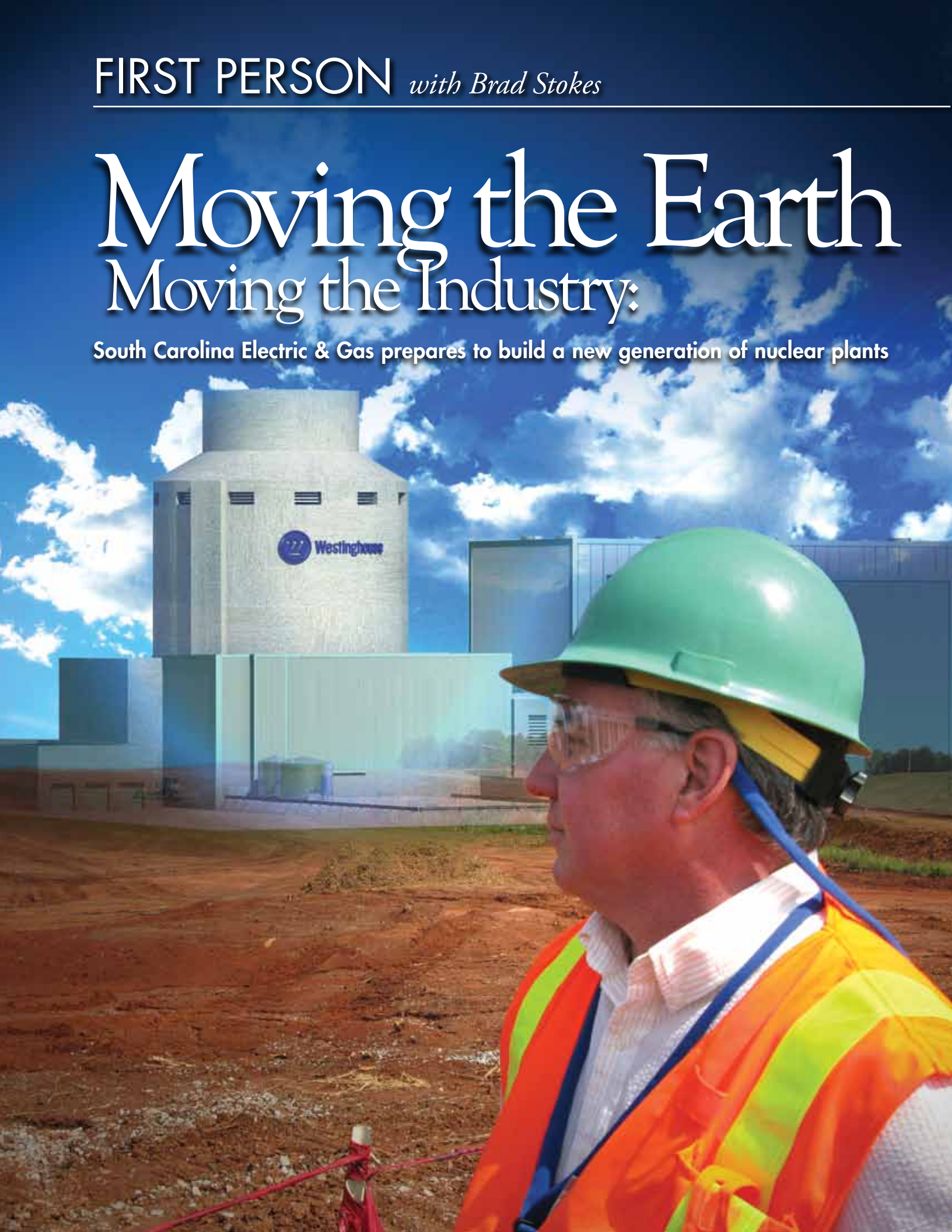
FIRST PERSON *with Brad Stokes*

Moving the Earth

Moving the Industry:

South Carolina Electric & Gas prepares to build a new generation of nuclear plants



In the rolling hills near South Carolina's Broad River, South Carolina Electric & Gas is moving more than just red clay. With more than 200 pieces of earthmoving equipment reshaping the landscape to accommodate two new nuclear generating units, the utility's undertaking is a harbinger of the U.S. nuclear industry's emergence from a decades-long construction hiatus.

EPRI Journal traveled to the V.C. Summer Nuclear Station, a one-unit, 966-megawatt plant that is jointly owned by SCE&G and the South Carolina Public Service Authority, to discuss the two new nuclear units that will add more than 2,200 megawatts of zero-emissions capacity to the two utilities' generation portfolios.

EPRI Journal spoke with Brad Stokes, engineering design manager for SCE&G, who is overseeing project engineering.

EJ: How would you summarize the business case for building two new units at V.C. Summer?

Stokes: One of the main things that turned us to nuclear was the economics. Nuclear plants are expensive to build, but with capacity factors greater than 90% and the low cost of nuclear fuel, we can anticipate a good return over the 40-plus-year economic life of a plant. The possibility of a constraints on CO_2 emissions was a consideration. Fuel diversity in our generation mix was also a major consideration. We have about 5,750 megawatts of capacity, of which about 75% is coal or gas, about 11% is nuclear, and a similar amount is hydro. That mix can make us susceptible to gas prices going up, like when we had Hurricane Katrina interrupt gas supplies in the Gulf. We've also seen fluctuations in coal prices. So, a more diverse fuel supply gives us options—a good mix. Also, by 2019 or 2020, when the second new unit comes on line, however, we'll be able to reduce our carbon emissions back to mid-1990s levels. At that point, we could see nuclear account for as much as half of our production.

EJ: What are you doing with your work force as you go from one unit to three units?

Stokes: We have the same issues as other utilities. Our work force is older, so we need to train and bring on new folks. We have to continue operating the existing plant successfully and economically, and we have to be careful how we bring employees over from our existing unit to our new units. So we are developing new talent. We're working with local colleges and tech schools, including the University of South Carolina's graduate program in nuclear engineering, South Carolina State University's undergraduate engineering program, and Midlands Technical College, where we've been cooperating to develop an operator training program. We recently brought in 15 people from the Midlands Tech program to see what operations is all about, and we got to see what kind of employees they would be. We expect to hire some of the folks out of this program.

EJ: Are you concerned about the limited experience of your new work force?

Stokes: Of the 15 engineers I have on board right now, about half have less than five years of experience.

EJ: By the time the second new unit comes on line, however, they will have 15 years of experience.

Stokes: That's right, and they will have had time to be mentored by my senior engineers here. Plus, by being involved with the project from day one, they will get to see what the issues are, how we solve problems as we go through the design and construction. You learn more about the plant by participating in construction, and I think that makes you a more informed plant engineer once the plant starts operation.

EJ: Where is the project in broad terms of the schedule and milestones that you have established?

Stokes: We are in a preconstruction stage right now. From a regulatory standpoint, we can't start nuclear construction until we get our license from the NRC (U.S. Nuclear Regulatory Commission). We expect our NRC license in 2011, sometime between June and October, depending on approvals for the Westinghouse AP1000 Design Certification Document and review of the standard plant combined operating license application. We expect to start nuclear construction on Unit 2 in late 2011, and from then until late 2015 we'll be in construction mode. Then fuel loading late in 2015, start-up testing, and check-out. We'll go operational in April of 2016. The timeline for Unit 3 will track about three years later. The timing of bringing on our second unit is based on our system load growth.

EJ: So what are you doing on site right now?

Stokes: In 2008, we received approval from the South Carolina Public Service Commission to begin preconstruction activities so we could stay on our overall schedule. To start with, we had to reroute the existing railroad spur that supported Unit 1. Unit 1 required the rail spur to

support an upcoming outage, and we needed to move the rail spur to allow preparation of the site. This required quite a bit of excavation, but we met the need for Unit 1's outage, and the rail spur is now in place to support construction. We will need the new spur to bring in the steam generator, reactor vessel, and other large components for Units 2 and 3.

We'll have to accommodate 3,000 people during construction, so we are building a "construction city," an administration building, and a training facility. We're already installing modular buildings for construction, engineering, quality assurance, and licensing. We probably have more than 200 vehicles involved in earthwork. By January, we expect to have the "tabletop"—where the two new units will be situated—down to its final grade in the area of Unit 2. Then we can start excavation for the units, but we cannot start safety-related vertical construction until we receive NRC license approval.

EJ: What are the key differences in the technology of Unit 1 and the two new units?

Stokes: They are all Westinghouse units. Unit 1 is a three-loop pressurized water reactor that relies on active systems for reactor cooling and containment pressure and temperature control during accident conditions. The new AP1000 units are Generation III+ plants, which rely on passive cooling for reactor safety. The advanced designs also allow for a smaller plant footprint, with fewer pumps, fewer valves, and significantly less electrical wiring. There is going to be less equipment for us to maintain and an increased level of safety well beyond the already high levels of safety at our current plant.

EJ: Are you working in concert with other companies that are building this same design?

Stokes: Very much so. One big benefit to this new wave of nuclear plants is the close cooperation. Most of the utilities considering new nuclear in the Southeast selected the AP1000 design. A number of these utilities formed a group to collaborate on design, construction, and operation of the AP1000 design. We are working closely with Southern Company, which is developing new nuclear units at their Vogtle plant; with Progress Energy, which recently signed a contract to develop a new plant in Florida; and with Duke Energy and Florida Power & Light, which are also considering new AP1000 plants.

We're also involved with the EPRI Advanced Nuclear Technology program. This includes utilities developing new plants based on other nuclear plant designs—Constellation, Entergy, Exelon—and international nuclear utilities such as EDF [France], Endesa [Spain], and KHNP [Korea].

EJ: That in itself represents a departure from the earlier generation of building, doesn't it?

Stokes: I was not around for the construction of the last generation of plants in the 1970s and '80s, but it's my impression everybody built plants using their own design philosophy. This resulted in a lot of unique plants, even though a lot of plants used similar nuclear steam supply technology. Now, after 25-plus years of operation, we are very interested in building standard plants and doing things the same way. We expect this method will help make the Generation III+ plants safer and more economical to build and operate.

EJ: What are some of the areas where your company and the others in EPRI's Advanced Nuclear Technology (ANT) program have focused your attention?

Stokes: We look at lessons learned from our operating experience at the existing units, to make sure those lessons are applied in the future. For example, as a result of issues related to alloy 600 in pressurized water reactors, we are using alloy 690 in the new AP1000 design. We learned the importance of materials selection, how those materials degrade, and how you can most effectively inspect those materials. Existing plants over the past 10 years have developed materials management matrix documents through their interaction with EPRI. One of the first things we did in ANT was develop materials management matrix documents for the new AP1000 design so that we would start off knowing the materials we're using, their abilities, how we should inspect them, and what we need to factor into our inspection processes going forward.

We're also making sure that risk-informed initiatives are in place for managing new nuclear plant operation and maintenance. Instead of the deterministic methods that were used historically, EPRI is investigating probabilistic approaches. Here's one example. By applying risk-informed techniques to the in-service inspection of welds at new plants, we can determine if it's possible to reduce the number of required inspections.

Another example is with nuclear fuel. We're looking to make sure that the fuel guidelines developed to help the industry meet its "Zero by 10" commitment [zero fuel failures by 2010] are applicable to the new nuclear plant designs. An EPRI project is currently under way to investigate if there's anything different about the fuel design or the way we are operating the fuel in new plant designs that might require some change to the guidelines for the new generation of plants.

EJ: Are program members looking at anything related to plant construction?

Stokes: We're collecting operating experience to see what we can learn about modular fabrication and construction over the past 5 or 10 years. What do companies do for testing, in shipping, to make sure that the modules are preserved and arrive on site in factory condition. We have an ongoing project to benchmark different

companies that are using modular fabrication and construction, to find out what they have learned, how they have changed their business, what problems they encountered, and how they have improved their processes over time.

EJ: How are you approaching engineering, procurement, and construction (EPC) for these two units?

Stokes: We realized early on that the process would be much better and much more beneficial to us if we were part of the team with Westinghouse and Shaw in completing our project under an EPC arrangement. Westinghouse is the plant nuclear steam supply system designer, and Shaw is performing site-specific designs and is the project constructor. The consortium [Westinghouse and Shaw] has worked closely with SCE&G to build our project team. My engineers are a part of the design team for our project. We participate in design reviews, provide design inputs and operating experience, and review and comment on design documents. People from our engineering group actually spend a couple of days a week in the Shaw offices in Charlotte and often travel to Westinghouse's home office in Pittsburgh to make sure that we are up to speed with what is going on in our project.

EJ: Do you have a sense that you're helping restart the nuclear industry in terms of construction? Of being out in front of the pack and having attention focused on you?

Stokes: I don't focus on whether we are leading or not. It's important for us to stay on schedule and to stay on budget and to do things the right way. The way the Vogtle project goes and the Summer project goes and other projects—they're going to set the pace for the rest of the industry. If we can build on schedule and within cost and meet all the regulatory requirements, that makes it easier for the next group coming through and helps ensure that there is a revitalization of the nuclear industry.

EJ: It sounds like collaboration really is at the heart of it, too.

Stokes: I have never known another industry to share information as openly from company to company. It has been that way with Unit 1 since I have been here. If I need information from Duke or Progress, I call their engineering lead and ask for it. They share procedures and technical experts and will even send staff to our site for consultation. We openly share information that other industries might hold to themselves for advantage, and it makes us all stronger.

EJ: Even though start-up is years away, what are you doing now to ensure that it goes smoothly?

Stokes: We know that there are experts and lessons learned out there, but not all in one spot. We have a project through the EPRI ANT program to actively look for operating experience from start-ups—whether it's in China, with TVA plants [that recently came on line after construction was suspended decades ago], or with some of the start-up engineers that were around for start-up of the last generation of nuclear plants, constructed in the 1970s and 1980s. The program is investigating what was learned—what were the big hurdles—and looking at how can we address those now. We certainly don't need to learn those lessons over again.

We'll start hiring start-up engineers in 2011 to 2012. We're using a team approach for that too. Westinghouse will have the lead, with Shaw and SCE&G providing support. Westinghouse is writing the start-up procedures, which will be based in part on the experience and insights that will be captured in the EPRI start-up report, reflecting input from Japan, Korea, the U.S., and elsewhere. We'll get this EPRI product just in time to help in developing these procedures. In addition, we will be able to capture lessons learned from start-up of the AP1000 units being built in China.

Brad Stokes on collaborative nuclear R&D

At one point in the interview, the conversation touched on the timing and value of collaborative R&D for nuclear utilities.

"We realize that some projects are not going to be finished in time to support Vogtle and Summer. They are still important—they still need to be done. We fund them because the industry needs them. Even if we can't take advantage of them right now, we know the industry can. On the other hand, some of the projects that we're benefiting from right now are being funded by companies with no immediate need for the results. They're confident they'll benefit from them in the future, and they recognize their importance to the industry."

With an emphasis on standardization, modular construction, and passive safety systems, the Westinghouse AP1000 is one of the most advanced nuclear power plants available in the world today.