The Expanding Niche in Nuclear Plant Deactivation

Nuclear power plants are being closed at a growing rate. Standardized testing and performance metrics for their deactivation and decommissioning **will help ensure public safety.**

By Joseph Sinicrope, Peggy Shoffner, Edward Walker and Leonel Lagos

Based on estimates provided by the U.S. Nuclear Regulatory Commission and the International Atomic Energy Agency, the deactivation and decommissioning, or D&D, of nuclear facilities worldwide is forecast to grow exponentially over the next 10 to 20 years.

The resurgence in nuclear power, predicted only a few years ago, has not materialized. First generation nuclear facilities are rapidly approaching their initial licensing limitations. Though extensions could be granted, drivers such as the public's negative perception of safety and the lack of political will after the Fukushima accident are now significant obstacles to overcome.

Furthermore, price competition from fossil fuels and the allure of renewable energy have made the decommissioning decision a largely economic one, rather than an operational and technical one. This will result in the premature closure of even more facilities.

Consequently, the industry and its governing regulatory agencies have found themselves faced with a strategic shift in focus — an expedited, and daunting, D&D requirement.

HUNDREDS OF CLOSURES

According to the World Nuclear Association, approximately 100 uranium mines, 110 commercial power reactors, 46 experimental or prototype reactors and 250 research reactors have been retired from operation worldwide. Of these, only a handful have been fully dismantled, with the most complex D&D activities associated with each still remaining. Conservative projections have more than 200 of the 434 active nuclear reactors currently operating across the globe being retired by 2040, with total estimated costs exceeding well over $300 billion.

Several factors, with perhaps the most prominent in recent history being the Fukushima nuclear accident in Japan, have prompted other countries to accelerate their plans to shut down nuclear facilities. For example, both Germany and Switzerland have established timelines for closing all their facilities (17 and 5 reactors, respectively).

In short, the sheer magnitude and scope of the effort will catapult deactivation and decommissioning as a major operation for governments and the industry on a global

scale. It is precisely here where ASTM International Committee E10 on Nuclear Technology and Applications, with its multi-nation membership, is perfectly positioned to serve as a central coordinator for the development of uniform performance standards and testing protocols for D&D technologies to address this nuanced and challenging area.

THE CRITICAL ROLE OF TECHNOLOGY IN D&D

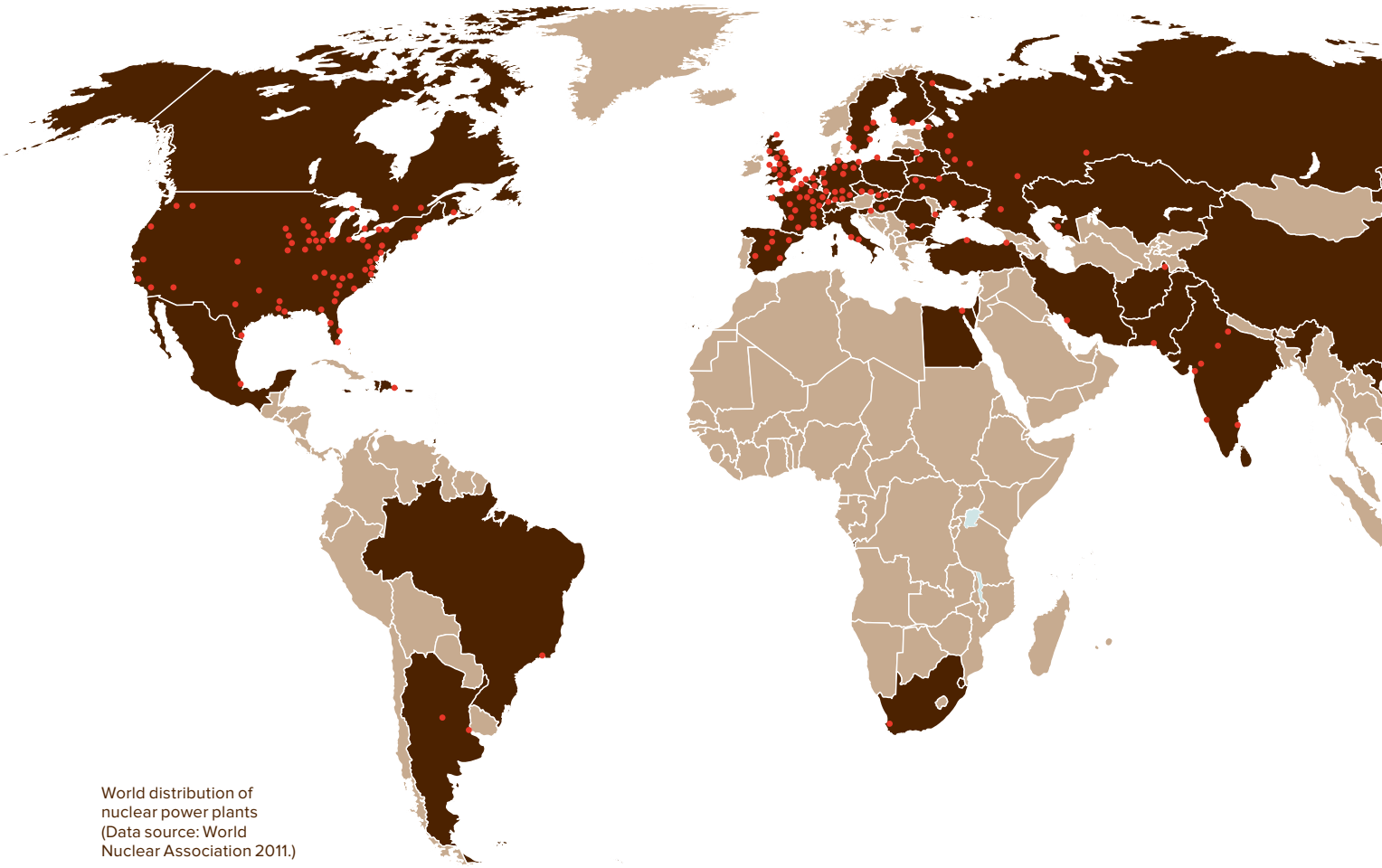
The pressure to do more with less is ever increasing, and this phenomenon will undoubtedly elevate technologies that support the very specialized, complex and technical activities characteristic of nuclear facility D&D. Unanticipated costs, declining federal and private sector budgets, increased worker safety requirements, more stringent U.S. Environmental Protection Agency and NRC regulations, and a host of other factors will place technology innovation, development, testing, evaluation and deployment at the forefront of any and all discussions related to D&D. The nuclear industry as a whole will need to aggressively pursue both incremental and disruptive improvements in approaches and technologies that facilitate a more intelligent and responsive decommissioning process.

The response of the Office of D&D and Facility Engineering, part of the U.S. Department of Energy's Office of Environmental Management, is one of several examples of government and industry working together to apply technological responses to this problem. This office, like others across the international community, is charged with the identification, development and demonstration of alternative technologies. Staff members work hand-in-hand with site project directors, project managers, prime contractors, national labs and academia to identify technical needs, priorities and gaps. Just as important, the office is responsible for estimating the benefits, costs and deployment schedules of the technologies and approaches selected for investment.

Several National Research Council (United States) reports have identified where technology development could make significant contributions to the unique challenges of D&D. These include:

- Characterization of contaminated materials,
- Decontamination of equipment and facilities,
- Remote intelligent systems/robotic capabilities, and
- D&D of reactors and entombment end states.

To help these organizations and the industry as a whole meet these challenges, the testing and evaluation community must rise to the occasion and create the standards that will guide the D&D technology acquisition process.



World distribution of nuclear power plants (Data source: World Nuclear Association 2011.)

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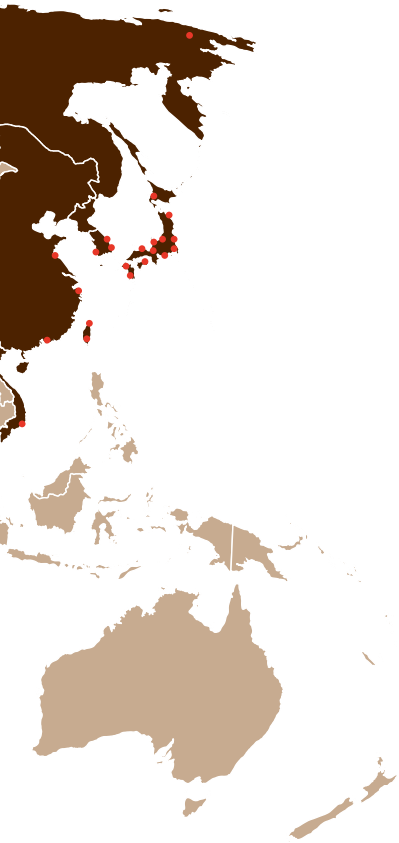

UNIFORM TESTING PROTOCOLS AND PERFORMANCE METRICS

A key factor in effectively and efficiently deploying D&D technologies in radioactive environments will be the development of uniformly accepted testing protocols and performance measures. Standards are cornerstones for successful technology acquisition programs and are absolutely critical for any valid testing and evaluation of those technologies.

Unfortunately, the lack of uniform testing protocols or performance metrics often results in haphazard, nondefensible efforts that do not meet operational and regulatory requirements. Furthermore, an accepted, systematic approach to assessing the cost benefits of such technologies to inform investment and prioritization is also lacking.

Addressing these shortfalls through standards will provide credibility, yield a significant return on investment and allow all types of D&D technologies (robotics, fixatives, characterization, decontamination, demolition, etc.) to be developed, tested, evaluated and compared to a set of uniformly accepted metrics. In addition, standards will ensure that D&D technologies satisfactorily address the three pillars of technology – quality, productivity and safety.

The U.S. Department of Homeland Security is a prime example of a federal agency that has taken proactive steps toward developing standards and has successfully engaged ASTM International in the process. By working with stakeholders in ASTM Committee E54 on Homeland Security Applications, the agency has numerous performance metrics and testing protocols to guide the development and acquisition of technologies that address their specific needs. By every measure, this process, and the partnership that produced it, has been expeditious, and it serves as an excellent model for others to follow for their respective requirements.

THE WAY AHEAD

Given the projected growth trend for global D&D, the need for uniform international standards and metrics is unequivocal. ASTM is widely recognized as a world leader in developing standards and solutions that stimulate innovation, foster industrial competitiveness, and improve measurement science and rigorous traceability. ASTM has developed tremendous access to an international membership of technical experts across government, academia and commercial sectors that can focus their talents on this particular challenge. Equally important, the organization has a proven track record and an established precedence of collaborating across organizational boundaries and cultures to expeditiously achieve meaningful, operationally relevant results. The conditions are set, and the time to take action has arrived.

In that vein, Committee E10 is uniquely positioned to lead a collaborative effort across the international D&D community to develop uniform performance metrics and testing protocols for the various categories of D&D technologies. This would also include the creation of standardized cost benefit and cost avoidance assessments. At the forefront of this effort will be Subcommittee E10.03 on Radiological Protection for Decontamination and Decommissioning of Nuclear Facilities and Components. E10.03 serves as the center of gravity for coordinating a phased approach with the various stakeholders in accomplishing these goals.

This undertaking is significant, but with the proper leadership and support, a solid foundation will be established to facilitate the D&D community's success in this critical area, which will benefit our environment and, by extension, our future.

Joseph Sinicrope is a research scientist at Florida International University's Applied Research Center and focuses on deactivation and decommissioning technologies in support of the Center's U.S. Department of Energy–Office of Environmental Management Cooperative Agreement. He is chairman of Subcommittee E10 on Radiological Protection for Decontamination and Decommissioning of Nuclear Facilities and Components.

Edward Walker is chairman of ASTM Committee E10 on Nuclear Technologies and Applications and a member of several other ASTM committees and working groups.

Peggy Shoffner is a research scientist and project manager at Florida International University's Applied Research Center and focuses on waste and D&D engineering and technology development in support of the Center's DOE-EM Cooperative Agreement.

Leonel Lagos is the director of research at Florida International University's Applied Research Center and the principal investigator for the DOE-EM Cooperative Agreement.