Development of the LWRS Program Innovation Portal to Support Nuclear Innovation

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The nuclear industry recognizes the need to innovate across key functional areas, and is working to effectively identify, select, and implement beneficial technologies. The traditional sociotechnical infrastructure of the existing U.S. nuclear fleet that once required large workforces and was part of a regulated market now greatly challenges the economical sustainability of these plants. Indeed, the nuclear industry recognizes the need to innovate across key functional areas, and is working to effectively identify, select, implement, and sustain meaningful change. A vital question that is being considered across the nuclear industry entails how to effectively manage innovation to improve the economic viability of the U.S. nuclear fleet.

The Light Water Reactor Sustainability (LWRS) Program Plant Modernization Pathway is addressing this question through a business-driven approach to innovation. The perceived risks of and need for change by an industry, influences how innovation is managed and executed. Consequently, these two drivers typically influence innovation to be incremental or drastic. In the nuclear industry, characteristics that challenge such change include a strong nuclear-safety culture, a high degree of regulation, and a culture averse to perceived risks. Changes at or to a nuclear power plant—whether it be technology- or process-focused—must be evaluated and determined not to adversely affect safety. Changes must also be evaluated to confirm regulatory compliance, and they

Figure. 1 Four-phase approach to nuclear innovation.

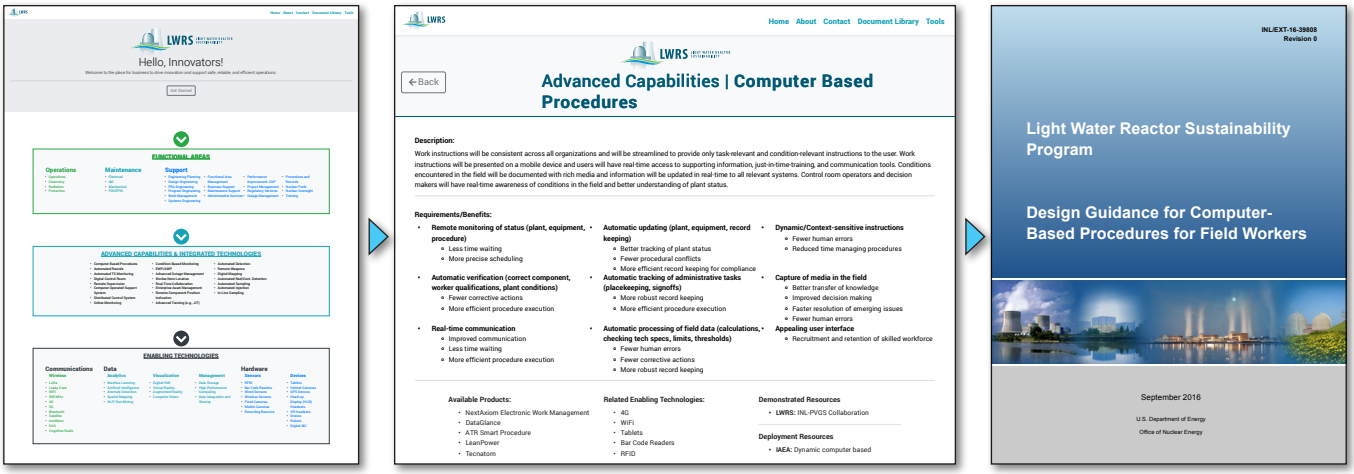

Figure 2. Advanced capabilities and technologies.

must be introduced in a way that will overcome perceived risks. Innovation leaders within the nuclear industry routinely face two forces: (1) the need to change; and (2) organizational resistance to change.

The Plant Modernization Pathway hosted a Nuclear Innovation Workshop in June 2019 to engage innovation leaders across the industry, providing them new insight and tools to help manage innovation. This workshop included facilitated discussions and industry presentations within the context of a four-phased approach to nuclear innovation. These phases include innovation identification, selection, implementation, and evaluation. (See Figure 1)

One of the most difficult parts of managing innovation is selecting and implementing innovation. The Plant Modernization Pathway recognizes to effectively select and implement innovation, both a top-down and

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How decades of work at Argonne led to a pivotal moment for U.S. nuclear plants

Following the 2011 Fukushima disaster, where an earthquake and tsunami touched off a series of fuel failures resulting in radioactive leaks, U.S. regulators considered a series of safety enhancements on nuclear power plants. But for many boiling water reactor operators, these new prospective requirements would have meant either closure due to noncompliance or massive retrofitting costs to keep operating. Eventually, a third path emerged, informed by research conducted at the U.S. Department of Energy's Argonne National Laboratory. Data from years of tests at Argonne supported an approach that could both preserve safety and avoid a crippling $1 billion in expenses for plant operators.

Nuclear reactors are protected by a steel-lined containment building reinforced with concrete both inside and out. In an accident, the challenge is to prevent corium—the lava-like material formed when uranium fuel rods in the reactor core melt, along with their protective metal cladding—from entering the environment if the corium escapes the reactor vessel and erodes the concrete floor below.

As a response to the 1979 partial meltdown at Pennsylvania's Three Mile Island power plant, Argonne researchers had been simulating the process of a reactor core melting to see how the resulting corium interacts with concrete, and how that interaction can be halted by flooding with water. The experiments were some of the largest of their kind in the world, and nuclear energy companies co-sponsored them to support safety improvements at their plants. Argonne's research effectively demonstrated that if corium were to migrate outside the reactor vessel, it could effectively be cooled by injecting water through the vessel while keeping the radioactive material inside the containment building—an approach that wouldn't require new equipment or expensive plant modifications.

For more information, please navigate to: How decades of work at Argonne led to a pivotal moment for U.S. nuclear plants.

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bottom-up approach is needed. This approach ensures strong alignment between the leadership's vision and the organization's implementation of that vision. Top-down refers to senior leadership developing strategic objectives for the organization to deliver safe, reliable and cost competitive operations. These objectives are used by the organization through a bottom-up analysis to select innovative solutions and develop implementation plans that will meet these strategic objectives.

These ideas were shared with the industry and three initiatives were identified from the workshop. These initiatives are being actively pursued by the Plant Modernization Pathway. First, developing an Innovation Portal to provide industry, researchers, and vendors with a resource for listing relevant technologies and demonstrating how those technologies interrelate for business-driven innovation that addresses a specific functional area. Second, initating and establishing an innovation group to routinely convene and discuss lessons-learned and any innovation progress for the industry. Finally, facilitating open discussion with industry about nuclear innovation; industry participants will be contacted by Plant Modernization Pathway researchers through phone or email. These discussions are meant to share lessons-learned through recurrent meetings with utilities, vendors, and research organizations.

The Innovation Portal will support these initiatives by faciliating business-driven innovation across the industry through key functions, including: (1) the ability to provide detailed information that enables the identification and selection of technology and capabilities, (2) an interface to help identify, select, and implement advanced capabilities and technologies, and (3) the ability to perform 'what-if' evaluations using enabling technologies, advanced capabilities, and processes for specific utilities. Using this unique innovation mapping, users are provided with insight as to how technology maps to business needs (See Figure 2). Further, this tool will support cost-benefit analyses and work function analyses for the strategic integration of technologies to support capabilities and key work functions.

The Plant Modernization Pathway researchers and developers welcome input from industry, including utilities, vendors, and universities to develop and improve the Innovation Portal. If you are interested in participating in the Innovation Portal development or becoming a member of the innovation group, please contact Casey Kovesdi at casey.kovesdi@inl.gov for more information.