



Photo: SCE&G

The deaerator for Summer-2, fabricated in South Korea, covered most of the distance to the site in South Carolina by ship, to the Port of Charleston. The final leg of the trip, by truck, took several days and involved coordination with numerous state, county, and local agencies.

Renaissance Watch: Four new reactors being built, for now

By E. Michael Blake

This expanded version of the Watch will begin with the author taking the opportunity to chide commentators everywhere for the sloppy use of references to the nuclear construction that is going on now in the United States, and how much time had elapsed since such construction had last taken place. When safety-related concrete was poured in March for Summer-2 in South Carolina and Vogtle-3 in Georgia, some of the news coverage (much of it in general media, but some of it on the technical side) referred to this as the first power reactor construction in 30 years. To be much more precise, it is the first *start of safety-related* construction of power reactors since 1978 (35 years). It is *not* the first time that such construction has been going on at all since then; TVA Nuclear resumed building Watts Bar-2 in 2007 (and is now aiming to finish in late 2015), and was also the last to finish construction on a reactor that entered service: Watts Bar-1, in 1996.

In fact, the first era of power reactor con-

This year and next, there should be visible progress on Summer-2 and -3 and Vogtle-3 and -4, along with Watts Bar-2—and nothing else here in the United States.

struction continued for a very long time, much to the dismay of the owners and contractors. Delays, deferrals, protracted hearings for operating licenses, design changes needed to meet the requirements of much-revised regulations, cost hikes, and shifts in power demand growth forecasts all had their effects on most projects, stretching some construction intervals past 10 years. (We note the exception of Florida Power & Light Company's St. Lucie-2, which took only its originally scheduled six years from construction permit issuance to startup.) There was only an 11-year period—between Unit 1 and Unit 2 at Watts Bar—when construction was not taking place.

Attempts to pin down when construction took place, and for how long, can be confused further by the amount of work and money that went into reactors that were nev-

er finished. In 1978, construction began on seven reactors, only two of which entered service (Vogtle-1 and -2, at one of the sites where new construction is under way). Statistics on the cost of the earlier group of reactors must take into account what was spent on the other five (Forked River, River Bend -2, Yellow Creek-1 and -2, and WNP-5), as well as on all of the other reactors that were canceled before they could produce electricity. The new generation of reactors already has some dead-end money on its books, with Exelon having withdrawn its early site permit application for Victoria last October, and five applications for combined construction and operating licenses in longtime suspension. Still, the current crop of COL applications isn't completely static—witness Dominion Generation's announcement on April 25 that it is switching back to GE Hitachi

Nuclear Energy's ESBWR, three years after switching to Mitsubishi Heavy Industries' US-APWR. (There is more on this later, and also in news coverage on page 26.)

As vigorous as the Summer and Vogtle projects are, and as different as the 10 CFR Part 52 licensing regime is from that in 10 CFR Part 50, the fact that there were only two graduates in the seven-strong Class of '78 might serve as a reminder that the pouring of concrete guarantees nothing. But that 10 CFR 52 difference could be really important, in two respects: We have been told that full evidentiary hearings will not be held before startup approval by the Nuclear Regulatory Commission, but journeys will be taken through the uncharted territory of inspections, tests, analyses, and acceptance criteria (ITAAC).

Waiting for confidence

The Nuclear Regulatory Commission will take no final actions on any more new reactor licenses until after the U.S. Court of Appeals for the District of Columbia Circuit is satisfied with the justification for the NRC's Waste Confidence Decision, which asserts that spent fuel can be stored safely at reactor sites for at least 60 years after the end of reactor operation. The NRC is working on an environmental impact statement for waste confidence, with the final version intended for issuance in September 2014. If all of the license applications still pending at the NRC were backed by the same readiness, willingness, and ability that Summer and Vogtle have, this waiting period might be a serious setback. In fact, for a variety of reasons, none of these projects is in a position to receive or use licenses until 2015 or later.

Each project has its own issues, but there are two factors that can work against all new reactor projects, including Vogtle and Summer. First, the U.S. economy has been slow to recover from the financial crisis of 2008, and that slow growth translates to little or no growth in electricity demand. Second, the price of natural gas has been lower in the past few years than it was before, in part because of increased domestic production from shale, and some observers (including some utility executives) expect gas prices to remain low for the next 10 years or more. To the extent that new generating capacity is being built in the United States, much of it is gas-fired—especially as a replacement for coal plants.

Not only have these two factors tended to slow down the projects for which license applications had already been submitted, they have also essentially blocked any more applications from being sought—at least for large reactors. A few partnerships have been established between small modular reactor (SMR) vendors and electricity providers, with an intent declared to pursue licensing. Some of this interest is tied in to the pursuit of cost-shared funding for SMR development from the Department of Energy. As

SMR work progresses, it should be remembered that the large-reactor projects that depended the most on receiving federal incentives (from the Energy Policy Act of 2005) are now among the least likely to progress to construction.

In the text that 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, Advisory Committee on Reactor Safeguards; ASLB, Atomic Safety and Licensing Board; 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 many cases, detailed schedules for the NRC staff's technical reviews are in effect, and the following abbreviations are used for their phases in 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); P6 (FSER). COLAs 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 with letters instead of numbers (SPA through SPD), essentially skipping SP2 and SP3. The COLA environmental review has four phases: EP1 (scoping); EP2 (DEIS); EP3 (comments on DEIS); EP4 (FEIS).

Under construction

WATTS BAR-2, 1177-MWe Westinghouse pressurized water reactor, Tennessee Valley Authority; Spring City, Tenn.; 75 to 80 percent complete. CS: December 2015, although a delay to mid-2016 is considered possible by TVA officials. FSER: April 2014, although perhaps with supplements later; FEIS: May 2013. The supplemental draft EIS was issued in November 2011. One contention has been admitted for an operating license hearing.

Because the hearing contention is environment-related, the ASLB has based the schedule for the hearing on the completion of the environmental review, with oral argument to take place six to eight months after the issuance of the final supplemental EIS. While that might have occurred by the time this issue of *Nuclear News* is published, the target dates for both the environmental and the safety reviews were recently changed, with the February EIS target revised (in March) to May, so a November-to-January window for the hearing might still be tentative.

Since the project's reset in spring 2012,



Photo: Georgia Power

Inside the Module Assembly Building, work was ongoing in April on the CA20 module (auxiliary building) for Vogtle-3. (And not, in this case, for Summer-2.)

TVA has issued quarterly reports on the progress toward meeting the reactor's (delayed) schedule and (increased) cost. The report for November 2012 through January 2013 that was issued to the public contains few details, mentioning things like hours without a lost-time accident and a risk assessment for improving the work environment. The progress of work in general was said to be consistent with the cost and schedule goals.

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. This means that the resumption of full-scale construction at Bellefonte would not begin until 2016 at the earliest,

which in turn means that TVA—according to its current schedules—would have submitted its construction permit application for Clinch River (see page 58) before devoting full attention to what could be its final large reactor project. (Unless, of course, TVA later decides to finish Bellefonte-2.)

VOGTLE-3, -4, 1100-MWe Westinghouse PWRs (AP1000s), Southern Nuclear Operating Company; Waynesboro, Ga.; completion percentage: about 33 percent. CS: 2017, 2018. **The COLs were issued on February 10, 2012.** ITAAC status: One completed on Unit 3, confirmed by the NRC.

Nuclear News apologizes in advance for any potential confusion our readers might experience as we present photographs of this country's new construction projects. The Vogtle and Summer sites both have two

AP1000s under construction and are progressing through the same construction stages at about the same time. In the May issue, we included photos of containment cradle placement at both Summer-2 and Vogtle-3. There is the further possibility of *déjà vu*, because the same actions may be carried out at about the same time next year on Summer-3 and Vogtle-4. We ask for our readers' understanding, because *NN* is taking this opportunity to recapture the feel of the magazine in the 1970s and 1980s. Back then, *NN* was full of photos of crane lifts, large-equipment deliveries, and people in hardhats dwarfed by the objects they were assembling.

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.

The construction of AP1000s in the United States can benefit from the experience at Sanmen and Haiyang in China, where the same reactor model has already gone through the same modular assembly process. At this writing, in the module assembly buildings at Summer and Vogtle, sub-assemblies are being connected to become the CA20 modules for Summer-2 and Vogtle-3. The CA20 is essentially the entire auxiliary building (with some concrete and other items to be added later), and it is ex-

pected to be the heaviest single item to be moved and placed.

License applications (active)

Calvert Cliffs-3, U.S. EPR, UniStar Nuclear Energy; Lusby, Md. CS: TBD; FSER: TBD; **FEIS issued May 13, 2011.** SP1 completed, April 2010; SP2 due, TBD (12 whole chapters are complete, as are parts of three others). The licensing proceeding has been terminated by the ASLB on the grounds of UniStar's foreign ownership, but the NRC staff is still carrying out technical reviews, and UniStar could apply later to reopen the proceeding.

NRC technical reviews can be measured not just by progress toward the FSER but by the billable hours of the NRC staffers. UniStar, wholly owned by EDF of France, is still committing to pay for those hours despite a daunting array of obstacles to the Unit 3 project. In addition to the termination of the licensing proceeding, there is the resolution of technical issues in the U.S. EPR design certification (for which the FSER is currently scheduled for November 2014), and the Exelon-Constellation merger, which has made UniStar, at best, a tenant at the Calvert Cliffs site.

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:

April 2015; **FEIS issued February 24, 2011.** SP3 completed, November 2010; SP4 due, July 2014. Two intervenor contentions have been resolved in NINA's favor; the hearing on the third (foreign influence) was not scheduled at this writing. An EPC contract was signed with Toshiba in February 2009; the contract was assigned to the Shaw Group in November 2010.

Unlike Calvert Cliffs-3, this project is based on a certified design, and there are no potential conflicts over site ownership. NINA, however, now faces the same licensing problem that UniStar has, because on April 29 the NRC staff told the ASLB that the agency does not consider NINA to be in compliance with regulations on foreign ownership, control, or domination (see page 28). Toshiba is a minority owner of NINA, but the reactor vendor has been covering all of the costs of South Texas-3 and -4 licensing for about two years. NINA has insisted that this is temporary, but a return to financing by U.S. interests depends on getting a loan guarantee from the DOE. The loan guarantee process still hasn't produced a final agreement on Vogtle-3 and -4, which is a much more firmly established project.

North Anna-3, ESBWR (yes, again), Dominion Generation; Mineral, Va. CS: no sooner than 2024; FSER: TBD; FEIS: TBD. SPA due, TBD. Dominion and GE Hitachi

have stated that they have agreed on all contract terms, although Dominion has not committed to building the reactor and so has not signed an EPC contract. A final EIS

ly quickly now that the ESBWR's technical reviews for certification have been finished. (The final certification rule is still on hold, however, pending the resolution of steam

dryer benchmarking issues.) In case you're keeping track, this is the fourth reactor model choice for North Anna-3. Dominion originally considered Atomic Energy of Canada Limited's ACR-700 in the early 2000s, then submitted its COLA in 2007 for an ESBWR, then in 2010 switched to the

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had been issued when the applicant previously planned to use an ESBWR, but it is not yet known if that EIS can be used now. The NRC issued an ESP in November 2007. The hearing record is closed, but a new contention has been submitted in connection with the August 2011 earthquake near the site.

See page 26. Seriously, if you haven't read that yet, read it now and then come back. Dominion hopes that the technical reviews begun by the NRC during North Anna-3's earlier interval as an ESBWR can be picked up where they left off, and perhaps advance fair-

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dryer benchmarking issues.) In case you're keeping track, this is the fourth reactor model choice for North Anna-3. Dominion originally considered Atomic Energy of Canada Limited's ACR-700 in the early 2000s, then submitted its COLA in 2007 for an ESBWR, then in 2010 switched to the US-APWR, and now has switched back to the ESBWR.

Lee-1, -2, AP1000s, Duke Energy; Gaffney, S.C. CS: 2022 or later; FSER: TBD; FEIS: TBD; MH: March 2013. SPA completed, May 2010; SPB due, TBD, as Fukushima Daiichi lessons-learned issues and the relocation of the reactor buildings are addressed. EP3 completed, June 2012. There are no intervenor contentions.

great deal of new information on soil and seismicity. Fourteen chapters have been completed in the advanced safety evaluation report, but the final SER and EIS have no target completion dates at present.

Levy-1, -2, AP1000s, Duke (formerly Progress) Energy; Levy County, Fla. CS: 2024, 2025–2026. FSER: September 2013; **FEIS issued April 27, 2012**. SPC completed, January 2012. The contested hearing was resolved in the applicant's favor on March 26. Progress signed an EPC contract with Westinghouse and Shaw Stone & Webster in January 2009.

Levy was the first new reactor project to go through reviews leading to a new SER chapter. Chapter 20, on Fukushima Daiichi lessons learned, was issued on December 13. With the EIS done, the final SER just three months away, and an EPC contract in place, this would be the project most likely to be stalled by the waste confidence hold—if it weren't stalled already. Even before the Duke-Progress merger, Progress had not planned to begin site preparation until 2015.

Fermi-3, ESBWR, DTE Energy; Monroe, Mich. CS: June 2020; FSER: January 2015; **FEIS issued January 4, 2013**. SP1 completed, August 2010; SP2 due, June 2014 (17 chapters are done, as is part of one other). Two intervenor contentions have been admitted into the hearing process, and the

hearing is scheduled to begin on October 30.

Meetings of the ESBWR design-centered working group had been fairly lonely for a while, with only Fermi-3 planners meeting with GE Hitachi. Now, Dominion is back, but this time in a different role. Fermi-3 became, by default, the reference COL (R-COL) application for the ESBWR after the departure of Dominion, Entergy (Grand Gulf-3 and River Bend-3, both suspended), and Exelon (Victoria, withdrawn). With nearly all of the Fermi-3 advanced SER finished, that reactor remains the R-COL, with North Anna-3 as the subsequent COL (S-COL). DTE Electric, however, has not announced the sort of closeness-to-a-deal expressed in April by Dominion.

Comanche Peak-3, -4, US-APWRs, Luminant; Glen Rose, Texas. CS: spring 2021, summer 2022; FSER: TBD. **FEIS issued May 13, 2011**; MH: November 2015. SP1 completed, October 2009; SP2 due, TBD (14 chapters done). There are no intervenor contentions.

We have observed what may be a discrepancy in the NRC's scheduling of the safety review phases. On April 4, the agency's Web page for Comanche Peak-3 and -4 revised the target dates for the remaining phases, in the wake of the February revision of the targets for US-APWR

certification. The Comanche Peak dates that were given are two to three months earlier than the dates for the same phases on the US-APWR, and because a phase must be finished on the certification before it can be applied on license applications, we are treating Comanche Peak as TBD.

Bell Bend, U.S. EPR, PPL/UniStar; Berwick, Pa. CS: TBD; FSER: TBD; FEIS: TBD. The NRC has begun a supplemental scoping process because of the relocation of the nuclear island. There are no intervenor contentions.

The footprint relocation here is much larger than the one at Lee, and was done to avert wetland disruption issues. The move was large enough, in the NRC's view, to go beyond the scope originally decided for the environmental review. Bell Bend is the S-COL for the U.S. EPR, with Calvert Cliffs -3 the R-COL. Bell Bend is also on a four-phase safety review, rather than the six-phase one being used at Calvert Cliffs, so progress on the second phase of the safety review can take place only after the U.S. EPR certification review gets to the advanced SER stage.

Turkey Point-6, -7, AP1000s, FPL; Florida City, Fla. CS: 2022, 2023; FSER: TBD; FEIS, TBD; MH: TBD. SPA due, TBD. EP1 completed, December 2010; EP2 due, TBD. One intervenor contention is currently admitted into the hearing process.

With Harris joining Bellefonte-3 and -4 on the suspended list, Turkey Point is now the last S-COL for the AP1000, and not a great deal of progress has been made on the licensing front. Westinghouse nonetheless continues to hold the lead in the new reactor race, with four AP1000s under construction, two more under contract, and four more in active licensing.

License applications (suspended)

Bellefonte-3, -4, AP1000s, TVA; Scottsboro, Ala. The COLA was submitted jointly with the NuStart consortium in 2007. NuStart folded last June, with its mission (to foster the development of new power reactors) considered accomplished. These reactors are not included in any current TVA energy forecast, but the COLA has not been withdrawn.

Harris-2, -3, AP1000s, Duke/Progress; New Hill, N.C. This is the most recent COLA to go from active to suspended (see page 33, this issue). Long before the Duke-Progress merger, it appeared to be the least urgent new reactor project in the Carolinas. A premerger Integrated Resource Plan by Progress Energy excluded Harris-2 and -3 altogether, because their expected startup dates had moved beyond the plan's 15-year horizon.

Grand Gulf-3, ESBWR, Entergy; Port Gibson, Miss. The early site permit issued

by the NRC in 2007 is in effect for another nine years, but Entergy's main new-reactor interest lies with gas-cooled reactor technology and potential siting near oil and chemical complexes in Louisiana.

Callaway-2, U.S. EPR, Ameren Missouri; Fulton, Mo. The COLA was based on a U.S. EPR, but Callaway is now proposed as the site for Westinghouse's small modular reactor, with either a revision to the COLA or a switch to an ESP application (see below).

River Bend-3, ESBWR, Entergy; St. Francisville, La. Despite what has happened with North Anna-3, there has been no sign that Entergy has warmed to the ESBWR again. As for gas-cooled reactors, Entergy has stated that the site having the most potential is Waterford, for which the company has no pending COLA.

Nine Mile Point-3, U.S. EPR, UniStar; Scriba, N.Y. Constellation's merger with Exelon has left this project, like Calvert Cliffs -3, without an on-site backer. This COLA had already been suspended long before the merger.

License applications (forthcoming)

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 (application now expected around the end of 2014) and operating licenses.

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; application date TBD.

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

Early site permits

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

Blue Castle Project, reactor TBD, Blue Castle Holdings; Green River, Utah. The NRC expected the application in early 2013, but as of this writing there had been no announcement of its receipt.

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 sub-

mitted, 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. For the Toshiba version, for South Texas-3 and -4, the **final certification rule was published on December 16, 2011, and became effective on January 17, 2012**. GE Hitachi and Toshiba have both applied for the renewal of the ABWR certification, which expired in 2012. The NRC has docketed both applications, with no review schedules issued as of this writing.

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, and became effective immediately, on December 30, 2011.**

ESBWR, 1520-MWe BWR, GE Hitachi. The approval process for the final rule is on hold pending the resolution of benchmarking errors; they were found in a power uprate proceeding but may also apply to this reactor design. On March 27, the NRC issued 25 new RAIs in response to GE Hitachi's answers to earlier RAIs.

U.S. EPR, 1600-MWe PWR, Areva. The certification target date is June 2015. P3

completed, May 2012; P4 due, June 2014.

US-APWR, 1700-MWe PWR, Mitsubishi Heavy Industries. The certification target date is February 2016. P1 completed, January 2009; P2 due, May 2014 (13 chapters done).

APR-1400, 1400-MWe PWR, consortium led by Korea Electric Power Corporation. Kepco has stated that the application will be submitted in July 2013.

Westinghouse SMR, 225-MWe integral PWR, Westinghouse. The application is expected in the second quarter of 2014.

mPower, 180-MWe integral PWR, Generation mPower (Babcock & Wilcox/Bechtel). The application is currently expected in early 2014.

NuScale, 45-MWe integral PWR, NuScale Power. The application is currently expected in the third quarter of 2015.

Also: There are no other declared certification candidates at the moment, but many other designs are being developed, among them Gen4 Energy's liquid metal-cooled *Gen4 Module*, Holtec International's integrated PWR *SMR-160*, and Areva's high-temperature gas-cooled *SC-HTGR*, named the preferred design of the NGNP Industry Alliance, which may apply for a construction permit in the period 2016 to 2018. The DOE is not pursuing licensing for the NGNP, and no public-private partnership has been established.

What to watch

Now that concrete is being poured and sub-modules are being joined into modules, it would be understandable for an observer to become a sidewalk superintendent at Vogtle and Summer and dismiss the other license applications as the shuffling of papers (or megabytes). Who knows when (or if) waste confidence will be accepted by the appellate court? What if fracked natural gas stays cheap for a decade or more? How much will Fukushima lessons-learned weigh down the licensing process? We've had it with all the lawyer and accountant stuff—we want to see cranes move heavy things.

Be that as it may, there are still quite a few interesting and important issues in the licensing realm. Not all of them are encouraging to a nuclear power proponent, but they merit attention. So be prepared for *NN* to keep you informed on the return to favor of the ESBWR (and what still has to be done for it to reach the final certification rule

stage); whether UniStar and NINA can either change themselves, or change the NRC's mind, to be accepted as being with-

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out foreign domination; the environmental issues still to be resolved as a result of footprint relocations at Bell Bend and Lee; ASLB deliberations on Fermi-3; U.S. EPR and US-APWR certification reviews, which seem like ever-growing hills for Sisyphus and his rock; the emergence of review processes for SMRs; and probably other developments that will catch us by surprise.

Whether this is a renaissance is open to question, and we have always used the term with more than a little irony. There is still, however, quite a lot to watch. **NN**