that he said could be developed under the OECD Nuclear Energy Agency's Nuclear Innovation 2050 program. That new paradigm would cover phenomena identification, the design envelope, initial simulation and uncertainty, a phenomena identification and ranking table, analytical experiments, model validation/uncertainty reduction, and design optimization, followed by integral tests.

Analytical experiments would be undertaken during the first three or four years of work to support modeling and simulation. "We need to work closely with the utilities and the regulators to make sure the analytical experiments—the way they are designed, the way they are conducted—answer the critical questions," Pasamehmetoglu said.

He posited that not all of the analytical experiments need to be conducted at a full length and time frame. He named a number of phenomena of interest, such as grain boundaries mobility and fission product transport, that are already well understood. "Those phenomena appear at the small timescale," Pasamehmetoglu said. "In many cases, that is not a three-year experiment. I truly believe that over many decades having worked with many different fuels, we do know the phenomena that we worry about.

"This paradigm would be very applicable to cases where we design reactor systems starting with fuel, building the reactor around the fuel to take advantage of the strengths of that specific fuel and compensate for what we've missed with the rest of the reactor design," he said.

During the question-and-answer session, Pasamehmetoglu was asked to comment on the prospects for international collaboration in fuel development. "In the early days of technology development, I think [collaboration] works really well along with the competitive markets," he said. "I'm hopeful that there will be a small group of countries that will come together with dedicated funding for this and really start running this as a project."

Chavers returned to the lectern to make a presentation from Southern Nuclear's perspective as a fuel customer. "We have found that innovation independent of external partners is less cost-effective and is riddled with obstacles," he said. Instead, Southern has embraced collaborations with government, other utilities, universities, and all three fuel vendors in the DOE's ATF program.

"A lot of what we used to do was very transactional," Chavers said. "What we're doing now is a paradigm shift. . . . We're engaging very early—and not just Southern Nuclear, but other utilities such as Exelon and Entergy—we're all engaging in a partnership, and it's much more collaborative than transactional. . . . Before this accident-tolerant fuel program, we at Southern Nuclear had never directly worked with a national lab to associate something that they're doing with one of our reloads."

Southern Nuclear's pursuit of ATF is driven by economics. "We really view accident-tolerant fuel technology as an enabler for us to get other things that we want or require, such as increased enrichment, increased burnup, and increased operational margins. All of this is to extract value to create an economically viable product."

As the session drew to a close, Csontos was asked a question that may have been on the minds of several attendees: "Will ATF save the nuclear industry, or just a few plants?"

"If you're already at risk of shutting down, ATF is not going to be there in time to save you," he said. "But for those plants that are going into subsequent license renewal or are thinking about going into subsequent license renewal, understanding the economic benefits and what it will cost to get there, and looking into the amortization of those benefits economically over the remaining life of the plant, I think will help those plants stay afloat longer."—*Susan Gallier* NN