Six Questions with EPRI: PLM and nuclear power

Editor's note: EPRI – the Electric Power Research Institute – is a global, not-for-profit corporation that performs collaborative R&D and technology deployment for its membership, the owners and operators of electric power generation and delivery systems. John Gaertner, Technical Executive, and Ken Barry, Senior Project Manager, specialize in nuclear power.

Q. Can you explain why nuclear power will continue to be an important part of the global energy mix?

A. Current plants (104 in the US and more than 400 globally) operate with excellent safety records, at high availability and reliability, and at low cost. In the US, 20% of our electricity is generated by nuclear power. Because nuclear power plants emit no greenhouse gases and almost no conventional pollutants, the number of nuclear plants will increase and the percentage of power supplied by nuclear could conceivably rise to 35% after 2030, to help meet expected emission-reduction goals. To achieve that level of output, though, we will need to keep our existing plants online and operating at high performance levels, and also build new nuclear plants.

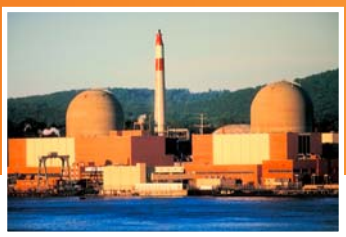
Q. When today's nuclear power plants were designed and built, they only expected to operate for 40 years. Now, many plants have had their licenses extended to 60 years. What are some of the challenges in maintaining a plant that long, and how can PLM help?

A. About 20 years ago, experts realized the condition of the plants was so good that they should be able to run for much longer than 40 years. To do so, however, major maintenance and modifications are often needed that were not anticipated in the original design. These include large power up-rates, modernization of components and systems, and refurbishment or replacement of major components. Furthermore, every plant is unique. So the industry is facing many new planning and logistical challenges. For example, clearances are less than two inches in some places, the equipment weighs tons, and the workers – while highly skilled – are expected to get it right the first time to maintain rigorous outage schedules. That's a difficult challenge even though nuclear plant owners have maintained excellent documentation of plant designs and design changes over the years.

The industry is investigating the contribution PLM can make. Owner operators can translate their paper blueprints into 3D CAD models. They can laser-scan the actual facilities to capture the changes and document the dimensions down to fractions of an inch. Then they can use PLM to simulate the maintenance operations, train workers, and manage information through the entire plant lifecycle. Refurbishments have to occur during infrequent and relatively short outages, and integrated plant modifications have to be phased in over a span of years. It's a tremendous engineering and planning feat. The industry is always seeking new technology such as PLM to perform these activities safely, reliably, and at lower cost.

Q. So how has the industry managed all these years without 3D PLM?

A. Very well, but at great expense. Documentation is complete and accurate, and configuration management of safety-related equipment is essential. In the nuclear industry, you never do anything until you're sure you can do it right, so the industry invests significant time and resources in planning, trying to anticipate and cover every possibility. A significant loss of configuration control can result in an extended regulatory shutdown. Therefore, nuclear power plant and support personnel train using physical mockups, perform tabletop exercises, and have staff such as crane operators walk through the operations they'll be expected to perform. PLM can be a much more efficient and effective way, because it allows you to plan virtually instead of physically, tie the 3D model to the schedule, perform human task analysis, track dosage exposure virtually – the list goes on and on. And it offers the potential to add that extra margin of safety and precision the industry constantly strives for, at a very attractive cost.



Q. What about PLM and new plants? What is the potential there?

A. The benefits will be much the same as for existing plants, but they will be achieved more readily because the new plants are being designed in 3D PLM. Because they will be built from the ground up using these technologies, applying it to long-term maintenance will come more easily and naturally.

Q. What is the benefit of using PLM to train workers?

A. With lifelike 3D models, workers can see precisely what they need to do before they attempt it. That's especially helpful when you're tasked with doing something that has never been done before or is only done during an outage, which normally occurs only once every 18 to 24 months. With PLM, owner operators can develop simulations that work like video games to give the workers near real-life experience in a virtual environment, before they report to the job site. When work must be done in a radiation area, owner operators can even use PLM to precisely model radioactive exposures. And they can save these models and simulations and re-use them the next time that same project or a similar project needs to be done, so PLM has exciting potential to capture institutional knowledge and pass it on to the next generation.

Q. What are some of the challenges to introducing this technology to an industry that grew up without it, and has operated without it for nearly 40 years?

A. The industry knows that what it does today works. What it needs is confidence that it can leverage these new technologies as effectively. They also must be confident the cost of maintaining the models is not prohibitive. EPRI's role is to help create a baseline with good practices and industry standards. We're identifying some pilot studies, demonstrations, and proofs of concept, along with guidelines that will help the industry share the practices and lessons-learned at one plant with another plant, for the benefit of the entire industry and all of its customers. In particular, EPRI is seeking a pilot plant to critically examine the extent to which 3D modeling and PLM can improve the planning and implementation of a representative refueling outage. For new plants, EPRI is developing "handover guidance" to ensure that 3D modeling and associated data used in design and construction is appropriately handed over to owners for acceptance testing and operations.

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