Focusing on the "firsts"

Review by NANCY J. ZACHA

Nuclear Firsts: Milestones on the Road to Nuclear Power Development, by Gail H. Marcus. La Grange Park, Ill.: American Nuclear Society (2010). 304 pp. $45.

The exciting times of the early years, as well as more recent events, have produced a vast array of nuclear firsts.

OKAY, I ADMIT it. I am one of those annoying people who "entertain" captive audiences at dinner and cocktail parties with bits of trivia. Want to know the names of the six wives of Henry VIII and their respective fates? Or the derivation of some obscure words in the English language? I'm the go-to girl.

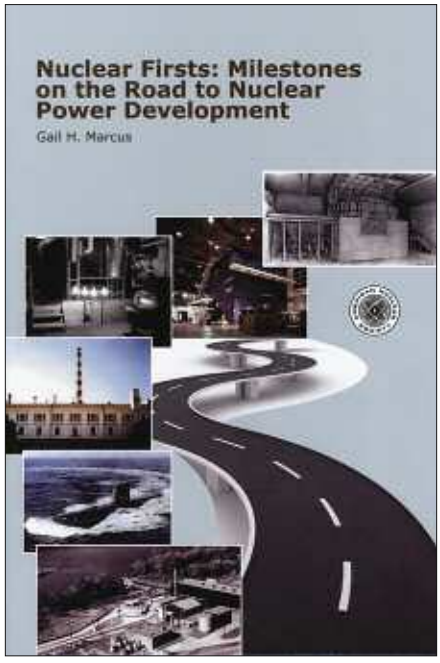
So I have really relished Gail Marcus's *Nuclear Firsts: Milestones on the Road to Nuclear Power Development.* Thanks to her tireless research, I have a whole new arsenal of trivia to inflict on unsuspecting friends and acquaintances.

And what an interesting concept: telling the history of nuclear power development by focusing on the "firsts" in the field. And not just the usual firsts we *think* we know about. (The first controlled nuclear fission? Everybody knows that one, but what about the first reactor to use enriched uranium? Betcha don't know that!) Marcus has taken an intriguing concept and then given us so much more—a genuine history book full of interesting facts and insightful analysis.

In her introduction, Marcus—who holds a doctorate in nuclear engineering from the Massachusetts Institute of Technology and is a past president (2001–2002) of the American Nuclear Society, and whose extensive professional career has included service with the U.S. Nuclear Regulatory Commission, the U.S. Department of Energy, and the OECD Nuclear Energy Agency—deals with the issue of what makes something a first, and she diplomatically tackles a question I immediately had when I picked up the book: How does one choose between an event that occurs in secrecy in one country versus a slightly later but much more publicized event in another? (It's the old "If a tree falls in the forest and there's no one there to hear, does it make a sound?" argument.) Marcus finds a way to include both events, giving the reader the whole story as it occurred. Even within the United States, there are arguments about some firsts, and Marcus finesses these issues with grace and tact. And in those cases where "seconds" and even "thirds" represent significant steps forward, Marcus includes sidebars when necessary to provide details of these developments. Tables and additional sidebars provide listings of first-of-a-kind technologies by country and/or by U.S. state.

Marcus's focus, of course, is nuclear *power* development, not nuclear weapons. In the early days, however, experimental reactors did not have a weapons-versus-power designation, and so a reactor built for weapons experimentation might also have a strong power-related significance. Marcus's book includes information on these early technological developments but does not get into such things as the first controlled nuclear explosion or the more obvious weapons production events. It does, however, include information on later reactors constructed outside the power industry, such as the nine reactors built by the U.S. Army for various purposes, not necessarily strictly defense related, as well as the reactors that led to the development of nuclear submarine and nuclear surface ship programs around the world.

And what exciting times the nuclear field has had! The late 1940s–early 1950s were years of incredible experimentation, invention, and discovery. And with Marcus's book, you are there every step of the way. What I found particularly interesting was the number of early reactors where operator errors led to partial core melts. Nuclear technology can be a delicate and potential-



A Trivia Quiz

(Derived from Gail Marcus's *Nuclear Firsts*)

1. We all know that the first human-made reactor (Chicago Pile-1, or CP-1, under the stands of the Stagg Field stadium at the University of Chicago in 1942) and the first full-scale or "large" reactor (B Reactor at the Hanford site in 1944) were built in the United States. Which country has the distinction of building both the first reactor to operate outside the United States and the first large reactor to operate outside the United States?

2. What was the S-50, and what did it lead to?

3. At which reactor was the principle of electricity generation from a nuclear plant first proven?

4. Where was the first reactor to supply electricity to the grid located?

5. At what institution was the first reactor licensed by the Atomic Energy Commission located, and why does it have the license number R-2 instead of R-1?

Hints and answers can be found on page 30.

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Hints

1. It wasn't the United Kingdom or the former Soviet Union.
2. It was located at the Oak Ridge site in Tennessee.
3. It's not EBR-I.
4. It's not Idaho.
5. Milton Eisenhower was president of the institution at the time.

ly dangerous one, and operators and experimenters had to learn, sometimes the hard way, how to control it.

In addition to reactors, Marcus also tracks the firsts in enrichment and reprocessing technologies, as well as the firsts in agencies and organizations that regulate or promote nuclear power.

Later chapters are perhaps less exciting, but only in the way that mature technologies are less exciting than their experimental precedents. Still, the accident at Three Mile Island in 1979 can be seen as the logical conclusion of the limited early trend of operator error leading to partial core melt (my opinion, not necessarily Marcus's). The final "first" in the book is the first U.S. nuclear power plant to achieve license renewal: the Calvert Cliffs plant, in March 2000.

Yes, I found a few statements and conclusions that I might want to disagree with, and I think Marcus underestimates the reader's intelligence—or memory—with her repetition of facts at various places in her chapters. (Each "first" listing includes a summary statement, background information, and legacy discussion. Often, almost exactly the same statement will be included in all three sections, giving the reader a feeling of *déjà vu.*) Finally, her index is not as user-friendly or consistent as I would have liked. (In searching for the B Reactor, I found nothing under *B*, but eventually found it under *H,* as "Hanford's B Reactor." In contrast, the X-10 reactor was listed under *X*, and not under *O* for Oak Ridge. Why the difference?) But these are minor quibbles about what is overall a well-written, highly informative, and ultimately entertaining book.

Who will like this book? Well, people like me, for one, but also people interested in history (especially anyone interested in the history of nuclear power), science instructors, nuclear engineering students, and those who work or have worked in the power industry. Almost every page is packed with information that you probably did not know, or "knew" incorrectly, or at the very least did not know in detail. As I mentioned earlier, Marcus has done some incredible research, and her list of sources at the end of each chapter is testament to that.

So, at this holiday season, instead of another reindeer sweater or poorly knitted scarf, why not give copies of *Nuclear Firsts* to your favorite discriminating readers? They will thank you, and you will benefit from some very entertaining dinners and cocktails parties in your future as they toss nuclear trivia tidbits out into the general conversation.

Oh, the first reactor to use enriched uranium, mentioned earlier? It was the LOPO (for "low power") reactor at Los Alamos on May 9, 1944. LOPO was also the world's third reactor, after Chicago Pile-1 at the University of Chicago and the X-10 Graphite Reactor at Oak Ridge. NN

Answers

1. Canada. The Zero Energy Experimental Pile at Chalk River, Ontario, achieved initial criticality on September 5, 1945. (The first Soviet reactor began operation on December 25, 1945, and the first U.K. reactor, on August 15, 1947.) The first large reactor outside the United States was Canada's NRX reactor, also at Chalk River, which started up on July 22, 1947.

2. The S-50 was a liquid thermal diffusion uranium enrichment plant that operated at Oak Ridge for about a year in the mid-1940s. It led to nothing; it was a dead-end technology, proving to be less efficient than the gaseous diffusion process developed around the same time.

3. The X-10 Graphite Reactor at Oak Ridge, on September 3, 1948. In what Marcus calls "a rather unpublicized footnote in the history of nuclear power," engineers connected a toy generator to the X-10 Graphite Reactor, producing the world's very first nuclear-generated electricity, enough to light a 1/3-W flashlight bulb. What the world generally considers to be the first generation of electricity from nuclear power took place more than three years later, at EBR-I in Idaho, on December 20, 1951.

4. In Obninsk, Soviet Union. On June 27, 1954, the AM-1 reactor, the first of the Soviet RBMK designs, began providing power to homes and businesses in Obninsk, one of the Soviet Union's "closed" cities (where sensitive scientific research was conducted). A little more than a year later, on July 17, 1955, the BORAX-III reactor supplied all the power to the town of Arco, Idaho, for a period of an hour. The Calder Hall I reactor at Sellafield in the United Kingdom was the first full-scale nuclear reactor to provide electricity to the grid, on August 27, 1956.

5. Pennsylvania State University. The research reactor there received its AEC license—License R-2—on July 8, 1955. License R-1 was reserved for the reactor at North Carolina State University, which started up in 1953, before the AEC had begun issuing licenses. Unfortunately, corrosion problems and fuel leakage led to the shutdown of the reactor before the license could be issued. It was replaced, over time, by a series of successively larger reactors of varying design.