Nuclear Power Generation at the Crossroads

WHITE PAPER
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IDC ENERGY INSIGHTS OPINION

In the past several years, nuclear power began to experience a renaissance as a clean source of generation. Radiation, however, remains a concern, as the industry seeks to protect plant workers from exposure, ensure the health and safety of the population surrounding the plants, and prevent the leakage of radiation into the environment. Certainly, events at the Fukushima plant in Japan have reopened discussions on how nuclear power will come together in the next decade. Regardless of the ultimate fate of nuclear power, IT will play a significant role in ensuring safety at nuclear power plants during that time period. Nuclear power plants will need to be managed over the next decade or more:

- In many areas of the world, nuclear power plant construction is continuing, although more cautiously, in the aftermath of the accident at Fukushima.

- Clean replacement power will not be able to come online fast enough, especially in regions where there is high dependence on nuclear power.

- Where the decision is made to decommission, the decommissioning process is protracted.

- To maintain safety, security, and compliance at power plants, management must have well-documented and highly visible information across the asset life cycle.

- New designs and prelicensed equipment mean that any changes to the vessel, either during construction or in operations, create a mismatch with the licensing basis, possibly requiring relicensing.

- Best practices are to establish a common taxonomy and data synchronization, ensuring timely access to structured and unstructured data for all parties involved in constructing and operating a plant.
IN THIS WHITE PAPER

This white paper takes a look at how IT can be deployed to improve safety and compliance in nuclear power plants. IDC Energy Insights examines the future of nuclear power across the globe; analyzes the role of IT in the design, permitting, construction, operation, and decommissioning of nuclear power plants; and provides recommendations to plant owners on ensuring a secure and robust IT infrastructure.

SITUATION OVERVIEW

In the past several years, nuclear power began to experience a renaissance as a clean source of generation. While the cost of construction of a nuclear power plant is quite high relative to other types of generation, operating and fuel costs are low and quite stable compared with the volatility of other fuel sources such as oil. Nuclear is also a cleaner source of power compared with coal, oil, and even natural gas, which all contribute to greenhouse gas (GHG) and other air emissions.

Radiation, however, remains a concern, as the industry seeks to protect plant workers from exposure, ensure the health and safety of the population surrounding the plants, and prevent the leakage of radiation into the environment. Certainly, events at the Fukushima plant in Japan have reopened discussions on how nuclear power will come together in the next decade. Because of these concerns, the nuclear industry and regulators remain highly focused on safety practices at the plant. In fact, nuclear power plants are ahead of other types of generation when it comes to best practices in asset management and strict operating procedures. Current events will prove to strengthen the industry in those practices.

Business Conditions

Demand for Electricity Continues to Increase

Demand for electricity worldwide is expected to continue to increase, with the fastest growth expected from emerging economies. According to the International Energy Agency's World Energy Outlook 2012:

Globally, demand for electricity is set to continue to grow faster than for any other final form of energy. In the New Policies Scenario, demand expands by over 70% between 2010 and 2035, or 2.2% per year on average. Over 80% of the growth arises in non-OECD countries, over half in China (38%) and India (13%) alone. In terms of electricity use, industry remains the largest end-use sector through 2035.
Nuclear Power Forecast to Grow

According to the World Nuclear Association, 435 nuclear reactors exist in 30 countries and generate 14% of the globe's electricity. Still, the World Energy Outlook New Policies Scenario notes that nuclear power output will rise by 58%, though its share will fall from 13% to 12%. The World Nuclear Association indicates that currently 64 nuclear projects are under construction totaling 61,442 MWe net (see Table 1).

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Nuclear Projects Under Construction</th>
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<tbody>
<tr>
<td></td>
<td>Number of Plants</td>
</tr>
<tr>
<td>Abu Dhabi</td>
<td>1</td>
</tr>
<tr>
<td>Argentina</td>
<td>1</td>
</tr>
<tr>
<td>Brazil</td>
<td>1</td>
</tr>
<tr>
<td>China, mainland</td>
<td>25</td>
</tr>
<tr>
<td>Finland</td>
<td>1</td>
</tr>
<tr>
<td>France</td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>7</td>
</tr>
<tr>
<td>Japan</td>
<td>2</td>
</tr>
<tr>
<td>Korea RO (South)</td>
<td>4</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>10</td>
</tr>
<tr>
<td>Slovak Republic</td>
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</tr>
<tr>
<td>Taiwan</td>
<td>2</td>
</tr>
<tr>
<td>Ukraine</td>
<td>2</td>
</tr>
<tr>
<td>United States</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
</tr>
</tbody>
</table>

Fukushima Brings Attention to Nuclear Generation

The nuclear power industry around the world responded to the accident at Fukushima with calls for further study of the conditions surrounding it. Across the board, industry and government studied the ability of plants to understand the lessons learned on:

- Natural disasters such as earthquakes and tsunamis
- Prolonged power outages
- Core meltdown
- Spent fuel storage leakages

While most of Japan's nuclear reactors remain offline, the future growth of nuclear generation will depend on a number of factors.

Current Dependence of a Region on Nuclear Power

Nuclear power makes up a substantial portion of power generation around the world. For example, France gets 75% of its electricity from nuclear power. Nuclear power makes up about 20% of the generation capacity in the United States and more than half of the power generation capacity in six states. Plants in these locations are unlikely to be decommissioned because of the time and level of investment it would take to stand up new generation to meet current demands.

The Increased Demand for Energy Combined with a Concern About Climate Change

Demand for electricity in emerging economies will increase as industry in the BRIC countries (Brazil, Russia, India, and China) continues to grow. Historically, countries like China and India have been highly dependent on coal as a lower-cost resource, but that is beginning to change as these countries seek cleaner energy resources. For example, China's current total installed wind power capacity stands at 44.7GW (China is ranked number 1 in the world, ahead of the United States), and existing nuclear power capacity was expected, prior to Fukushima, to increase sixfold to at least 50GW by 2020.

The Need for Energy Security and Low-Cost Energy

For Europe and North America, energy security and low-cost energy have emerged as issues. Europe is highly dependent on imports of fuels for generation. Renewable energy is an avenue that countries such as the Netherlands, Germany, and Denmark have been pursuing in part to address GHG emissions and lower dependence on natural gas as feedstock for power generation.
**Nuclear Design Advances Improve Safety and Economic Viability**

Smaller reactors may provide an alternative to the high costs, risks, and long time to operations characterized by older, larger nuclear power plants. These features may include underground containment and "passive" safety systems that might have decreased the chances of the Japan accident. The Tennessee Valley Authority is looking to develop a small version of the technology at the Clinch River site near the Oak Ridge National Laboratory in Tennessee. Before the Fukushima accident, France was investigating the idea of "moving industry offshore" and giving it a new twist — plant small nuclear reactors in the seabed and transport the electricity back on land.

**Aging and Changing Workforce**

The U.S. Department of Labor estimated that 30% of the nation's nuclear engineers, 26% of its reactor operators, and 26% of its nuclear technicians would retire by 2012. The challenge for the utility is to capture this experiential knowledge and transfer it to the incoming workforce to be able to access as much knowledge as possible needed to run the plants. Each nuclear facility is unique and has its own rich collection of documentation that needs to be easily accessible to staff.

**Shutdown and Relicensing of Existing Nuclear Plants**

When a nuclear power plant reaches the end of its licensing period, that plant can either apply for a license extension or be decommissioned because there is no longer an economic justification for operation. In the United States, 61 nuclear power plants have received a 20-year extension of their licenses, and another 13 plants are waiting to be relicensed. The industry has experience with the decommissioning of plants. According to the World Nuclear Association, "About 100 mines, 90 commercial power reactors, 45 experimental or prototype reactors, over 250 research reactors, and a number of fuel cycle facilities have been retired from operation. Some of these have been fully dismantled." The three approved means of decommissioning are immediate, safe enclosure, and entombment. The process is particularly long with safe enclosure. For example, the French Atomic Energy Commission is decommissioning the UP1 reprocessing plant at Marcoule. Progressive decontamination and dismantling of the plant and waste treatment will span 40 years and cost some 5.6 billion euros, nearly half of which will be for treatment of the wastes stored at the site. Over this entire period, management and reporting of the decommissioning effort is required.
Regulatory Conditions

Increased Compliance and Regulatory Oversight After Fukushima

The focus is clearly on processes to manage standard operating procedures to handle unforeseen events. For example, in March 2012, the Nuclear Regulatory Commission (NRC) issued post-Fukushima regulations that require that "power reactor Licensees and CP [construction permit] holders develop, implement and maintain guidance and strategies to restore or maintain core cooling, containment, and SFP cooling capabilities in the event of a beyond-design-basis external event."

Moratorium on New Nuclear Development

More immediately, some regions have put a halt to development of new nuclear power plants:

- Following the 2011 nuclear meltdown at Fukushima, German Chancellor Angela Merkel decided to replace atomic reactors with more fossil-fired plants and a growing share of clean-energy sources. Eight reactors were shut immediately, and the last are scheduled for closure by 2022. In June 2011, Switzerland decided to abandon plans to build new nuclear reactors and will phase out its existing plants when they reach the end of their normal lives.

- Italy will once again halt development of nuclear power plants as a result of a recent referendum.

- After Fukushima, all Japan's nuclear power plants were shut down and only two have resumed operation. Given Japan's dependence on nuclear power, it is still unclear whether the country will phase it out entirely.

However, some countries have resumed nuclear development after brief suspensions. For example, China temporarily suspended all project approvals until the beginning of 2012 in the wake of Fukushima. However, the approvals were resumed in October 2012, and now China plans to add another 32.81GW of nuclear generation.

More Inspections, More Regulation

The Fukushima accident has raised concerns that existing nuclear power plants are not capable of withstanding natural disasters or terrorist attacks. Regulators have ordered inspections at nuclear power plants within their jurisdictions.
Initial inspections have been completed on 104 nuclear power plants in the United States. While the NRC found that plants were safe, there is still much work to be done on maintaining and training on guidelines that will ensure public safety in the event of an accident.

**The Process for Relicensing Is Expected to Be More Complicated**

Another impact of Fukushima is increased scrutiny for plant relicensing. According to Professor Ernest Moniz of the Massachusetts Institute of Technology in his testimony before the United States Senate Committee on Appropriations, Subcommittee on Energy and Water Development, March 30, 2011, "The expected relicensing of 40-year-old nuclear plants for another 20 years of operation will face additional scrutiny, taking more time than expected. Indeed some of the license extensions already granted for more than 60 of the 104 plants operating in the U.S. could be revisited. These plants, like those at Fukushima, rely to a large extent on active safety systems in case of accidents or natural disasters, rather than the passive safety systems built into the new designs."

**Reducing the Carbon Footprint**

Climate change and greenhouse gas emissions are still on the agenda for many countries. The Copenhagen Accord of 2009 set a nonbinding limit on the increase in global temperature to 2 degrees centigrade above preindustrial levels. It also required signatories to establish emissions targets for 2020. Carbon emission reduction goals are still in question in the United States, as Congress has not been able to pass an energy bill. While the cap and trade market is active in Europe, cap and trade is off the table in the United States. However, there is a strong push to limit carbon emissions through enforcement of air emission regulations.

**Security Is a Constant Consideration**

The Fukushima event has focused attention not only on natural disasters but also on potential dangers from terrorist attacks. The last major look at physical security in nuclear power plants was after September 11 when concerns were raised about whether nuclear containment vessels could withstand a terrorist attack. The Stuxnet virus certainly raised concerns among those that are cybersecurity focused. The potential of a virus infiltrating the process control system at a nuclear power plant, as was the case in Iran, put plant operators on notice. The security of operating data and design documents is also important because they provide contextual information about potential vulnerabilities.
Management Challenges

An effective strategy for managing large capital assets, such as nuclear power plants, is to look at ways to improve management across the asset life-cycle management process (see Figure 1).

**FIGURE 1**

**Asset Life-Cycle Management Process**

Source: IDC Energy Insights, 2013

Planning, design, and engineering → Procurement

Procurement → Construction

Construction → Operations and Maintenance

Operations and Maintenance → Redesign or decommissioning

Redesign or decommissioning → Planning, design, and engineering

Planning, design, and engineering → Procurement

Planning, Design, and Engineering

Accessing Financing

Companies with plans to develop additional nuclear power will face some setbacks going forward. Development of a nuclear power plant is already costly and will become even more so with the requirements for more safeguards. Even before the Fukushima accident, the industry in the United States was dependent on loan guarantees by the federal government. In the short run, there may be some impact on a company’s ability to finance a project, if loan guarantees are affected in the federal budgeting process.
Permitting and Licensing

Permitting and licensing are document-intensive processes. Applications for a construction permit, an operating license, a license for waste disposal, a license transfer, a license amendment, a license renewal, or a standard design approval are typically processed through a regulatory body. In the United States, the application process is covered by the NRC Regulations, Title 10 of the Code of Federal Regulations. Companies must file applications and, depending on the applications, environmental impact statements, with the federal regulators as well as state and local authorities having jurisdiction. In the European Union (EU), the European Nuclear Safety Regulators Group (ENSREG) works to establish the conditions for continuous improvement and to reach a common understanding in the areas of nuclear safety and radioactive waste management. ENSREG is composed of senior officials from the national nuclear safety, radioactive waste safety, or radiation protection regulatory authorities from all 27 member states in the European Union and representatives of the European Commission.

Construction

Adapting to Prelicensed Reactor Configurations

One of the differences between nuclear power plants being constructed today and those designed 20 years ago is that there are more prelicensed vessels. Prelicensing provides a way to ensure quality control of a self-contained unit prior to delivery and installation onsite. This makes for a more efficient construction process, but it poses the issue that any changes to the vessel, either during construction or in operations, create a mismatch with the licensing basis, possibly requiring relicensing.

Project Work in Multiple International Locations

The construction of a nuclear power plant has always been a large capital project, involving multiple parties — engineering and design companies, equipment vendors, prime construction contractors, and owners/operators — in a joint project management organization. The industry has become more globalized as nuclear power plants are constructed in various parts of the world. This also means that systems must be able to accommodate multiple languages.

Procurement

Ensuring Local Content in Emerging Economies

With many of the nuclear power projects being developed in emerging economies, there are requirements to use "local content" for procurement of equipment and services. These requirements add another layer to procurement as vendors are reviewed and equipment is approved for proper certification, adherence to the licensing basis, and local content.
**Operations and Maintenance**

**Strengthening a Zero Tolerance for Accidents**

Owners and operators of nuclear power plants, along with vendors of equipment, are responding to concerns about the safety and security of nuclear power. The industry has already established a zero tolerance for accidents as have the airline and oil and gas industries. Management must be able to assess current conditions at their units, looking not just at the obvious containment areas but also at the backup and recovery equipment. This will also mean a revisiting of standard operating procedures and change management, especially in the area of disaster response.

Compliance is largely dependent on the nuclear operators themselves to report potential noncompliance. In the United States, this is the case, although the NRC maintains at least two resident inspectors at each nuclear power plant to examine plant systems, observe the performance of reactor personnel, and prepare regular inspection reports. The NRC has adopted "risk-informed regulation," which relies on performance indicators to determine the level of scrutiny for each reactor.

Following the nuclear accident in Fukushima on March 11, 2011, the EU Commission pressed for a reassessment of all 143 EU nuclear power plants. To guarantee the highest safety standards in the world, the EU draws on the lessons from Fukushima and focuses the tests on all sorts of natural disasters and also includes the effects of man-made accidents such as airplane crashes as well as terrorist or other malevolent attacks. The Commission is also in close contact with countries outside the EU — in particular Switzerland, the Russian Federation, Ukraine, and Armenia — and is working with them on reassessing their nuclear power plants. This means that the burden is on the owners to maintain and manage complete and auditable records.

**High Impact of Prolonged Outages**

Each day that a nuclear power plant is out of service is costly to the plant owner. Owners are able to make arrangements for replacing lost power when the outage for maintenance or replacement for major plant equipment is planned. However, if an outage is extended or unplanned, the company must purchase power on the spot market, often at high prices, with expenses exceeding the cost of the repairs themselves. For example, Progress Energy experienced a prolonged outage at one of its plants. Over about 16 months, the company spent approximately $150 million on the repair and $290 million on replacement power costs. The company's insurer — Nuclear Electric Insurance Limited — paid $181 million during that time period. Of the $181 million received, $117 million covered replacement power and $64 million covered repair costs.
In these cases, management seeks to identify what is within their control to reduce the length of the outage. Of course, finding additional potential safety hazards that must be addressed, as was the case with the Progress Energy plant previously described, is unavoidable. There are other ways to streamline outages, such as tighter management of work crews. Management can also take steps to enable easy access to up-to-date engineering drawings and maintenance history, as well as creating a streamlined workflow for engineering sign-off.

**Decommissioning**

A number of nuclear power plants have reached the end of their useful lives and must be decommissioned. Regulatory bodies are responsible for overseeing the decommissioning process to ensure safe handling and containment of nuclear waste. The costs of decommissioning can run into the hundreds of millions of dollars. The first three nuclear reactors decommissioned in the United States cost from $490 million to $790 million to decommission.

Plants being decommissioned were built long before electronic documents. With the prospect of future decommissioning, there is a push to convert paper files to electronic content to manage content and enable archiving and imaging.

**IT Challenges**

**Managing Data (Structured and Unstructured) and Information**

The major challenge with managing documents and knowledge at a nuclear facility is the sheer volume of records requiring significant storage, indexing, and querying capabilities. The volume of documents can be quite large. Every record has both content and metadata for indexing, searching, and formal auditability. In addition, nuclear regulations require that all records be stored in two physical locations—one onsite and one offsite. For one company, there are typically 1,000 users and 6 million documents of various types and sizes to be managed on a daily basis regarding nuclear operations.

**Documenting Changes to Prevent Accidents**

Because of the extreme complexity of a nuclear power plant, even small changes in equipment can have significant impacts on plant operation. For example, in one situation, it was taking too long for a pair of remotely operated valves in the emergency cooling system of a nuclear power plant to move from completely closed to completely open. Engineers shortened the distance between the two positions, but two other pairs of valves were interlocked with the first pair. These valves could not open at all until the first pair opened all the way. No one noticed until the valves refused to open during a test 18 months
after the engineers made the changes. Fortunately, the company had redundancy in the system, with backup pumps that could be activated.

A best practice approach is to create a culture that enforces documentation of changes and makes that data available for analysis — ideally in some automated way through analytics — to alert operators to the potential impact on plant processes.

**Competing Taxonomies**

One of the obstacles to efficient document and data management is that often multiple taxonomies (numbering) are in use at a plant. Equipment providers and contractors may have different taxonomies from the owner/operator. In fact, owners of a nuclear fleet may be using multiple taxonomies across the enterprise, often due to acquisition of plants from other owners. This not only makes integration between applications and data repositories more difficult but also slows communications between parties as engineers spend time "translating" and reconfirming equipment and parts.

**FUTURE OUTLOOK**

Nuclear generation will continue to be a part of the generation portfolio meeting the demands of the world for electricity. It is clear that there will be more regulations and increased regulatory oversight for both existing and future nuclear generation plants. Enhancements to safety and security will certainly add to the capital costs of nuclear power, but with the right information technology in place, the industry will meet many of these challenges.

Enterprise content management is one of the five major pillars of a comprehensive capital project management strategy. Successful capital project management and execution depends on the sharing of data between developers, owners, venture partners, operators of the physical assets, and third parties at various stages of the process. Much of that data is "unstructured" data in the form of drawings, documents, or other content. In contrast to structured data, which can be found in applications and databases, this "unstructured" content is not formatted for easy transfer between parties through integration or exchanges (see Table 2).
<table>
<thead>
<tr>
<th>Function</th>
<th>Content Type</th>
<th>Project Participants</th>
<th>Key Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning, design, and engineering</td>
<td>• CAD drawings • Project specifications • Vendor documentation • P&amp;IDs • HSE plans • Permits • Licensing • Transmittals • Project reporting • Environmental impact reports • Site suitability review</td>
<td>• Partners — joint venture partners • Contractors — engineering and design, architecture • Regulators — environmental review boards, permitting authorities, nuclear regulatory authorities</td>
<td>• Workflow for design approval • Integration with authoring systems • Collaboration • Audit trail for regulatory approvals • Drawing/CAD management • Transmittal management • Document bulk loading • Scanning/imaging • Business process management</td>
</tr>
<tr>
<td>Procurement</td>
<td>• Approved designs • Transmittals • Purchase orders • Bill of material • Qualifications • Certifications • Contracts</td>
<td>• Contractors — engineering and design, architecture • Equipment manufacturers</td>
<td>• RFP dissemination and tracking • Contract management • Transmittal management • Collaboration • Records management • Archiving</td>
</tr>
<tr>
<td>Construction and commissioning</td>
<td>• Approved designs • Transmittals • Inspection documentations • Punch lists • As-built drawings and specifications</td>
<td>• Contractors — engineering and design, architecture, construction contractors and subcontractors • Regulators — local building departments, occupational health and safety, nuclear regulatory authorities</td>
<td>• Collaboration • Workflow for change order approval • Transmittal management • Records management • Archiving • Drawing/CAD management • Business process management</td>
</tr>
<tr>
<td>Handover</td>
<td>• As-built drawings and specifications</td>
<td>• Partners — joint venture partners • Contractors — engineering and design, architecture</td>
<td>• Collaboration • Workflow/transmittals for handover acceptance • Bulk loading</td>
</tr>
<tr>
<td>Operations and maintenance</td>
<td>• Operating procedures • Exploded views • P&amp;IDs • As-built, as-operated drawings and specifications • Maintenance instructions</td>
<td>• Maintenance staff • Contractors • Management oversight</td>
<td>• Integration with maintenance management systems • Audit trail for regulatory approvals • Collaboration • Transmittal management • Maintenance optimization/integration • Records management • Archiving • Business process management</td>
</tr>
</tbody>
</table>
### Table 2

**Essential Content for Capital Project and Asset Management**

<table>
<thead>
<tr>
<th>Function</th>
<th>Content Type</th>
<th>Project Participants</th>
<th>Key Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redesign or decommissioning</td>
<td>• As-built, as-operated drawings and specifications • Exploded views • Decommissioning documentation</td>
<td>• Regulators • Contractors — waste management, construction, engineering and design • Equipment manufacturers</td>
<td>• Collaboration • Workflow for engineering document approval • Scanning/imaging</td>
</tr>
</tbody>
</table>

Source: IDC Energy Insights, 2013

### Best Practice Approach

One greenfield nuclear plant development project has taken an innovative approach. On one project, the participants have accepted a set of best practices, including a common taxonomy. The taxonomy is constructed by structure, system, and component to coincide with the organization in the design system. There is one central database for release of engineering, procurement, quality control, and correspondence. It serves as the repository for design basis and technical support documents.

The project has also managed to tackle data synchronization between the participants. Data from the nuclear plant equipment provider is delivered with metadata, validated, and transformed, and then documents with metadata are loaded into the central repository. Transmittals are automatically generated as new information is delivered to the project.

### Must-Have Information Technologies Capabilities

This section highlights the best practice capabilities and expected business value associated with content management for the nuclear industry that are needed to support zero tolerance for accidents and reduce construction and operations costs.

1. **Constant information transparency, version control, and change management.** Because the process of nuclear generation is so complex, there is a need to have access to the most up-to-date and approved engineering and commercial documents and to understand the history of revisions. For example, with newer prelicensed vessels, any change to the equipment can affect licensing of the unit and is required to be approved to maintain licensing status.

   Expected business value: Safety and compliance
2. **Workflow for approvals.** Ensuring proper sign-offs and the ability to control how information progresses within the enterprise and to external partners is essential. Due to safety considerations, the nuclear industry follows strict protocols for engineering, design, and construction. There are requirements for multiple levels of approval and sign-off associated with plant and equipment design documents and any changes to these engineering designs, construction execution, or alterations to prelicensed equipment, etc. Electronic workflows can ensure that critical information is made available to the appropriate parties for approval and that the process can always be audited to verify the completeness of the process. This capability is especially important since there are always multiple sign-offs and integration of workflows with email systems.

Expected business value: Increase productivity, improve the accountability of individuals for task completion, drive consistency across the project and adherence to strict nuclear project standards

3. **Single source of the "truth," synchronization, and validation.** Large capital projects involving multiple contractors benefit from having access to the most up-to-date approved versions of drawings and design documents. There needs to be a single source of the truth or system of record throughout the project. Typically, all major participants in the construction process for a nuclear power plant — equipment suppliers, prime construction contractors, owners/operators — are delivering information on their designated tasks as the project progresses. A change in one area may have a significant impact on how the project progresses in another area, so synchronization of activities and associated data and documents is critical.

It is important that the data and documents that pass from each of the participants to the main data repository are made available after passing the quality and validation processes. Typically there is a "staging area" on major projects where engineers can validate data before it goes into the repository. Automated validation can streamline this process.

Expected business value: Adherence to change management processes and protocols and associated increase in quality, safety, and productivity in a decentralized project

4. **Audit trail for regulatory documentation.** This involves the ability to provide a description of the activities performed during a compliance audit, such as preidentification of noncompliance issues to ensure safety and environmental adherence. This is particularly important as compliance is largely dependent on ongoing reports by the project participants of the nuclear power plant.

Expected business value: Meet compliance requirements and take a proactive approach to ensuring safety and zero tolerance for accidents
5. **Collaboration and sharing.** This involves multiple parties collaborating via data models and drawings while controlling versioning and approvals. Organizations have version management and design collaboration, typically using electronic collaboration tools. Best practice organizations use virtual electronic document rooms or engineering collaboration software.

Expected business value: Reduce length and cost of design process

6. **Ease of access to documentation.** The ability to conduct searches and quickly access current documents and drawings associated with an asset is especially helpful in the operations and maintenance stage of the asset life cycle. Designs become as-built drawings and documentation, which, when modified during operations, become as-operating drawings and documentation. Access is typically achieved through integration between enterprise content management (ECM), enterprise asset management (EAM), project portfolio management (PPM), materials management (MM), enterprise resource planning (ERP), and construction management systems. The ideal for a complex facility like a nuclear power plant is to make accessing data intuitive, "simple," and pervasive.

Expected business value: Shorten project duration (construction) and wrench time (operations and maintenance)

7. **Ensuring security.** At a minimum, access to documents should be role based with strict security protocols and continuous monitoring. This ensures that the people working on a process have access to the requisite information, but others may have no knowledge of its existence. Secure file synchronization and sharing for mobile devices are a "must" for maintaining the confidentiality of data.

Expected business value: Reduce risk of unauthorized personnel making changes that could endanger health, safety, and the environment

8. **Standard operating procedure (SOP) management.** Central repositories and business processes for the creation, management, updating, and sharing of SOPs for all operational practices within a plant or a facility. Changes to SOPs require a rigorous change management process and an auditable process for notification to affected personnel.

Expected business value: Reduce training costs and production delays while improving safety conditions and compliance

9. **Integration with procurement and project management applications.** Integral to a nuclear power plant project process is the ability to translate design specifications to procurement of equipment. Thus, modern projects require tight integration between the design specifications and the procurement process, as
managed in the materials management and procurement systems. This integration also allows for the review of the proposed equipment drawings, details, and specifications prior to finalization.

Expected business value: Decentralized procurement while ensuring current and validated procurement bases

10. Integrated records management. While the design basis documentation must be maintained beyond the life of the plant, there is much in-process information that does not need to be maintained as long. An integrated records management system ensures that documents are secured against destruction until such time as the retention is no longer required.

Expected business value: Ensured retention of design and operating basis information for compliance and safety reasons while optimizing storage efficiency

CONCLUSIONS

By creating and maintaining a consolidated system for document and information storage, management, and distribution that permits access to all information associated with a nuclear plant project, whether it is an expansion, an upgrade, or new construction, a utility can increase productivity and security and mitigate economic, health, safety, and environmental risks. IDC Energy Insights has the following recommendations for energy companies:

- Get a head start with vendors that have templated project data models, workflows, and change management practices based on experience. Given the complexity of the nuclear power plant, this is essential to streamlining and shortening the process, but more importantly, ensuring proper regulatory compliance.

- During design and construction, work to develop content-centric processes and identify engineering document control workflows for approvals within the organization. Determine the manner to share documents with project partners to ensure change management is effective. The engineering, procurement, and construction contractors; nuclear equipment providers; and owners/developers/operators can work together to develop a common taxonomy to ensure consistent master data management. Stay up to date with environmental, health, and safety and nuclear regulations. Don't forget to include content management for compliance as well as work.
● Involve the operations and maintenance teams early on to ensure the handover process is understood and relevant to operations/maintenance. As the project moves into operation, continue involvement of operations and maintenance and ensure that up-to-date data required for both operations and maintenance processes is easily found, secured, and archived. Don't overlook the productivity gains that mobile devices can provide. Fast and secure access to critical information can optimize content-centric processes and increase documentation accuracy.

● Look to areas of high vulnerability or inefficiencies in your current operations, such as current processes that rely on paper files that can potentially be difficult to find and update and may be misfiled or lost. This is particularly important when anticipating a plant life extension or decommissioning.

**ABOUT EMC**

The EMC Information Intelligence Group (IIG) delivers enterprise solutions and services for information management that range from compliance to business process in order to provide people with the right information at the right time. IIG technologies can be delivered either on-premise or in the cloud and are designed to simplify the complexity of managing and protecting an organization's most valuable asset: information. EMC Documentum for Energy solutions support capital projects and plant operations in the energy industry to reduce risk and improve compliance. For more information, visit [www.emc.com/documentumforenergy](http://www.emc.com/documentumforenergy).

**Challenges and Considerations**

EMC has built a strong offering with Engineering, Plant, and Facilities Management (EPFM) solutions based on experience working with energy companies and specialist systems integrators on a diverse set of projects. Project portfolio management lends itself well to a cloud application where collaboration between owners, operators, oilfield service companies, suppliers and regulators is critical to success. However, it may be difficult to convince the industry of the use of cloud due to security considerations, especially when it comes to critical infrastructure protection for assets such as nuclear power plants. Another seemingly intractable challenge for the energy industry is the handover from engineering, design, and construction to maintenance and operations of a large and complex capital project. EMC will need to convince the industry that EPFM with workflow and asset-connected documentation can serve as a bridge between engineering and design to enterprise asset management and operational applications that are used on a daily basis.
ABOUT IDC ENERGY INSIGHTS

IDC Energy Insights provides research-based advisory and consulting services focused on market and technology developments in the energy and utility industries. Staffed by senior analysts with decades of direct industry experience, IDC Energy Insights covers the energy value chain — upstream, wholesale, delivery, and customer service — providing independent, timely, and relevant analysis focused on key business and technology issues. IDC Energy Insights serves a diverse and growing global client base, including electric, gas, and water utilities; IT vendors; independent power producers; retail energy providers; oil and gas companies; equipment manufacturers; government agencies; financial institutions; and professional services firms. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

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