



The 12-story module assembly building stands to the right of the foundation excavation for the new reactors—Units 2 and 3—at the Summer site. (Photo: Robert Clark/SCANA)

Renaissance Watch: Settling in with a few projects

BY E. MICHAEL BLAKE

WORK THAT CAN be done only under combined construction and operating licenses is now taking place at two U.S. locations. Work is also under way at another site under a construction permit. Power reactors are under construction in the United States, with the owners intending to bring them, and between 5000 and 6000 megawatts, into service before the end of the decade. Beyond that . . .

The enthusiasm for large light-water reactors in 2007 and 2008 has long since ramped down, with just a few license applicants that are firmly committed, some others that are hanging back, and a few that are facing obstacles they may not be able to overcome. The reasons for this? Try any or all of the following:

- The financial crisis of 2008, and the ensuing economic slowdown that has flattened electricity demand growth.

- The boost in domestic natural gas production from hydraulic fracturing of gas-bearing shale deposits, and the related belief that this will ensure low natural gas prices (and cheap gas-fired electricity) for the next several years.

In the United States, four new reactors are being built, and an earlier one is being finished. This is not likely to change in the next couple of years.

- Limited support in Washington for the use of new-reactor deployment incentives in the Energy Policy Act of 2005, especially in the awarding of federal loan guarantees and structuring them for the specific needs of an established electricity provider.

- The emergence of small modular reactor (SMR) proposals, some of which are intended to come close enough in cost per watt to limit a large LWR's comparative economy of scale and thus present an alternative to the "bet-the-company" total cost of large LWRs.

- The realization of exactly what is required to navigate the Nuclear Regulatory Commission's technical reviews for license applications and design certification under the 10 CFR Part 52 process that has been on the books for years but had not previously been used.

And all of these issues arose *before* March 11, 2011, when an earthquake and tsunami ravaged the northeast coast of Japan's main island of Honshu.

In light of the Fukushima Daiichi accident, it is noteworthy that all of the active applications for combined construction and operating licenses (COL) have remained active, and that since the accident, two design certifications have been finished and four COLs have been issued. It is not likely, however, that construction will begin anywhere else anytime soon. Meanwhile, the construction that has been authorized at Vogtle in Georgia and Summer in South Carolina will probably be slower than originally hoped, as the old unknowns of licensing reviews are replaced by the new unknowns of construction inspection.

There have been two other notable developments recently that apply not to all projects but to a specific few, and they will be elaborated on below. Still, they are worth mentioning as part of the current state of affairs of the overall effort to add new nuclear capacity. First, Tennessee Valley Authority officials finally conceded in April that problems with meeting deadlines for the com-

pletion of Watts Bar-2 reflected basic flaws in their approach, and a hard look at what really needed to be done has led to an increase of 60 to 80 percent in the cost estimate and a two-year delay in startup, which is now projected for late 2015. Second, the earliest two applicants for COLs—UniStar Nuclear Energy and Nuclear Innovation North America (as their names are now)—are facing the prospect of having their applications denied on the grounds that the companies are foreign owned, controlled, or dominated. These issues just add to the range of what can go wrong with a new nuclear project, but perhaps Vogtle and Summer will show what can go right.

The usual, only more so

This is the fourth time that the “Renaissance Watch” summation, normally a part of the *Nuclear News* Power section in even-numbered months, has been transformed from an oversized sidebar to an even more discursive feature article. What is now a June-issue tradition still uses the same format and summarizes each project’s basic information, but then carries on quite a bit longer.

In what follows, **BOLD CAPITALS** are used for projects under (or approved for) construction; **bold** indicates a submitted application; *italics* means that an application is forthcoming. Acronyms: ACRS, Adviso-

ry Committee on Reactor Safeguards; ASLB, Atomic Safety and Licensing Board; COL, combined construction and operating license; COLA, COL application; CS, proposed date for the start of commercial operation; EPC, engineering, procurement, and construction; ESP, early site permit; FEIS (DEIS), final (draft) environmental impact statement; FSER (DSER), final (draft) safety evaluation report; ITAAC, inspections, tests, analyses, and acceptance criteria; MH, mandatory hearing and final decision; RAI, request for additional information; TBD, to be determined.

In some cases, detailed schedules for the NRC staff’s technical reviews have been made public, and the following abbreviations are used for the phases of design certification: P1 (RAIs issued by the NRC); P2 (SER with open items); P3 (ACRS review of SER); P4 (advanced SER); P5 (ACRS review of advanced SER); and P6 (FSER). COLA reviews have been based on the same six phases (referred to below as SP1 through SP6), but in some cases the NRC is using a four-phase safety review, essentially skipping SP2 and SP3, with letters (SPA through SPD) rather than numbers identifying the phases. The COLA environmental review has four phases: EP1 (scoping); EP2 (DEIS); EP3 (comments on DEIS); and EP4 (FEIS).

Under construction

WATTS BAR-2, 1177-MWe Westinghouse pressurized water reactor, Tennessee Valley Authority; Spring City, Tenn.; 86 percent complete, but subject to rework. CS: September to December 2015, although further delay to mid-2016 is considered possible by TVA officials. FSER: December 2013, perhaps with supplements later; FEIS: September 2012. The supplemental draft EIS was issued in November 2011. One contention has been admitted for an operating license hearing.

In 2007, while in the closing stages of its five-year project to restart Browns Ferry-1 (which for a number of reasons had been off line since 1985), TVA was setting up its next big nuclear restoration effort: the completion of the unfinished second reactor at Watts Bar. One of the things TVA admitted this spring was that it had approached Watts Bar-2, a construction project, in the same manner as it had Browns Ferry-1, which although it required a lot of physical work was still a finished reactor. In the runup to the announcement of the new cost estimate and completion date, TVA also rearranged some contractor responsibilities, giving TVA personnel greater involvement. When it was first developing its nuclear program in the 1960s and 1970s, TVA acted as its own architect-engineer, but the agency is not looking to resume that role now, and Bechtel Corporation remains the prime outside contractor.

BELLEFONTE-1, 1213-MWe Babcock & Wilcox PWR, Tennessee Valley Authority; Scottsboro, Ala.; 55 percent complete. CS: 2018–2020. On-site construction will not resume until Watts Bar-2 loads fuel; procurement and other project spending is under way.

At one time, it seemed like a natural progression: TVA refurbished and restarted Browns Ferry-1, moved on to the completion of Watts Bar-2, and then would take that accumulated experience and finish Bellefonte-1, with Bellefonte-2 a possible next goal. Perhaps the Watts Bar-2 reality check will help TVA recognize that Watts Bar-2, a Westinghouse PWR that is essentially a replicate of Watts Bar-1 in its original design, may provide limited experience transferrable to Bellefonte-1, a Babcock & Wilcox PWR model that has been built only once, in Germany, and was operated only briefly before it was closed. During the Watts Bar-2 announcement, there was a sign that the lesson might have been learned: Watts Bar-2 was started without all walkdowns having been finished, but TVA President Tom Kilgore said that all of the Bellefonte-1 walkdowns have now been done.

VOGTLE-3, -4, 1100-MWe Westinghouse AP1000 PWRs, Southern Nuclear Operating Company; Waynesboro, Ga.; completion percentage not yet stated. CS: April 2016, April 2017. *The COLs were issued on February 10, 2012.* ITAAC status: not yet stated.

As involved a process as it was for Southern to obtain the COLs, the receipt of the licenses did not mean the end of approvals. The company has expected all along that it would apply for a variety of amendments to the licenses to bring the COLs in line with the plant's final detailed design. The NRC has finished the acceptance review of requests to revise internal structural module shear stud size and spacing (and has issued the first RAI) and to update technical specifications for operator usability. Among the requests awaiting acceptance review at this writing were those to change structures and layout of the annex, turbine, and radwaste buildings and to add four new non-Class 1E containment electrical penetration assemblies.

SUMMER-2, -3, AP1000s, SCANA/Santee Cooper; Parr, S.C.; completion percentage not yet stated. CS: late 2016, mid-2018. *The COLs were issued on March 30, 2012.* ITAAC status: not yet stated.

As similar as the Vogtle and Summer projects are, there had previously been one notable difference. While the two Vogtle reactors have startup dates about a year apart, Summer-2 was originally scheduled to enter service about three years before Unit 3. As construction proceeds, the number of ITAACs that must be conducted and closed out rises steeply, and many of the ITAACs

are specific to each reactor. This means that two reactors built in quick succession will have a much higher ITAAC peak than a two-reactor plant with more widely spaced completion dates. It turns out, however, that SCANA/Santee Cooper found it necessary to delay the completion of Unit 2 by a few months, and in compensation, Unit 3 will be pegged to an earlier completion date. The targets at Summer are still more widely spaced than those at Vogtle, with almost two years between Summer-2 and -3, and this may still produce a lower ITAAC peak.

License applications (active)

Calvert Cliffs-3, U.S. EPR, UniStar;

Lusby, Md. CS: TBD; FSER: TBD; *FEIS issued May 13, 2011.* SP1 completed, April 2010; SP2 due, TBD (11 whole chapters are complete, as are parts of two others). A hearing was held January 26–27 on one of the two intervenor contentions; how to proceed on the other contention will be determined when the decision on the first contention is issued by the ASLB.

The fate of this COLA may have been decided before this magazine is printed. The hearing was on a contention on alternative sites, and the ASLB stated at that time that it expected to reach a decision during the spring on the potentially more serious foreign-control issue. When Con-

stellation Energy pulled out of the project in October 2010 over the credit subsidy fee set by the Department of Energy on a loan guarantee offer, UniStar was left as wholly owned by EDF of France. Constellation has since agreed to a merger with Exelon, which has stated flatly that it will not participate in a third reactor at the Calvert Cliffs site, which it now owns. The NRC staff has decided that as things stand, UniStar is foreign controlled and so is ineligible to own or operate a power reactor in the United States.

The ASLB has told UniStar that it should use the time while it is awaiting a decision on the first contention to find partners that would give majority control of UniStar to U.S. owners. At this writing, UniStar had not announced a change in ownership, and the decision on the first contention could be handed down at any time.

South Texas-3, -4, Toshiba ABWRs, Nuclear Innovation North America (NINA); Palacios, Texas. CS: “as early as” June 2018 and July 2019, according to NINA. FSER: TBD; *FEIS issued February 24, 2011*. SP1 completed, September 2009. Two intervenor contentions have been resolved in NINA’s favor; the hearing on a third was not scheduled at this writing. An EPC contract was signed with Toshiba in February 2009, and the contract was assigned to the Shaw Group in November 2010.

Here is the other instance of potential foreign control, but NINA—a joint venture of U.S.-based NRG Energy and Japan-based Toshiba—insists that the fact that Toshiba is currently covering all the costs of the licensing reviews does not mean that a foreign interest is in charge of the project. NINA refers to the Toshiba payments as loans and states that Toshiba’s ownership of the project would be capped at 10 percent and that a loan guarantee from the DOE would make the project a going concern, bringing in domestic investors. NINA is not under the same time pressure as UniStar to show domestic control, with RAIs and responses on the ownership of the new reactors expected to continue at least through this summer.

North Anna-3, US-APWR, Dominion Generation; Mineral, Va. CS: 2022; FSER: TBD; FEIS: TBD. SPA due, TBD. Because a final EIS had been issued when the applicant planned to use an ESBWR, there will be a draft and a final supplemental EIS. The NRC issued an ESP in November 2007. There are no intervenor contentions in the hearing process, but the proceeding remains open, pending the availability of SER- and EIS-related documents.

The certification process for the US-APWR has a long way to go, and the licensing of projects based on that design generally has to wait until issues are resolved in certification. Dominion Chief Executive Officer Thomas Farrell, however,

stated recently that he expects that the reactor will eventually be built. If nothing else, the new seismic review of the site (spurred by last year's earthquake, which was briefly beyond the design basis in a few locations) will be finished long before a decision is made on construction.

Lee-1, -2, AP1000s, Duke Energy; Gaffney, S.C. CS: first quarters of 2021 and 2023 (Duke's 2011 integrated resource plan puts Unit 1 "in the 2020 timeframe"); FSER: November 2012; FEIS: October 2012; MH: March 2013. SPA completed, May 2010; SPB due, May 2012, although it was not known at this writing if that deadline was met (11 whole chapters are done, plus part of one other). EP2 completed, December 2011; EP3 due, June 2012. There are no intervenor contentions.

The proposed merger of Duke and Progress Energy has not advanced very far in recent months, and both this project and the next two depend on whether, how, and when that transaction occurs.

Harris-2, -3, AP1000s, Progress Energy; New Hill, N.C. CS: 1Q2026, 3Q2027, or later; FSER: September 2013; FEIS, January 2014. SPA completed, April 2010; SPB due, April 2013. EP1 completed, November 2008; EP2 due, January 2013. There are no intervenor contentions.

As has been noted here before, Progress has stated that it does not foresee a need for

more than 25 percent of the power from these reactors. It seems unlikely that a merged Duke-Progress, with no apparent prospect for DOE loan guarantees, would build six new reactors, and the Harris reactors appear to have the lowest priority.

Levy-1, -2, AP1000s, Progress Energy; Levy County, Fla. CS: 2024, 2025–2026. FSER: June 2012 or later, because of new RAIs related to the Fukushima Daiichi accident; **FEIS issued April 27, 2012**. SPC completed, January 2012. One intervenor contention is in the hearing process. Progress signed an EPC contract with Westinghouse and Shaw Stone & Webster in January 2009.

This is the only Duke-Progress project that is under an EPC contract, but the May 1 announcement of a new schedule and cost estimate actually pushes the startup dates for Levy farther into the future than those for Lee. There seems to be little urgency for reactors expected to start up 12 to 14 years from now. (More on the May 1 announcement can be found on page 16 of this issue.)

Fermi-3, ESBWR, DTE Energy; Monroe, Mich. CS: June 2020; FSER: May 2013; FEIS: November 2012. SP1 completed, August 2010; SP2 due, September 2012 (15 chapters done). EP2 completed, October 2011; for this application, EP3 is the FEIS. Four intervenor contentions have

been admitted into the hearing process.

This is the only ESBWR project anywhere in the world, and while Detroit Edison has not signed an EPC contract with GE Hitachi, the licensing reviews are continuing. This proceeding has the largest number of intervenor contentions, but an allegation of foreign control is not among them.

Comanche Peak-3, -4, US-APWRs, Luminant; Glen Rose, Texas. CS: Spring 2021, Summer 2022; FSER: July 2014; **FEIS issued May 13, 2011**; MH: December 2014. SP1 completed, October 2009; SP2 due, April 2013 (six chapters done). There are no intervenor contentions.

This is the reference COLA for the US-APWR. Under the design-centered working group system, all COL applicants for a standard reactor model work jointly with the vendor and the NRC to address nuclear safety issues, so that once the issues are resolved for the design certification application, their resolution in the COLAs is fairly straightforward. Issue resolution with the US-APWR will take until 2014 or later, so the safety reviews for both this project and North Anna-3 (the subsequent COLA) will continue at least that long.

Bell Bend, U.S. EPR, PPL/UniStar; Berwick, Pa. CS: December 2018; FSER: TBD; FEIS: TBD. There are no intervenor contentions.

PPL has submitted what it believes to be

sufficient information on the relocation of the reactor footprint within the site property in order to avert excessive wetland impacts. The Environmental Protection Agency has questioned the sufficiency of other data, including that on river water use. At this writing, the NRC had neither stated whether the information is sufficient nor developed a new schedule for the environmental review. The safety review depends on the review of the U.S. EPR reactor model design, which is also without a firm schedule at this writing.

Turkey Point-6, -7, AP1000s, FPL; Florida City, Fla. CS: 2022, 2023; FSER: November 2013; FEIS, February 2014; MH, June 2014. SPA was due in March 2012, but it was not known at this writing if that took place; SPB is due in January 2013. EP1 completed, December 2010; EP2 due, February 2013. One intervenor contention is currently admitted into the hearing process.

Florida Power & Light Company, like Progress Energy, has not been satisfied with the Florida state government's handling of requests for rate recovery to support the project before it begins operation. This has led to the deferral of the planned startup dates, and no EPC contract is in place. The company is working on both the new-reactor project and on extended power uprates for all four of its operating reactors in Florida.

Clinch River, two to six mPowers, TVA; Clinch River, Tenn. This would be a 10 CFR Part 50 application, with separate proceedings for construction permits and operating licenses.

The NRC most recently stated that it expects the permit application around mid-2014, but this was before the Watts Bar-2 delay was announced. Whether this will affect the Clinch River schedule was not known at this writing.

Callaway, one to five Westinghouse SMRs, Ameren Missouri; Fulton, Mo. This would be a COL application under the 10 CFR Part 52 system being used for other new reactor projects.

The April 19 announcement of Westinghouse's partnership with Ameren to pursue certification and licensing of the Westinghouse SMR (*NN*, May 2012, p. 17) has produced the odd circumstance in which Callaway is the site of both an inactive COLA (see below), a proposed ESP (see below), and a proposed new COLA.

Payette, reactor TBD (perhaps an APR-1400), Alternate Energy Holdings Inc.; Payette, Idaho. The NRC has not expected the submission of a COLA, but the applicant has stated an intention to submit one in the third quarter of 2014.

This publication does not take a stand on whether AEHI is a genuine contender to build and operate power reactors. As usual,

it is noted here simply that AEHI is a venture with no electricity generation assets, that the company had to give up on two other sites in Idaho before getting local approval at Payette, and that the Securities and Exchange Commission filed suit against the company, alleging improper practices. AEHI has hinted that its reactor choice would be the APR-1400, but if it hopes that the South Korean consortium behind the reactor design will help out with financing, this could be yet another instance of potential foreign control.

License applications (inactive)

Bellefonte-3 and -4, AP1000s, TVA/NuStart; Scottsboro, Ala. This was the first proposed COL application, backed by the NuStart consortium, which was made up of several utilities that later moved on to pursue their own projects.

Grand Gulf-3, ESBWR, Entergy; Port Gibson, Miss. Entergy has an ESP for the site, and NuStart made this the test COLA for the ESBWR, but the company and GE Hitachi made no headway on a price agreement. Large forgings were obtained from Japan Steel Works but were later written off.

Callaway-2, U.S. EPR, Ameren Missouri; Fulton, Mo. This project depended heavily on every possible federal incentive, plus state legislation for rate recovery, none of which panned out. Even so, Ameren has

not withdrawn this COLA.

River Bend-3, ESBWR, Entergy; St. Francisville, La. At one time, Entergy was so eager that it went beyond the NuStart COLA project and planned another ESBWR on its own. Entergy is now more interested in a gas-cooled SMR (see the SC-HTGR, below), but still has not withdrawn either of its COLAs.

Nine Mile Point-3, U.S. EPR, UniStar; Scriba, N.Y. The original UniStar plan envisioned the greatest degree of standardization in the industry, and in paper studies, UniStar also proposed U.S. EPRs for Nine Mile Point-4 and Ginna-2. Despite everything that has happened to UniStar, however, even this COLA has not been withdrawn.

Early site permits

Victoria, reactor TBD, Exelon; Victoria County, Texas. FSER: April 2014; FEIS: March 2014. SPA due, December 2012. EP1 completed, July 2011; EP2 due, March 2013. Exelon had applied for COLAs for this site in 2008 but withdrew the COLA in 2010 after applying for the ESP. Eight intervenor contentions have been admitted into the hearing process.

PSEG site, reactor TBD, PSEG; Salem, N.J. FSER: April 2014; FEIS: June 2014. SPA due, November 2012. EP1 completed, December 2010; EP2 due, June 2013.

Blue Castle Project, reactor TBD, Blue Castle Holdings; Green River, Utah. The NRC expects the application in early 2013.

Callaway, reactor TBD, Ameren Missouri; Fulton, Mo. This has been proposed for submission in late 2013, but may be supplanted by the Westinghouse SMR COLA.

Piketon, reactor TBD, Duke Energy; Piketon, Ohio. This is aimed at the creation of the Southern Ohio Clean Energy Park. Areva is a partner in the project, but the ESP will not specify a reactor model. The NRC does not project a submission date, and Duke has said that if an application is submitted, it will not be before the end of fiscal year 2013.

Design certification

ABWR, 1350-MWe boiling water reactor, GE Hitachi Nuclear Energy or Toshiba. The original General Electric design was certified in 1997. The Toshiba version, for South Texas-3 and -4, had its **final certification rule published on December 16, 2011, with the certification going into effect on January 17, 2012**. GE Hitachi and Toshiba have both applied for the renewal of the ABWR certification, which expires this year. The NRC has docketed both applications, with no review schedules issued as of this writing.

There are four ABWRs licensed in Japan, and four under construction (two in Japan

and two in Taiwan), based on the original design.

AP1000, 1100-MWe pressurized water reactor, Westinghouse. This design was certified in 2006. In 2007, Westinghouse applied to amend the design. The **final certification rule was published on December 30, 2011**. Although the design certification was effective immediately, the Vogtle COLAs were not issued until February.

In China, four AP1000s are in advanced stages of construction, and six more are in site preparation or early construction phases.

ESBWR, 1520-MWe BWR, GE Hitachi. The approval process for the final rule is on hold, pending the resolution of benchmarking errors. The errors were found in a power uprate proceeding but may also apply to this reactor design.

No ESBWRs are under construction, but the design is among those being considered in Poland.

U.S. EPR, 1600-MWe PWR, Areva. The certification target date was TBD at this writing, but a new schedule was expected soon. P2 completed, February 2012.

The EPR, on which the U.S. EPR is based, is being built in China (two reactors), Finland (one), and France (one).

US-APWR, 1700-MWe PWR, Mitsubishi Heavy Industries. The certification target date is October 2014. P1 completed,

January 2009; P2 due, January 2013 (nine chapters done).

The APWR, on which the US-APWR is based, is not under construction. The two APWRs planned for Tsuruga, Japan, had been delayed for years before the Fukushima Daiichi accident made approval much less likely.

APR-1400, 1400-MWe PWR, consortium led by Korea Electric Power Corporation. Kepco has stated that the application will be submitted in March 2013. No license applicants have been announced.

Four APR-1400s are under construction in South Korea, and contracts have been signed for four to be built in the United Arab Emirates.

Westinghouse SMR, 225-MWe integral PWR, Westinghouse. The application is expected in mid-2013, but of more immediate concern is the application already submitted to the DOE to share the costs of first-of-a-kind engineering, certification, and licensing.

mPower, 180-MWe integral PWR, Generation mPower (Babcock & Wilcox/Bechtel). The application is currently expected in late 2013. As with the Westinghouse SMR, the short-term issue is the application for DOE cost-sharing. It may be worth noting that mPower is now rated at 180 MWe, rather than the 125 MWe planned previously. The original SMR concept of many

modules linked to one control room may be falling out of favor, encouraging design features intended to make a single reactor a reasonable proposition.

NuScale, 45-MWe integral PWR, NuScale Power. Until the company's assets were acquired last year by Fluor Corporation, NuScale had been forced to strip down its operation because of the legal problems of the main venture capital investor. At this writing there is no announced submission date, although NuScale is seeking DOE funding (which, however, would be given for no more than two reactor models).

Others: There are no other declared certification candidates at the moment, but plenty of SMR designs are being developed, and eventually we may see whether encouragement from the Savannah River Site holds more promise than the traditional approach involving potential customers and NRC approvals. Among the designs are Gen4 Energy's liquid metal-cooled *Gen4 Module*, Holtec International's integral PWR, *SMR-160*, and Areva's high-temperature gas-cooled *SC-HTGR*, which has been named the preferred design of the NGNP Industry Alliance, even as the NGNP project has been put in limbo, with the DOE not currently pursuing licensing and no public-

private partnership established to take up the load.

Financial repercussions

There has long been a school of thought asserting that any utility that orders a new reactor would immediately be shunned by the investment community, causing its stock price to plummet. Here are the stock prices and trends of companies that have signed EPC contracts for new reactors:

Company	Stock price just before EPC contract	Stock price at end of trading, May 2	Change
NRG	\$20.60 (2/24/09)	\$16.61	-\$3.99
Progress	\$40.65 (1/2/09)	\$53.54	+\$12.89
SCANA	\$40.00 (5/26/08)	\$45.97	+\$5.97
Southern	\$36.27 (4/7/08)	\$45.90	+\$9.63

Between March 6 and May 2, NRG declined by less than 1 percent, Progress rose by less than 1 percent, and Southern and SCANA rose by about 4 percent. SCANA received its COLs during this time, but its rise was the same as Southern's, whose COLs were issued in February. The Shaw Group, which is involved in all of the projects shown above, closed at \$29.52, up about 3.3 percent since March 6, another modest gain, but the stock remained far below the \$40 per share for which it traded just before the Fukushima Daiichi accident in March 2011.

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