putting Enterprise Information Management in Context*

³Gartner, ID No. G00143330, *Gartner Definition Clarifies the Role of Enterprise Information Management*

- ◆ A solution that manages information throughout the life cycle of the nuclear facility.
- ◆ A solution built upon industry best practices and guidelines provided by industry organizations including the NRC, INPO®, and the IAEA.
- ◆ A solution that provides actionable information.

Introducing eB Nuclear Knowledge Management

eB Nuclear Knowledge Management is a component of the eB Nuclear Application Suite—which also includes design engineering, compliance, performance improvement, information management and training. Each module has been developed based on industry guidelines and best practices (See Figure 1).

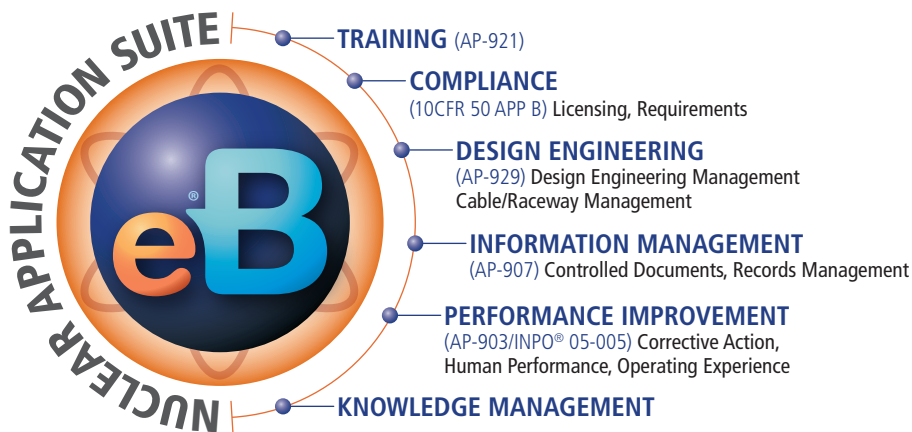


Figure 1 - eB Nuclear Application Suite

eB for Nuclear ensures the integrity of controlled information by uniquely managing its connectivity to all other relevant information. It captures, stores and manages structured data and unstructured content such as records, specifications, engineering drawings, procedures, reports, emails, design and licensing documents and identifies and relates this content through object modeling to physical

items such as equipment, systems, structures and components that comprise the plant. It further allows both content and equipment to be related to certain events that may occur at the plant, such as conditions adverse to quality (CAQs), corrective actions, operating experience (OE) and Human Performance observations. By building information bridges between documents, records, assets, people, events, processes and projects, eB for Nuclear creates an enterprise information management ecosystem for the rapid access of accurate and actionable information in context.

eB for Nuclear offers a practitioners' approach to knowledge management based on best practices which conform to emerging guidelines from the IAEA and leverage the nuclear process definitions established by the Nuclear Energy Institute's (NEI) Standard Nuclear Performance Model. It enables the

implicit contribution of valued knowledge into the operational processes and seeks to expose workers to existing information, including local and industry operating experience (SOER), corrective action events, applicable procedures, drawings, calculations and manuals.

eB Nuclear Knowledge Management supports the identification of all the enterprise information assets, processes, persons and their interdependencies.

“The ePIC (Electronic Performance Improvement Center) Performance Monitoring functions are closely linked to Constellation’s commitment to Knowledge Transfer and Retention. Integrated with the Corrective Action Program and other business processes, KT&R addresses the risk of losing experienced individuals and identifies gaps in process and program health. With eB, information is readily accessible in a predetermined object modeling system, so personnel turnover does not affect process efficiency and safety.”

- Jeffrey Germain, R.E. Ginna Nuclear Plant

It leverages the eB Nuclear Application Suite to fill the gaps found across the enterprise in specific areas such as the capture of tribal knowledge. eB enables the capture of this information through existing business processes to ensure it is available when needed and to minimize the risk of vulnerability in areas where knowledge workers will no longer be available to support the transfer of knowledge.

Though eB encapsulates the entire knowledge management process, it would be unrealistic to believe that plants would choose to replace all their applications with an eB solution in one complex deployment.

For this reason each of eB’s nuclear applications, including Knowledge Management, is designed to be modular and can be configured to work with existing legacy document and asset management applications, providing an enterprise information management platform that supports all nuclear business processes.

What to make of it all

The value of having a living knowledge management system cannot be overstated. The most effective method to achieve this is the implementation of a true Enterprise Information Management platform. Integrating actual plant business processes into the capture and management of tribal

knowledge ensures that the resulting knowledge management system is productive and can provide actionable information.

The availability of such a system adds additional value by empowering all participants in the daily activities of a nuclear plant with the responsibility of knowledge building and organizational learning, while at the same time providing the opportunity to each to expand their personal expertise.

For more information about the eB Nuclear Application Suite and eB Nuclear Knowledge Management, visit www.ebformuclear.com or call 800-992-6784.

