

WASTE MANAGEMENT CONFERENCE

Advanced technologies

The potential of robotics and remote systems to improve the safety and efficiency of nuclear decommissioning and remediation was the focus of this year's Waste Management Conference.

The theme of WM Symposia's 2018 Waste Management Conference, held March 18–22 in Phoenix, Ariz., was “Nuclear and Industrial Robotics, Remote Systems, and Other Emerging Technologies,” and based on many of the discussions held during the conference, both in the sessions and on the exhibit floor, the spirit of the conference was very forward-looking. Along with new technologies aimed at making decommissioning and the cleanup of legacy radioactive waste safer and more efficient, talk circled around the challenges that lie ahead and the pathways for making progress, both in the near and long terms.

One subject that came up repeatedly during the meeting's opening plenary session was the future of the nuclear workforce—an issue long talked about but with no real clear answers. As one attendee put it, “It is time to stop admiring the problem and start working on it.”

Rep. Chuck Fleischmann (R., Tenn.), appearing via prerecorded video, spoke on the need to train and keep a skilled nuclear workforce to support the work of the Department of Energy's Office of Environmental Management (EM). “Workforce development is critically important,” he said. “Not only in the EM field as we clean up these sites, but also to make sure that we have a new crop of great, young nuclear engineers and a workforce to support them as we move America's nuclear industry forward.”

Fleischmann, who said he has seen a decline in interest in nuclear education and programs on the part of young people, often speaks at schools and universities about the importance of nuclear energy,

and he urged the meeting attendees to do the same. As chairman of the Congressional Nuclear Cleanup Caucus, Fleischmann also urged the attendees to continue to work with members of Congress and to advocate for the cleanup mission. “We're getting it done,” he said, “but with your help, we're going to do an even better job in the future.”

As a model of what is possible, Fleischmann pointed to the cleanup work being done at the Oak Ridge Reservation, which is in his district, and the East Tennessee Technology Park (ETTP), which is turning over remediated land from Oak Ridge's decommissioned gaseous diffusion plant to private companies for economic redevelopment. The ETTP model, and the public/private partnerships that helped create it, is one that could work very well across the United States, Fleischmann said, adding that it demonstrates to taxpayers that they are “getting great bang for their buck.”

Following Fleischmann, Billy Morrison, president and chief executive officer of VNS Federal Services, also called attention to the “human-capital cliff,” noting that in two years, fully half of the nuclear

workforce will be at retirement age. “We are at a point now where we have to invest in the employees and the leaders that will stand on the shoulders of all of you in this room and get this job done,” he said.

In addition to workforce issues, Morrison noted the challenges that vendors face in completing cleanup missions, including the difficulties of working in technically challenging environments, completing complex projects, maintaining a robust supply chain,



Fleischmann



Morrison

Photo: WM Symposia

and planning projects based on federal appropriations and continuing resolutions.

Morrison also discussed the difficulty corporations have in weighing risk against possible reward. A contractor's revenue margin may be 5 to 7 percent when everything goes well, he said, adding that the margin may go down to 2 to 4 percent or less when unforeseen expenses and the costs of putting together a bid proposal and contract are added in. "We have to sell that back to our companies, and it is not always an easy sell," he said. The low margins, Morrison said, are among the reasons the industry has seen a lot of consolidation.

According to Morrison, progress is largely contingent on what he called the "art of the possible." This includes clarifying the regulatory definition of high-level radioactive waste and how it is managed based on its risk and not its source. In Morrison's view, clearer HLW regulations have "the largest potential to have the biggest impact and the soonest." Morrison also said that it is past time for the update to the DOE's Order 435.1 on radioactive waste management to be completed. "We need to stop polishing this cannonball," he said.

To get the cleanup work accomplished, Morrison said, companies have to be nimble and move past the "this is the way we have always done it" way of thinking. "I believe that kicking the can down the road and having protracted cleanup schedules is ultimately what could be the most risky thing that we have in front of us," he said. "It's incumbent upon us to do the things we know we can do now, and do them safely."

James Colgary, chief of staff to the deputy secretary of energy, agreed with Morrison that things need to get done now, and he assured the audience that DOE leadership is moving in the right direction. "We don't need more information, we don't need another study," he said. "We need to get it done quickly, now. Even if it's just small victories, let's get it done."

Colgary said that the DOE's leadership is focusing on a few key priorities, including energy dominance, which, he explained, means promoting an energy plan that includes fossil fuels, nuclear, and renewables. The DOE is also looking at energy storage options, which he said include everything from battery storage to pumped hydroelectric systems.

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WM Symposia's Jan Carlin

Jan Carlin says she feels blessed in her 40-plus-year career in the nuclear industry, a career that began with Westinghouse Electric Company in its Nuclear Fuels Division. And now Carlin, who joined Wälischmiller Engineering in 2014 as director of business development, is taking on a new role as the managing director of WM Symposia (WMS), having replaced longtime director James Voss in September 2017.



Photo: WM Symposia

Carlin

"People ask, 'Aren't you ready to retire?'" Carlin said. "It hasn't even entered my mind. I'm excited about this opportunity with Waste Management. I'm working with great people who are the lions of the industry. And now with the opportunity to do STEM [education] and take on some more interesting things, why would I quit?"

STEM (science, technology, engineering, and math) education is something that Carlin said she is passionate about, and as managing director, she plans to pursue a much larger and more aggressive STEM program through WMS, which already recognizes teachers for their work in STEM education. Using the work Washington state is doing in STEM education as an example, Carlin said that she would like to create a pilot program based on the Washington model to use at other sites.

In addition to increased involvement in STEM programs, Carlin listed three other areas in which she would like to see growth within WMS, including raising the role of women in the conference, an increased participation by the United Kingdom and European countries, and a larger presence of utility companies, which she admits have not been involved with the conference in the way they once were. "I want to very aggressively engage the utility community and get them to come back to Waste Management," she said, noting that the 2019 conference will feature panels and sessions focused on issues specifically related to utilities.

Carlin also said that she feels that women are underrepresented at the conference. In her position with German-based Wälischmiller, she said, she sees a larger percentage of women in key technical roles in Europe than she does in the United States. The question, she said, is how to get professional women, and their management, to recognize the value of participating in WMS and attending the conference. As for the United Kingdom and the rest of Europe, Carlin pointed out that those countries are forging ahead with nuclear programs, and their presence at the conference would be valuable.

Noting that for 2018, WMS exceeded its previous registration by 10 percent and had a record number of papers and panels, Carlin said that the WMS brand remains strong, and the conference fills a valuable service for the nuclear industry. "I don't know of any other conference like it anywhere in the world," she said. "I think this year we had more than 400 Department of Energy representatives here. That interface, and that ability for our vendors to be in close contact and everybody being in the same place at the same time, I think is a very important service to the industry."—T.G.

university programs, to enhance national security by rebuilding the U.S. nuclear security enterprise, and to meet its legacy waste cleanup obligations. The cleanup of legacy waste, he said, "is a commitment that the department and the administration take very seriously."

Colgary also called attention to the DOE's administrative reorganization, which he said is an improvement that will boost cleanup momentum. The DOE's reorganization plan, announced in December 2017, places the EM office under the purview of Paul Dabbar, the undersecretary for science, and, Colgary said, will leverage the expertise and project management capabilities of the DOE's Office of Science and the national laboratories to better solve EM challenges and manage costs while ensuring a high lev-

el of safety. "Paul is the right man at the right time in history to be able to get this done," he said.

DOE-EM Robotics

In addition to a robotics pavilion on the exhibit floor, there were eight panel sessions and 11 technical sessions devoted to robotics, remote systems, and other emerging technologies. Kicking off the conference was a panel session titled "DOE-EM Robotics," which set the stage for many of the following sessions and presentations. The panel featured presentations on the subject from various perspectives, including federal and international agencies, universities and national laboratories, and end users.

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Photo: WM Symposia

Rodrigo Rimando, director of technology development in the DOE's Office of Environmental Management, speaks during a panel session on robotics.

Environmental Management, led off the session by discussing the role of robotics as it applies to EM's cleanup mission. He began by putting robotics in the context of what he referred to as the fourth industrial revolution (4IR), which he said is transforming entire systems of production, management, and governance. "Unlike the past three industrial revolutions, 4IR is evolving at an exponential pace, rather than a linear pace," he said.

This new industrial revolution is marked by the fusion of advanced technologies that blends physical, digital, and biological systems, Rimando said, adding that at its core, robotics is an integrated system of many variant technologies. Because of the nature of its work, he said, EM has the opportunity to leverage and exploit robotics to help complete its mission.

Rimando then provided his top 10 mission drivers, or reasons that robotics and remote systems are needed to advance EM's cleanup work. They include, in no order of priority or importance, the following:

- To reduce the nation's environmental liability.
- To complete tasks that are high hazard, high consequence, high risk, and high value.
- To reduce worker dose.
- To prevent injuries.
- To help assist an aging and aged workforce.
- To provide tools for planning, ALARA studies, and modeling.
- To assist workers in dull, dirty, dangerous, and difficult work.
- To allow entry into challenging spaces and conditions.
- To sustain national assets, one-of-a-kind facilities, and critical infrastructure.

■ To respond to off-normal events, operational upsets, and emergencies.

Thomas Nance, director of research and development engineering at Savannah River National Laboratory, followed Rimando with a discussion of robotics and remote systems from the perspective of the DOE's national laboratories. He described some of EM's early work with robotics, adding that EM is entering a "new era of deployment" of robots and remote systems, including the use of crawlers for remotely inspecting Savannah River's H Canyon and removing debris from liquid-waste vitrification melters.

Nance noted that there are many quality off-the-shelf remote vehicles that can be used for nuclear work. They simply need to be modified to the specific task, he said, with the addition of battery packs and tethers to increase the vehicle's range and operational capacity, actuators and other tools for completing specific tasks, and cameras and sensors for gathering data.

Echoing Rimando, Nance said that much of the work EM does can be accomplished by leveraging existing technologies and resources. "Robots are tools," he said. "We've been blessed with a number of advanced technologies that are very commonplace now. It is just a matter of applying them."

As president of the United Steelworkers' Atomic Energy Workers Council, Jim Key provided insight into the end users' experience with robotic technologies. He said that robotics, specifically worker augmentation technologies such as robotic exo-

skeleton and physical assist systems, has the ability to improve worker safety and performance.

Initially, Key said, the union saw robotics as a "job-threatening" development, as has been the case in other industries where automation has replaced human workers. Nuclear cleanup tasks, however, require a lot of human interaction and cannot be performed with a high level of automation, Key said, adding that robotics has become a job enabler, not a job killer for the nuclear industry. The use of robotics is allowing workers to access hazardous environments while reducing their dose and also reducing the physical demands of the work.

Key particularly noted the importance of robotics to an aging nuclear workforce. "We have a huge vacuum of workers across the nation that will take 10 to 15 years to fill," he said. As the industry deals with an older workforce, worker augmentation systems such as the robotic exoskeleton have become more valuable in helping workers complete tasks. New technologies also have the potential of creating another class of worker, which can attract younger workers, Key added. "It's just another method to modernize our toolbox," he said.

The potential of robotics and advanced technologies to draw younger people into nuclear was also addressed by Rob Buckingham, a director at the U.K. Atomic Energy Authority, who provided an international perspective on robotics. "How do you get young people into nuclear? You give them the tools to do really cool stuff,"

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he said, pointing to advancements in artificial intelligence.

Buckingham noted the emerging use of autonomous vehicles, such as self-driving cars, saying they are important to consider as part of the vanguard of robotic applications. "They are coming, and they are going to affect the lives of everyone in this room," he said. The question, he added, is how do we use the technology and adapt it to decontamination and decommissioning work.

Buckingham said that his agency has been working with robotics for decades and that only by using the technology can workers and project managers get comfortable with it and maximize its potential. He noted that there is a wide array of technologies available and said, "What we

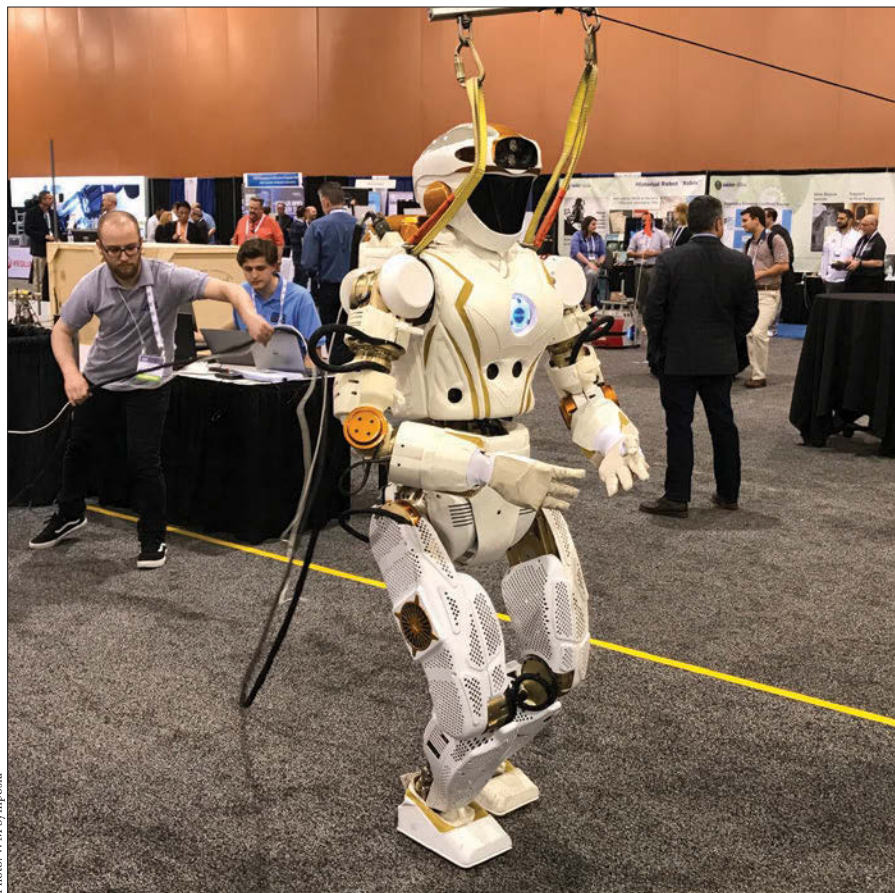


Photo: WM Symposium

The Robotics Pavilion at WM2018 featured NASA's Valkyrie humanoid robot.

need to do in the nuclear sector is grab it, use it, and get on with it.”

A U.S. government perspective was offered by Robert Ambrose, division chief of software, robotics, and simulation at NASA. He provided an overview of developments within the National Robotics Initiative (NRI), the National Science Foundation program to accelerate the development and use of robots in the United States. The initiative, Ambrose said, has two phases, beginning with NRI 1.0, which lasted from 2012 to 2017 and focused on collaborative robots that work beside or cooperatively with people. The second phase, NRI 2.0, which will run from 2018 to 2023, will focus on the ubiquity of robotics and the seamless integration of collaborative robots into the workplace.

Ambrose said that to date, nearly \$200 million in NRI grants has been awarded to universities by the government agencies involved in the program. “In the world of university robotics research, that’s considered a big deal,” he said.

Ambrose finished by noting a couple of case studies of robotics development that NASA has been working on, including the development of a robotic glove that allows the user to do physically demanding work for an extended period. He said that NASA is currently licensing the glove to various companies for industrial applica-

tions, including healthcare. “If you have an application where a worker needs to hold something for a long time, give us a call,” he said.

Decommissioning

Closing a nuclear power plant—taking it from operations to decommissioning status—requires not only a lot of strategy and planning but also a cultural shift. That cultural shift has been noted by many people involved in commercial reactor decommissioning, including Kerry Rod, who spoke on the San Onofre Nuclear Generating Station decommissioning project during the technical session “Plans for and Experience in Transitioning from Operations to Decommissioning.”

Rod, general manager of decommissioning oversight at San Onofre, explained that the plant had 21 discrete management systems that had to be transitioned from an operational standpoint to one focused on decommissioning. That transition, he said, was a gradual process that began even before Southern California Edison (SCE) awarded the San Onofre decommissioning contract in 2016. To facilitate the transition, SCE directed program owners to develop transition plans for each of the 21 management systems.

Rod said that a number of factors contributed to SCE’s successfully completing

the transition of management systems to the decommissioning contractor within a year. These included actively fostering a collaborative environment with the contractor, facilitating the transfer of knowledge, keeping to a rigorous schedule, and working to keep transition teams aligned. Experience shows, Rod said, that a one-year period is a reasonable amount of time to complete the transition process.

Andreas Roos, a manager at Sweden’s OKG Aktiebolag, also noted the change in mindset that needs to occur when a nuclear reactor is transitioned from operations to decommissioning. That transition is further complicated, he said, when it occurs at a site where other reactors remain operational, such as at Oskarshamn in Sweden, where Units 1 and 2 were shut down in 2017 and 2016, respectively, and Unit 3 remains in operation.

Having operating and decommissioning reactors at the same site presents a number of challenges, Roos said. These include transferring personnel within the company, finding the needed competencies within the available workforce,

and acclimating personnel to new interfaces with different authorities and stakeholders.

OKG, however, had a number of factors in its favor. Roos noted that the company had a skilled workforce to draw upon, as

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well as a healthy decommissioning fund available to finance the work. In addition, he said, OKG was able to coordinate work with Oskarshamn’s sister plant, Barsebäck, which is also undergoing decommissioning.

To prepare the two Oskarshamn units for dismantling, Roos said, OKG began intensive preparations early in the process, including obtaining the necessary permits, moving spent fuel to storage, and completing partial dismantling. Cutting and segregation of reactor internals is to begin at Oskarshamn-2 in 2018 and at Oskarshamn-1 in 2019.—*Tim Gregoire* **N**