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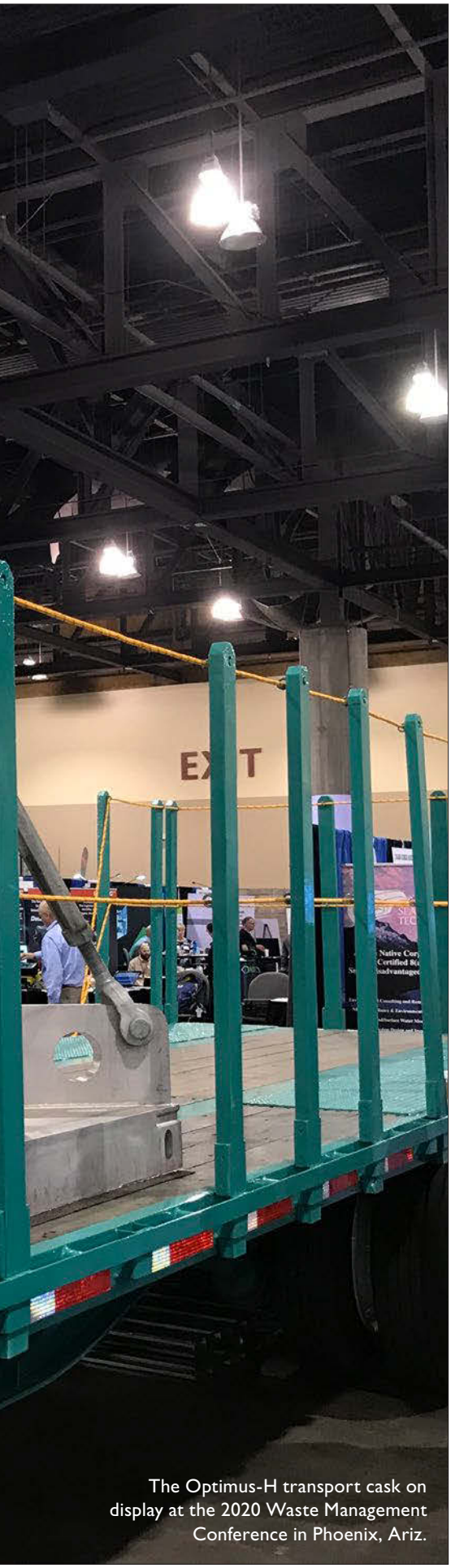

The Optimus-H transport cask on display at the 2020 Waste Management Conference in Phoenix, Ariz.

Thinking inside the box

Producing packages for radioactive materials takes time, attention to detail, and a thorough commitment to quality assurance.

By Tim Gregoire

Jeff England, director of transportation projects for NAC International, pointed to the large stainless steel canister, which looked like a giant-sized silver dumbbell, perched on the flatbed of a semitrailer truck parked in the middle of the expansive exhibit hall in the Phoenix Convention Center. NAC, a provider of nuclear storage, transportation, and consulting services, was using the 2020 Waste Management Conference, held March 8–12 in Phoenix, Ariz., to unveil its newest transport casks, the Optimus-H and Optimus-L.

"These are a different niche," England said of the casks, which were designed to transport radioactive materials, including remote-handled transuranic waste, high-activity intermediate-level waste, low-enriched uranium, and fissile materials. "You have a lot of [small] drum-sized packages, and you also have a lot of big packages that will hold around 10 55-gallon drums. But there's not anything in between. We hold a 110-gallon drum capacity."

Both the Optimus-H, which was on display at the Phoenix conference, and the smaller Optimus-L, are Type B(U)F transportation packaging, designed to meet the regulatory requirements of the Nuclear Regulatory Commission under Title 10, Part 71, of the *Code of Federal Regulations*. England said that the transport casks are intended to provide increased flexibility for smaller nuclear facilities, such as research reactors and laboratories, adding that NAC has already sold 23 Optimus casks to Canada, where they are licensed.

According to Miles Smith, director of waste management at Whiteshell Laboratories, Canadian Nuclear Laboratories contracted NAC for the Optimus casks, which will be used for the removal of intermediate-level radioactive waste generated from the decommissioning of the nuclear research site in Pinawa, Manitoba.

Manufacturing

As long as there are nuclear materials, there will be a need for containers to keep, store, transport, and dispose of them. While in the overall scheme of things, not much thought may be given to these containers, commonly referred to as "packages" by those who produce them, there is a long and intricate path to follow to design, certify, and build them.

It typically begins with the primary customer, such as a government agency, utility, or contractor. The customer will then work with one of the larger waste management companies, such as Orano, Holtec International, or EnergySolutions, for the design and delivery of the packages. Those companies will, in turn, subcontract the manufacturing of the packages to a specialist manufacturer. NAC, for example, contracted the Camden, N.J.–based company Joseph Oat Corporation for the manufacture of the Optimus casks. Many of those manufacturing companies were on the floor of the Waste Management Conference exhibit hall.

"We are by and large a build-to-print contract manufacturer," said Joel Manship, vice president of business development for Major Tool and Machine (MTM),

which had a booth at the Phoenix conference. Manship said that MTM is working on producing several package designs for use by the Department of Energy's National Nuclear Security Administration for transporting fissile material as the agency prepares to implement its plutonium pit production program at the Savannah River Site in South Carolina. Manship noted that designing, certifying, and building engineered containers for radioactive materials often takes a significant amount of time. "Some of the packages that we are working on began in the development phase five, seven years ago, and are just now going into a production phase," he said.

The design and certification process accounts for much of that time. Obtaining an NRC license for a spent nuclear fuel cask, for example, can take as long as two years. Manufacturing unique and complex steel containers can also take a lengthy amount of time. Dan Payne, sales manager for Wagstaff Applied Technologies, recommended that customers should consider eight months as the shortest time it takes to complete the fabrication of a cask design.

Wagstaff AT

A Wagstaff welder attaches components to the inner container of the Orano-designed 435-B package.

An NNSA team uses a 435-B Type B container to recover a cesium-137 self-shielded irradiator from a hospital in Houston. (Photo: NNSA)

Payne said that Wagstaff built four Orano-designed 435-B transport packages for the NNSA's Off-site Source Recovery Program (OSRP) at Los Alamos National Laboratory, one of which was donated to the International Atomic Energy Agency by the U.S. government. The OSRP works to remove excess, unwanted, or disused radioactive sealed sources that pose a potential risk to national security.

Small orders of a unique and complex nature, such as the 435-B transport casks, pose a number of manufacturing challenges, Payne said. In the case of the OSRP casks, this included the welding of thin pieces of steel in close tolerances, which necessitated welders to apply dry ice to portions of the steel as it was being welded to prevent the material from heat warping. "It was a very challenging fabrication in that sense," he said. "We had to come up with some unique processes that are not typical industry practices."

Rob Despain, vice president of business development at Petersen Incorporated, of Ogden, Utah, also noted the significant amount of effort that goes into fabricating packages for high-activity nuclear materials. "They are very intricate and difficult to build," Despain said of the spent nuclear fuel storage casks Petersen makes for

NWP

A standard waste box produced by Petersen Inc.

Pac-Tec LiftPacs are used to remove decommissioning debris from Canada's Whiteshell Laboratories.

a number of waste management companies. "They are a thick-walled, very high-end product, and that takes an extreme amount of fabrication and machining capabilities to pull off."

Manship said that to facilitate the manufacturing process, his company communicates with customers and package designers early in the process. "Even though we are not the design authority, we are engaged with [designers] to help make a producible package," he said, adding that the goal is to increase the manufacturability of the package in order to reduce costs and turnaround times.

Likewise, Payne said that the designers can assist the manufacturing process by thinking about the specifications they include in their licensing documents, which, once defined, cannot be changed. He noted that different components, when welded together to form a larger structure, can change shape, to where the individual pieces no longer meet the required specifications. "Think about your dimensions as a designer in terms of what you need—what actually impacts the performance of the cask or container," Payne said. "Don't specify unneeded dimensions and don't add incredible complexity where it's unneeded."

Not all packages, however, are solid steel, heavily shielded canisters. PacTec is one company making certified flexible containers for packaging low-level and mixed radioactive waste. The company makes, among other things, flexible Type IP-1, IP-2, and 7A Type A IP-3 containers, as well as overpacks for shipping nuclear components.

While commonly used for packaging and disposing of large volumes of contaminated soil and debris from decontamination and decommissioning activities, these are not your everyday garbage bags. They are, said Bill Smart, PacTec's nuclear sales director, highly engineered and tested products. "I'm not going to overglamorize it . . . but what we do is important, and you've got to do it right," he said. "It's not just a bag."

Quality assurance

While a container design company such as NAC International is responsible for the licensing and certification of its casks, the fabricating company is responsible for following a certified quality assurance program. That program is the NQA-1 (Nuclear Quality Assurance-1) program, the industry consensus standard created and maintained by the American Society of Mechanical Engineers. In other words, Despain said, the designer is responsible for conducting all the calculations to ensure that the cask specifications meet all required shielding and dose requirements. "But building to meet that criteria is 100 percent our responsibility," he added.

Having an NQA-1 program and keeping that program current is key to working with nuclear customers, Despain said. "Otherwise, they are not coming to talk," he said, adding that NQA-1 tells the customer that the fabricator will do what it says it will do. "It is really a recipe for how you go through the entire build of that container."

The controlling document in the quality assurance process is the license, which contains all the design drawings and specifications. Because the design cannot be modified without redoing the license, Wagstaff's Payne said, there is continuity along the entire supply chain, from customer, to designer, to manufacturer. It is the customer's responsibility, however, as the end user, for showing compliance to the license, including overseeing the fabrication process, Payne explained.

In the case of the transport casks Wagstaff produced for the OSRP, the NNSA contracted Nuclear Waste Partnership (NWP), which manages the Department of Energy's Waste Isolation Pilot Plant in New Mexico, to oversee the production of the casks. An NWP inspector was in the Wagstaff shop for the entire contract

production period of about two years, Payne said.

Each time a contract is awarded for a container or cask, an audit of the manufacturer's NQA-1 program is conducted by the customer. This can result in several audits of the same company for similar orders. Manship pointed out that if his company receives an order from a DOE laboratory, an audit of MTM's program will be conducted by that lab. If another lab in the DOE complex places a similar order, however, that lab will also conduct its own audit. To remove this apparent redundancy and streamline the process, Manship said, MTM and other manufacturing companies have been pushing for the establishment of a governing body within the DOE to standardize the NQA-1 auditing process.

Noting that customers such as the DOE and nuclear utilities are being held accountable to their stakeholders, Pac-Tec's Smart said that his company welcomes whatever quality assurance requirements are asked of them. "We welcome it because it is important," he said. "That's not to say you want it to be inefficient and expensive, but you don't want to cut corners."

Workforce

Manufacturing issues and NQA-1 compliance are not the only challenges facing package makers. Like much of the rest of the nuclear industry, fabricators are facing an aging workforce and a dearth of skilled craftspeople to take their place. "Young people today are just not interested in becoming welders," said Dwight Campbell, president of Container Products Corporation (CPC).

Campbell said that his company is looking into building an internship program to attract new talent, but for now CPC's main focus is working with local community colleges that offer welding programs. In addition to recruiting community college graduates, CPC donates much of its scrap metal to the colleges to provide students with material that they can use to practice different welding techniques. Campbell said that being based in Wilmington, N.C., many of the welding program students come from a military background.

Payne, likewise, said that while his company generally has not had a problem finding talented engineers, the ability to recruit skilled craftspeople, including welders and machinists, is a major concern. While Wagstaff is currently well staffed with around 450 employees, Payne said that in the next 10 years, the company expects to lose about 45 percent of its staff based on anticipated retirements, not including natural attrition and loss. "That is huge," he said. "Inside of 10 years we will essentially need to hire and train, without any expansion, 200 people." In addition to being very active in working with community colleges and trade schools, Wagstaff has implemented an internship program to attract and train craftspeople, Payne said.

MTM, which is based in Indianapolis, Ind., announced in October 2019 that it was working with Vincennes University to establish the second Indiana Federation for Advanced Manufacturing Education (INFAME) initiative in the state to prepare students for careers in advanced manufacturing. Through the initiative, students will be trained in automation, robotics, and other aspects of advanced manufacturing. The first class of INFAME students was expected to start this fall.

Maintaining a workforce to meet demand is likely to continue to be a pressing issue, as many manufacturers are seeing a growing demand for radioactive waste packages as more nuclear power plants are moving into decommissioning and governments around the world step up the cleanup of their legacy waste sites. Given the ability to secure those skilled workers, however, the package industry is ready to meet those decommissioning and cleanup challenges. "Our basic philosophy is, if it fits, it ships, to steal a U.S. Post Office term," NAC's England said. NN