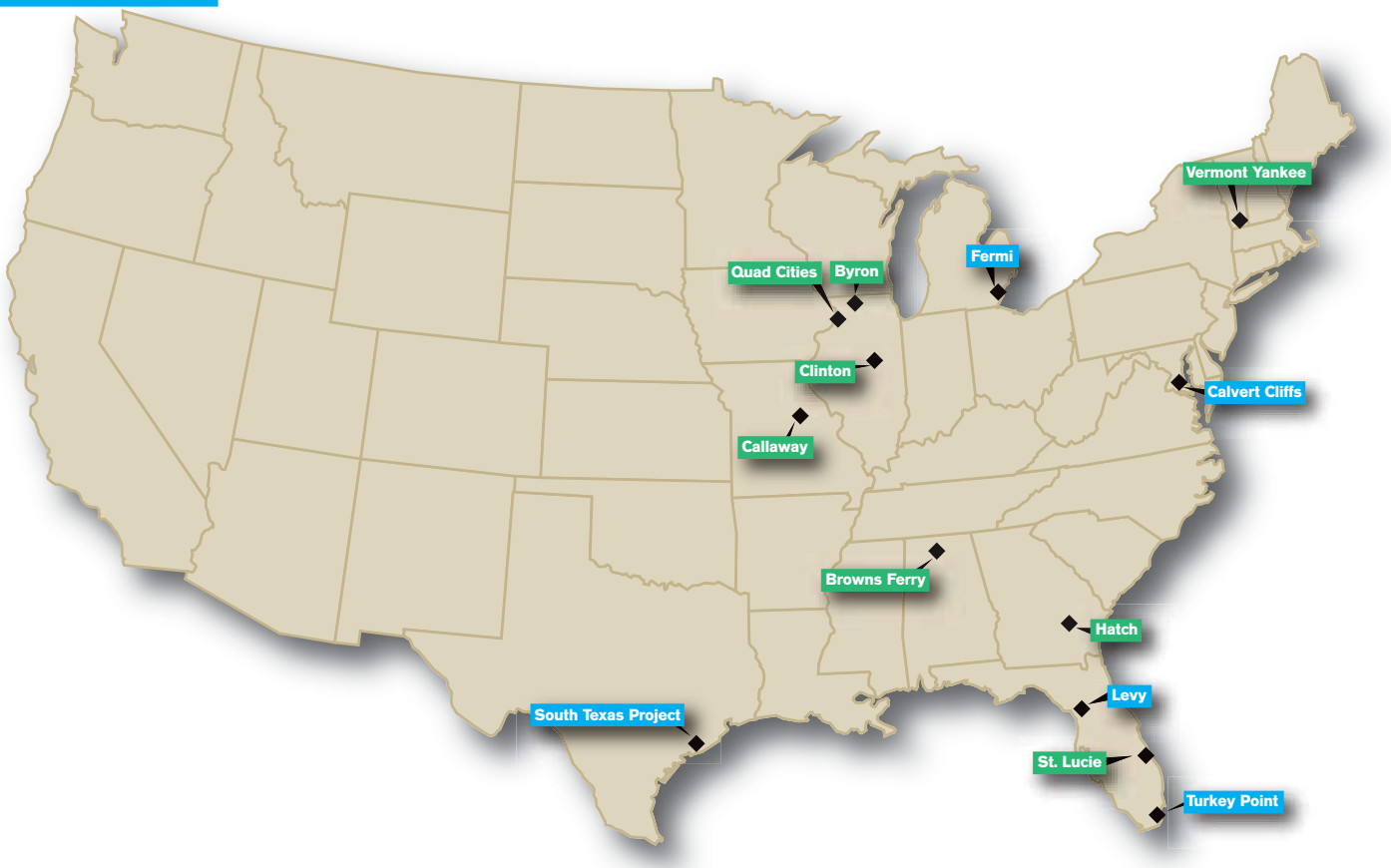
*Plant sites shown on this map are involved in news stories in this section. Green tags indicate existing plants; blue tags represent licensing projects.*




VERMONT YANKEE

# Final shutdown completed as scheduled

*Despite a recently renewed license and a power uprate, Vermont Yankee became the fifth U.S. power reactor to be closed this decade, and the second to be shut down for purely economic reasons.*

The Vermont Yankee reactor was near full power when the coast-down began on September 20. Over the next several weeks, plant personnel steadily lowered the power level, and the 617-MWe boiling water reactor near Vernon, Vt., was at 74 percent power on the morning of December 29. At 12 minutes past noon, the reactor was disconnected from the grid for the last time, and operators inserted control rods to halt the nuclear chain reaction in a reactor vessel where the first such reaction had begun on March 24, 1972. And so Vermont Yankee became the fifth power reactor in the United States to cease operation or to be declared closed in this decade, after more than a decade in which no U.S. power reactors had closed.

The closure of Crystal River-3 in Florida followed unexpected, costly problems in containment concrete repair, and the closures of San Onofre-2 and -3 in California followed unexpected early wear in the replacement steam generators. In the cases of Vermont Yankee and Kewaunee in Wisconsin, there was nothing unexpected in the operation and maintenance of the reactors, but the economic environment for both reactors, which in recent years have been op-

**Vermont Yankee:** The lack of a long-term power purchase agreement was a key factor in the decision to close the plant.

erated as "merchant" plants, gradually worsened as a result of factors such as the need to line up long-term power purchase agreements and the low cost of "fracked" natural gas, which made it more difficult to sell power competitively.

Entergy Nuclear Vermont Yankee had prevailed against a state administration that wanted the plant closed. After buying the plant from Vermont Yankee Nuclear Power Corporation in 2002, Entergy gained approval from the Nuclear Regulatory Commission in 2006 for an extended power uprate, and in 2011 for license renewal, deferring expiration from 2012 to 2032. After all that, it came as an unpleasant surprise to Vermont Yankee supporters when Entergy announced in August 2013 that it would close the reactor at the end of its next fueling cycle. Even the severity of the winter of 2013–2014 in the Northeast, which at times prevented access to natural gas completely, could not change what Entergy saw as unacceptable flaws in the market for the electricity Vermont Yankee produced. Like Kewaunee before it, Vermont Yankee was without a long-term power purchase agreement after its original license expiration date, and this made the future too uncertain for the company to continue operating the plant.

As unhappy as merchant operators are with their current situation, it can be argued that the merchant option has kept several reactors in service. Vermont Yankee, along with Haddam Neck, Pilgrim, Millstone-1, and Maine Yankee, were early Generation II units that were built in New England at a time when nuclear power appeared ready to feed power to the grid steadily over the long term. Most of these reactors were owned and operated by "Yankee" companies that used a merchant model in their own way, although in some cases there were connections to the full-service Northeast Utilities. The 1990s were hard times for these reactors, with only Pilgrim and Vermont Yankee still operating when the decade ended. Haddam Neck and Millstone-1 might have reached reasonable end points, but many nuclear advocates believe that Maine Yankee should not have closed. When Entergy, a large, deep-pocketed utility from the Southeast, bought Pilgrim and Vermont Yankee, the addition of new resources allowed both reactors to follow the general trend of the U.S. reactor fleet to achieve capacity factors in the 90 percent range. This kept in service, for more than a decade, two reactors that were thought of by some as too small to keep operating in the gigawatt-reactor era.

Ever since the Vermont Yankee announcement, the question of Pilgrim's future has also been uncertain. The 690-MWe BWR, near Plymouth, Mass., has a renewed license (good until 2032) but operates in roughly the same economic conditions that led to the decision to close Vermont Yankee. Entergy's statements regarding Pilgrim's continued operation have been tepid at best.

Vermont Yankee ended its service after producing 171 terawatt-hours of electricity over a period of 42 years, and its performance had remained strong, with a 91.23 design electrical rating net capacity factor from 2011 through 2013. It was by far the largest electricity producer in the state of Vermont, accounting for 71.8 percent of the power generated within the state since 1972.

On December 19, Entergy submitted to the NRC a post-shutdown decommissioning activities report and an update to its decommissioning funding status report. As of October 31, the decommissioning trust fund had a balance of about $655 million. The company has opted to mothball the plant and carry out full decommissioning later (what the NRC refers to as the SAFSTOR option). In a post on its Vermont Yankee decommissioning website, Entergy stated that the further accrual of funds from interest and other sources suggests that dismantling and decontamination activities could begin "potentially as early as the 2040s."

## Power Briefs

**EPRI'S UTILITY REQUIREMENTS DOCUMENT NOW INCLUDES SMRS.** The Electric Power Research Institute announced on December 19 that its Utility Requirements Document (URD), which essentially states what electricity providers want a power reactor to be able to do, has been updated to address the attributes associated with small modular reactors. A report designated 3002003130 summarizes the SMR-specific changes to the URD; it is available for download at <www.epri.com>.

**A HEARING REQUEST ON ST. LUCIE-2 WAS DENIED** by the Nuclear Regulatory Commission on December 19. The Southern Alliance for Clean Energy (SACE) requested a hearing last March on the grounds that the replacement in 2007 of the St. Lucie-2 steam generators by Florida Power & Light Company should have required a license amendment, in part because the replacement steam generators made possible a later power uprate, for which a license amendment was issued. Recently, some organizations opposed to nuclear power have challenged operating reactors over an asserted lack of license amendments (and their accompanying public input). Friends of the Earth succeeded in its 2013 argument that the limited power operation plan for Southern California Edison Company's San Onofre reactors effectively amended the licenses without public input. Although SACE cited the San Onofre precedent, the commissioners did not agree that it applied in the case of the St. Lucie-2 steam generators.

**A SECOND TRY FOR BROWNS FERRY POWER UPRATES** is planned for October, when TVA Nuclear will apply to the Nuclear Regulatory Commission for extended power uprates at all three boiling water reactors at the site near Decatur, Ala. The NRC staff scheduled a meeting with TVA for January 15, chiefly to discuss the treatment of hydrogen embrittlement issues in the uprate applications. In its slides for the meeting, TVA showed that it intends to submit the application in October and hopes to receive approval for Unit 3 in March 2018, Unit 1 in October 2018, and Unit 2 in March 2019. TVA had originally applied in June 2004 for uprates to take all three reactors to their allowed maximum power level (about 1,278 MWe), but after encountering a wide variety of difficulties in the review process, TVA withdrew that application last September.

**A HATCH-1 FIRE BARRIER WAS FOUND ADEQUATE** by Southern Nuclear Operating Company personnel, who retracted a December 9 report that a penetration between switchgear rooms in the diesel generator building was not qualified as a three-hour barrier (*NN,* Jan. 2015, p. 27). In a December 30 update to the Nuclear Regulatory Commission, it was noted that at least 10 inches of silicone foam seals the penetration, and a 9-inch thickness is sufficient to provide a three-hour barrier.

**THE NRC STILL RANKS HIGH AMONG FEDERAL WORKPLACES,** but it is no longer as close to the top as it was in recent years. On December 9, the nonprofit organization Partnership for Public Service issued its annual rankings—compiled from an annual survey conducted by the Office of Personnel Management—on the best places to work in the federal government. The Nuclear Regulatory Commission placed sixth among the 25 mid-sized agencies. In another recent survey of federal workplaces, the NRC placed second, third, or fourth in the various indices that were used (*NN,* Dec. 2014, p. 32).