THE *NUCLEAR NEWS* INTERVIEW

# Dan Patten: A job "weld" done

*A weld program manager for FirstEnergy Nuclear Operating Company talks about generic rules relief and the advancements coming in the field of welding.*

Dan Patten is a metallurgist who has been involved with repair welding his whole career. He is a weld program manager for FirstEnergy Nuclear Operating Company (FENOC) and is also the current utility chairman of the Electric Power Research Institute's Welding and Repair Technology Center (W&RTC), in Charlotte, N.C. The W&RTC, which recently changed its name from the Repair and Replacement Applications Center, is undertaking a process that the nuclear power industry would use to make the Nuclear Regulatory Commission's job of reviewing requests for relief from repair weld requirements more efficient. It also would maintain the integrity of the process to ensure safe and reliable plant operations. For his efforts, Patten has received EPRI Technology Transfer Awards in the past two years.

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Patten, who has been with FENOC for four years, is responsible for the company's welding, in-service inspection, nondestructive examination (NDE), and repair replacement, all of which involve welding and materials. As a fleet program manager, he works as needed at each of FENOC's nuclear plants—Beaver Valley-1 and -2, in Shippingport, Pa.; Davis-Besse, in Oak Harbor, Ohio; and Perry, in North Perry, Ohio.

After graduating as a materials engineer from Drexel University, in Philadelphia, Pa., Patten began his career working in metal foundries. Since then, he has completed his graduate studies in materials engineering and engineering management at Drexel and has spent nearly 15 years working in the power industry at both nuclear and fossil-fuel power plants. "But it has always been about welding repair and materials," he said. "I just enjoyed it and started specializing in it."

Welding, for those reading this article who have never gone beyond holding a soldering gun in high-school shop class, is the process of joining separate pieces of metal by simultaneously applying heat and adding filler material. The various processes include shielded-metal arc welding, or stick welding, which involves a consumable electrode rod that is melted by the arc between the piece being welded and the rod itself, and gas-tungsten arc welding, or TIG welding, which involves a nonconsumable tungsten electrode and the addition of filler metal wire.

Patten talked about welding with Rick Michal, *NN* senior editor.

*You won EPRI awards in the past two years for your work on welding codes. What did that involve?*

EPRI's Welding and Repair Technology Center is working on developing code rules for certain types of welding repairs. I won the 2007 award for my effort in developing best practice guidelines for weld overlay repairs of nuclear plant components during refueling outages. And this year's award is for advancing the implementation of a generic industry code case for repair overlays. Basically, it means that I helped put all the welding rules for overlays into one document as part of the W&RTC's generic relief request project. The project involves something called a code case, which is a request to the NRC for permission to do repairs on certain components. In this instance, the NRC would need to issue its approval—or relief from those requirements—prior to commencement of the repair. The development of a generic relief document combines all of the various code cases into one generic code case. The idea is to put all of the requirements for overlays into one document, in a format that the industry and the NRC have agreed to, so that it can be submitted consistently and approved more easily by the NRC.

*Could you give an example of how this generic relief would work?*

The NRC could order that the industry make generic-type repairs to a component in a nuclear plant, and the result would be that each plant would do the same overlay welding job. If all the plants submitted their relief requests in the same manner, it would make the NRC's reviews more efficient.

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*How will the generic relief go into effect?*

Once the code cases are developed through the ASME (American Society of Mechanical Engineers) committee, the nuclear utility has to ask the NRC for formal relief. If the code case is placed in Regulatory Guide 1.147, then it could be used without asking for relief.

*In the big picture, what gets welded at a nuclear plant?*

Just about every piece of metal equipment out there has some welding and fabricating aspect to it. One aspect involves new construction or project-related replacement of component parts. Piping systems are fabricated by welding, and large components such as pressure vessels and generators are all welded in contractor shops. The fabricated systems or replacement component parts are then delivered to the plant site where they are assembled together in the plant mostly by welding.

The other aspect is repairs. A weld cracks or component materials degrade through various in-service corrosion and/or cracking mechanisms. One of the most effective and reliable ways to handle this is to weld and repair it.

*What is the state of the technology right now?*

*Continued*

The biggest issue surrounding welding today deals with resources. As nuclear plants run longer, we're expecting a great demand for welding projects that involve component replacements in existing plants. And there is hope that soon, welders will be needed to build new nuclear plants. A potential issue is that we don't have enough craftspeople getting involved in welding. To my knowledge, there is just one degreed welding institute in the United States—at Ohio State University. From a resource perspective, the industry will need more welders in the future.

*How can welding become an attractive career choice?*

We have to start with the unions and craft shops, find a way to get them to promote welding, and make a pipeline for prospective welders to receive training. Most welders are nearing retirement age. To be honest, it's not a field that a lot of young people are entering. While being a welder means working in a construction-type atmosphere, the pay is very good, comparable with engineering pay. This potential manpower issue exists not only for welders, but for NDE examiners, inspectors, and the whole crafts infrastructure that will be needed to build new nuclear plants and replace the retiring workers.

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*How does a welder become qualified to work in a nuclear plant?*

First, let me say that welding is the same regardless of the type of power plant—whether a pressurized water nuclear reactor, a boiling water nuclear reactor, or a fossil fuel power plant. As for qualifications, they are pretty similar for working at nuclear plants or fossil-fuel power plants. The welders have to meet the minimum qualifications of the ASME Boiler and Pressure Vessel Code, Section IX, which gives requirements for performance. The American Welding Society has comparative requirements for welding procedures and welding performance. The key to the issue, however, is something called "knowledge capture." Current welders have knowledge that has been gained by working in the field for a long time, but there are only a few young people in the industry who can capture it.

*Does FENOC contract out most of its welding work?*

We do have a certain number of staff welders at FENOC who are available to do emergent work, but most of our big projects are contracted out. But even for that work, the contracting companies make arrangements with local unions to use some craftspeople to support the jobs.

*What weld materials are used now, and are they stronger and longer-lasting than previous materials?*

A great amount of research has been done regarding filler materials—especially nickel-based filler materials used in overlays. Nickel-based filler materials are prominent in the industry for joining carbon steel materials or low-alloy carbon steel materials to austenitic stainless steel materials. Because of their corrosion- and cracking-resistance properties, these materials are used for overlays. There is an industry project to further improve the weldability of these filler materials—especially to improve their cracking resistance when welded. We will need improved filler materials as the welds become thicker, since there is more of a propensity for cracking as the weld thickness increases.

*Could you explain how a weld overlay works?*

A weld overlay is deposited on the outside diameter of a pipe. I heard one of my coworkers state that it is analogous to a cast placed on a broken arm. There are two types of overlays: a full-structural overlay and an optimized overlay. The full-structural overlay is designed to take the full loading and stress of the underlying piping material. It assumes that the underlying material is cracked completely through, and the overlay replaces the cracked material. Meanwhile, the optimized overlay assumes that some of the underlying material is not cracked. The result is that the optimized overlay is thinner.

In addition to overlays, there are onlays and inlays. An onlay is a thin layer of material welded in place on the ID [inside diameter] of a pipe. The onlay covers a crack or corroded area, and the purpose is to create a barrier to avoid stress corrosion cracking from the ID. We access the inside of the pipe by cutting through it or going through a nearby valve.

An inlay is a thin layer of material placed in a ground-out portion of the ID of a pipe. A welder can do this manually, but we can also insert a robotic crawler that remotely places a welding machining head on the affected area of the pipe, grinds it out, and then applies the welded inlay. In fact, laser welding can be used to apply very thin inlays through water inside the pipe so that the system doesn't have to be drained. This is a new technique recently demonstrated at the W&RTC by a specialty welding vendor.

*Are onlays and inlays thin enough so that they don't affect flow inside the pipe?*

Yes. For all practical purposes, the final dimension with the weld inlay applied is the same as the original ID of the piping. The damaging crack is machined from the ID, and the excavation is filled with weld material with improved corrosion-resistance properties. Onlays are typically very thin and do not protrude into the flow path.

*How is quality control done for the work on the ID?*

Strict foreign material exclusion (FME) practices are in place whenever the system is breached. FME is a term for the process established to prevent and control materials that can enter a system. Examples include tools, tape, plastic, dust, and grinding chips. Constant oversight for FME is established. The consequences of leaving something inside after the system is closed can be great, leading to such events as fuel defects in nuclear plants.

*What will be the state of welding in 10 or 20 years?*

I expect a lot more robotics, a lot more automation on process applications, a lot faster welding deposition rates, and improved weld process controls, which means we're going to put more quality metal down and weld faster. As far as the training of welders, visual training aids are now available to instruct and test trainees while they sit at their computers at their desks. Through the movement of the trainee's hands, the computer program can tell whether the simulated welding is being done properly or not. I expect to see advancements in that area.

I also expect to see new code developments in welding, advanced filler materials that have longer service lives, and more uniform and controlled weld deposits via friction stir welding and laser welding. Gas-metal arc welding, with its greater welding deposition rates, has a place in future welding. I don't think anything new will come out for qualifying the welders, but time will tell. Right now we're working on these things in the EPRI's W&RTC, so I know they'll be coming to fruition in 10 years. NN