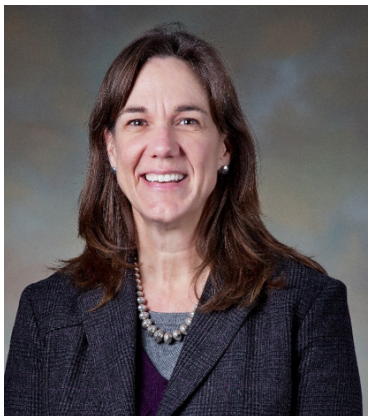
Learning from my past

What more than 28 years in the nuclear energy fuel cycle taught me about systems, knowledge management and running nuclear facilities

By Susan Y. Pickering



Susan Y. Pickering, Director Emeritus, Sandia National Laboratories, has over 28 years of experience in nuclear-related research and development at Sandia National Laboratories.

The theme for the 2019 IAEA International Conference on the Management of Spent Fuel from Nuclear Power Reactors is "Learning from the Past, Enabling the Future." There are important lessons to be learned from our collective experience working in nuclear energy, whether we come from mature or emerging nuclear power programmes, and the conference provides an ideal venue for sharing them.

Nuclear energy programmes require a very long commitment of time and resources in order to be successful. They generate many challenges — both technical and non-technical. I worked in the nuclear energy fuel cycle for over 28 years. I faced many challenges and learned many, many lessons. Let me share a few of my observations and thoughts.

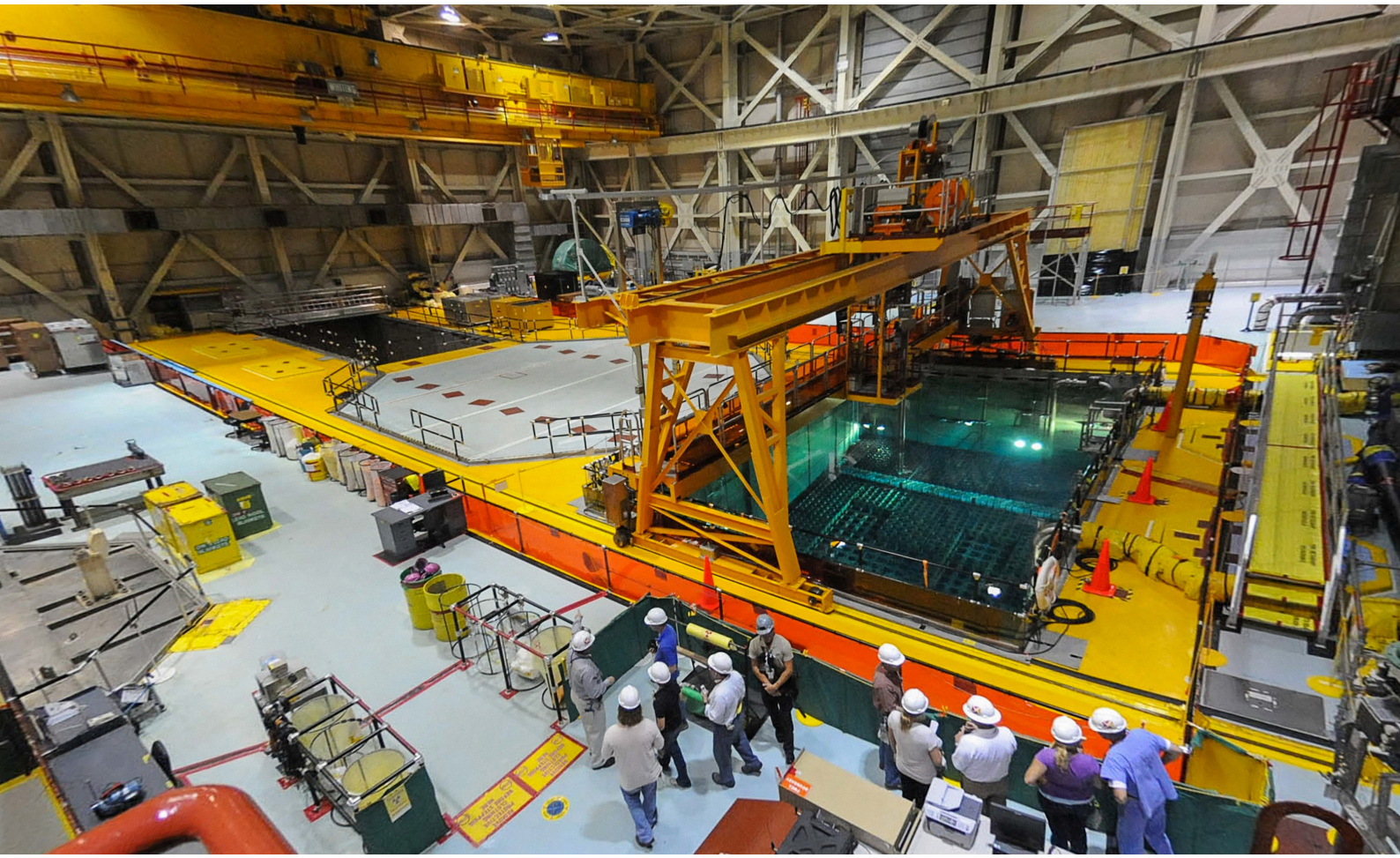
Nuclear energy systems are complex and integrated. For example, disposal facilities are multi-barrier containment systems comprised of the waste form, container, backfill and host rock, and the performance of each component impacts the others. How will storage decisions made today affect future disposal options? Could a spent fuel container preclude a specific mode of transport or disposal concept/site? We need to view these systems using a cradle-to-grave approach.

The life of nuclear facilities can span many decades. Over the lifetime of a nuclear facility, questions will arise that will have to be answered by people who did not do the original work — possibly by people who were not even born when the original work was completed! A quality assurance (QA) and knowledge management programme should therefore be initiated as soon as possible.

Issues at nuclear facilities can often be attributed to inadequacies in people, parts or procedures; also known as the Three Ps. People in leadership positions have a great deal of influence over the Three Ps. A strong QA and knowledge management programme will introduce controls to strengthen the Three Ps. Such a programme will (1) provide objective evidence of personnel qualifications, (2) provide a process for resolving differing professional opinions, (3) ensure equipment and parts are adequate for their intended use, (4) enhance consistency by defining work processes, (5) increase the credibility and defensibility of technical work, (6) provide for knowledge management across the project's lifespan and (7) provide insights into project issues and their resolutions. A well-designed, well-implemented QA and knowledge management programme is a critical success factor.

I believe there are two broad categories of information to be preserved in a QA and knowledge management programme: information defined by traditional standards, e.g. QA records, and information not defined by such standards, e.g. the logic behind key decisions. This second category of information is often overlooked even though it is essential for defending a nuclear facility when issues arise. For example, does the nuclear facility capture how results and conclusions from critical activities were generated? Can they be reproduced?

Nuclear systems are often perceived as controversial. Stakeholders are many, often with opposing views, and may be a source of conflict. The impact of stakeholders must be appreciated, as they may influence policy and decision makers. Stakeholders generally want frequent engagement, transparency and influence. The relationship between a nuclear facility and its stakeholders is important, and resources must be applied



Spent fuel pool of Unit 2 at the Brunswick Nuclear Power Plant, USA.
(Photo: Nuclear Regulatory Commission, USA)

to support it. Collaborating with the public, stakeholders and local governments increases the likelihood of success.

Maintaining a high level of operational excellence will be difficult over the long lifespan of a nuclear facility. Pressure to reduce costs could lead to unwise decisions. Personnel and organizational turnover can lead to lost knowledge. Complacency could grow over time. Facilities age and could become less reliable. New, unanticipated vulnerabilities could emerge over the years, such as cybersecurity.

An understanding of risk is critical to properly managing a nuclear programme. An accident at a nuclear facility typically falls into the risk category of "high-consequence, low-probability events." Even though accident frequency estimates are extremely low, consequences could be significant, costly and long-lasting. The systems are complex and require credible science and sophisticated engineering to ensure risks are managed properly. Technically competent leadership in the government sponsor, regulatory agency and implementing team is a major success factor.

A strong tool for leaders is independent review. This can occur as peer review or independent assessment. The IAEA provides many types of review. In all cases, the reviewers must be qualified and independent of the work under review. We are all human and make mistakes. Wise leaders rely on independent review at critical steps and decision points to identify problems while impacts are still small and solutions are less costly to implement.

Leaders at all levels of an organization must embrace the behaviours that foster a strong nuclear safety culture. Every day and in every situation, they must demonstrate their commitment to safety, reward positive behaviours and discipline negative behaviours. They much accept that there will be surprises, and plan for normal and abnormal events. They must understand uncertainty, risk, margin, defence in depth and resilience. Competent people are the most important success factor for a strong safety culture. As Admiral H.G. Rickover, the father of nuclear safety in the USA, said, "Rules are not a substitute for rational thought."