U.S. capacity factors: Still near 90 percent

By E. Michael Blake

Even without the effect of closed reactors, some slippage has occurred, but performance remains close to the level of the past 15 years.

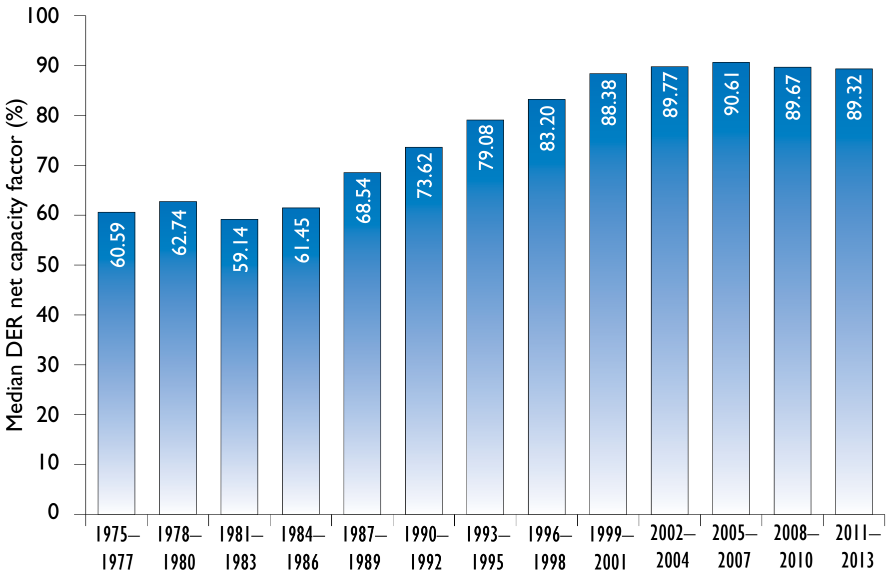

Fig. 1: All reactors. While capacity factors have trended downward for the past few years, the effect has been very slight, and the median capacity factor has been within a range of about 2.25 percentage points for the past 15 years. The median in the far-right column covers all 104 reactors that began 2011 as either operable or intended for operation. Those 104 reactors are represented in the previous four three-year periods, and in the earlier periods, the number of reactors in service at the time are included (down to 32 in the first period). During the latest three-year period, four reactors were declared to be closed. If the four closed reactors were removed from consideration, the median factor of the remaining 100 reactors would be 89.67 in 2011–2013, and 89.71 in 2008–2010.

For about 30 years, with a few interruptions, *Nuclear News* has been tracking U.S. power reactor capacity factors and analyzing the plants' performance trends. This same sort of analysis is presented here again, but with two caveats. First, the closure of four reactors during the most recent three-year period means that we have to do some more crunching of the numbers to ensure like-to-like comparisons. Second, a long-standing assumption—that a high capacity factor is an essential good—can no longer be taken for granted. The economics of nuclear power seems to be changing, in that steady baseload operation and the delivery of the greatest amount of electricity at all times might no longer bring the most lucrative compensation—even if the emission-free energy (and the displacement of fossil-fired generation) provides the same societal and environmental benefits as it always has. For the ongoing three-year period of 2012–2014, *NN* is considering ending this capacity factor analysis, because in 2015 and beyond, the analysis may no longer be relevant to what has to be done to keep power reactors in operation.

In recent years, there has been a fairly steady data base, with 104 licensed reactors. Browns Ferry-1, with its long string of zero capacity factors, was kept around because it was never formally closed and, starting in 2002, was clearly intended to reopen (which it did, in 2007). With four reactors closing during the 2011–2013 period, however, the effects on fleet-wide capacity are as high as the second significant figure, so 2011–2013 will be compared to 2008–2010 for all 104 reactors and, to a limited extent, also for the 100 that were fully operable during both periods. It should be noted that no exceptions are being made for Fort Calhoun, which was supposed to be operable all along and into the future. The good news for the Omaha Public Power District, the owner of Fort Calhoun, is that its reactor returned to service just before 2013 ended, so its three-year capacity factor will probably never again be as low as it is in this survey's Table I.

The closures of Crystal River-3, Kewaunee, and San Onofre-2 and -3 have been reported on at length in the pages of *NN*, and for the most part that coverage will not be rehashed here. It should be mentioned, however, that Dominion's decision to close Kewaunee stands as the first clear manifestation of what may be nuclear power's new economic reality: A reactor with a strong performance history and a renewed license, operating in a merchant environment, was closed partly because of the perception by the merchant's customers (electricity providers in the Upper Midwest, including Kewaunee's one-time owners) that getting electricity from other sources (notably methane from fracking) was a better bet, even for the long term, than signing a new power purchase agreement for Kewaunee. As readers of this publication surely know already, Entergy will close Vermont Yankee this fall, despite a renewed license and a large power uprate, for reasons related to merchant operation.

More reactors may be closed. Others may be sold. There may be attempts to improve the economics through different operating schemes, such as load-following. It is therefore possible, at the very least, that reactor personnel will no longer be able to measure success through their capacity factors. This is not a definitive statement that we will no longer present this survey, but we may emulate Exelon. In an earnings presentation in February, Exelon stated that its nuclear fleet's performance in 2013 was its best ever, but added that if there is no clear path to

Table I. 2011–2013 DER Net Capacity Factors of Individual Reactors

Rank	Reactor	Factor[1]	Design Electrical Rating (DER), MWe[2]	Type	Owner[3]
1.	Quad Cities-1	99.85	866	BWR	Exelon
2.	Dresden-2	98.26	894	BWR	Exelon
3.	South Texas-1	97.75	1250.6	PWR	STPNOC
4.	Dresden-3	97.32	879	BWR	Exelon
5.	Farley-1	96.67	854	PWR	Southern
6.	Calvert Cliffs-1	96.41	845	PWR	Exelon
7.	Farley-2	95.94	855	PWR	Southern
8.	Comanche Peak-2	95.01	1207	PWR	Luminant
9.	Comanche Peak-1	94.93	1218	PWR	Luminant
10.	Peach Bottom-2	94.92	1179	BWR	Exelon
11.	Surry-1	94.89	874	PWR	Dominion
12.	Three Mile Island-1	94.73	819	PWR	Exelon
13.	Braidwood-1	94.66	1187	PWR	Exelon
14.	Braidwood-2	94.42	1155	PWR	Exelon
15.	Clinton	94.39	1062	BWR	Exelon
16.	LaSalle-1	93.92	1178	BWR	Exelon
17.	FitzPatrick	93.90	816	BWR	Entergy
18.	Calvert Cliffs-2	93.50	845	PWR	Exelon
19.	Catawba-2	93.48	1145	PWR	Duke
20.	Indian Point-2	93.45	1035	PWR	Entergy
21.	Quad Cities-2	93.40	957.3	BWR	Exelon
22.	Vogtle-2	93.38	1169	PWR	Southern
23.	Vogtle-1	93.19	1169	PWR	Southern
24.	Diablo Canyon-1	93.09	1138	PWR	PG&E
25.	Oconee-3	92.54	886	PWR	Duke
26.	Indian Point-3	92.39	1048	PWR	Entergy
27.	Beaver Valley-2	92.25	904	PWR	FENOC
28.	LaSalle-2	92.18	1178	BWR	Exelon
29.	Beaver Valley-1	91.97	911	PWR	FENOC
30.	Hatch-1	91.88	885	BWR	Southern
31.	Millstone-3	91.82	1229	PWR	Dominion
32.	Byron-2	91.77	1155	PWR	Exelon
33.	Catawba-1	91.72	1145	PWR	Duke
34.	Cook-2	91.25	1107	PWR	IMP
35.	Vermont Yankee	91.23	617	BWR	Entergy
36.	Peach Bottom-3	91.15	1179	BWR	Exelon
37.	Palo Verde-2	91.10	1336	PWR	APS
38.	Arnold	90.98	621.9	BWR	FPL
39.	River Bend-1	90.88	967	BWR	Entergy
40.	Browns Ferry-1	90.80	1120	BWR	TVA
41.	Salem-2	90.73	1181	PWR	PSEG
42.	Salem-1	90.59	1169	PWR	PSEG
43.	McGuire-1	90.49	1166	PWR	Duke
44.	Hope Creek	90.41	1228.1	BWR	PSEG
45.	Ginna	90.37	585	PWR	Exelon
46.	Byron-1	90.28	1187	PWR	Exelon
47.	Summer-1	90.20	972.7	PWR	SCE&G
48.	Nine Mile Point-2	90.11	1299.9	BWR	Exelon
49.	Palo Verde-1	89.81	1333	PWR	APS
50.	Surry-2	89.71	874	PWR	Dominion
51.	Limerick-1	89.62	1205	BWR	Exelon
52.	Sequoyah-1	89.43	1184.37	PWR	TVA
53.	Oconee-2	89.22	886	PWR	Duke
54.	Palo Verde-3	88.74	1334	PWR	APS
55.	Limerick-2	88.65	1205	BWR	Exelon
56.	Millstone-2	88.52	877.2	PWR	Dominion
57.	Oyster Creek	88.51	650	BWR	Exelon
58.	Nine Mile Point-1	88.45	613	BWR	Exelon
59.	Davis-Besse	88.43	908	PWR	FENOC
60.	Harris-1	88.33	973	PWR	Duke
61.	Callaway	88.28	1228	PWR	Ameren
62.	Diablo Canyon-2	88.04	1151	PWR	PG&E
63.	Watts Bar-1	87.71	1160	PWR	TVA
64.	Brunswick-1	87.51	983	BWR	Duke
65.	North Anna-2	87.30	973	PWR	Dominion
66.	Browns Ferry-3	87.18	1120	BWR	TVA
67.	Cook-1	86.94	1084	PWR	IMP
68.	Point Beach-1	86.75	615	PWR	FPL
69.	McGuire-2	86.39	1170	PWR	Duke
70.	ANO-2	86.20	1032	PWR	Entergy
71.	Sequoyah-2	85.88	1177.46	PWR	TVA
72.	Browns Ferry-2	85.86	1120	BWR	TVA
73.	Cooper	85.80	815	BWR	NPPD
74.	Robinson-2	85.59	795	PWR	Duke
75.	Prairie Island-1	85.51	557	PWR	NSP
76.	Hatch-2	85.42	908	BWR	Southern
77.	Waterford-3	84.95	1173	PWR	Entergy
78.	North Anna-1	84.71	973	PWR	Dominion
79.	Grand Gulf-1	84.59	1279	BWR	Entergy
80.	Palisades	84.35	805	PWR	Entergy
81.	Oconee-1	84.33	886	PWR	Duke
82.	Pilgrim	84.23	690	BWR	Entergy
83.	Point Beach-2	84.10	615	PWR	FPL
84.	Seabrook	83.70	1248	PWR	FPL
85.	Perry	82.47	1268	BWR	FENOC
86.	ANO-1	81.76	850	PWR	Entergy
87.	Susquehanna-1	80.38	1287	BWR	PPL
88.	Brunswick-2	80.34	980	BWR	Duke
89.	Susquehanna-2	77.98	1287	BWR	PPL
90.	South Texas-2	75.97	1250.6	PWR	STPNOC
91.	St. Lucie-2	75.21	1074	PWR	FPL
92.	Turkey Point-4	75.00	840	PWR	FPL
93.	Prairie Island-2	74.64	557	PWR	NSP
94.	Columbia	74.52	1153	BWR	Northwest
95.	St. Lucie-1	73.58	1062	PWR	FPL
96.	Turkey Point-3	73.02	831	PWR	FPL
97.	Wolf Creek	72.28	1200	PWR	WCNOC
98.	Kewaunee	71.82	574	PWR	Dominion
99.	Monticello	71.26	600	BWR	NSP
100.	Fermi-2	68.44	1150	BWR	DTE
101.	San Onofre-2	34.88	1070	PWR	SCE
102.	San Onofre-3	32.09	1080	PWR	SCE
103.	Fort Calhoun	9.64	502	PWR	OPPD
104.	Crystal River-3	0.00	860	PWR	Duke

[1] These figures are rounded off.

[2] This is the design electrical rating (DER) in megawatts (electric), effective as of December 31, 2013. If the reactor's rating has changed during the three-year period, the capacity factor is computed with appropriate weighting.

[3] As of December 31, 2013. In most cases this also means the reactor's operator, but Entergy and Exelon are the contracted operators of Cooper and Fort Calhoun, respectively.

profitability, the company will have to consider its options, perhaps including reactor closures. *NN* will consider its own options.

By the numbers

First, a brief explanation of what you're looking at. We compute each power reactor's design electrical rating (DER) net capacity factor for a period of three calendar years, in the belief that this indicates sustained performance. Reactors with two-year fueling cycles (including many boiling water reactors) can seem inconsistent when three-year periods are examined. Reactors with 18-month cycles can show smoother trends, but even the refueling outage timing of reactors with two-year cycles leads to variations of only a few percentage points from one three-year period to the next.

We obtain the data from the Nuclear Regulatory Commission's quarterly compilations of monthly operating reports from power reactor licensees. When a reactor's DER changes, which happens fairly often because of power uprates and operational improvements, the three-year capacity factor is appropriately weighted. The three-year factors are then compared to those of earlier three-year periods in order to determine trends. Within groups, we track the median value as the most significant, although we also compute averages and (when reasonable) the top and bottom quartiles.

In 2011–2013, the median DER net capacity factor for all 104 reactors was 89.32

Table II.
Capacity Factor Change, 2008–2010 to 2011–2013

Rank	Reactor	Change (percentage points)	Rank	Reactor	Change (percentage points)	Rank	Reactor	Change (percentage points)	Rank	Reactor	Change (percentage points)
1.	Cook-1	+38.86	27.	Palo Verde-1	+1.82	53.	Oconee-1	-1.37	79.	Susquehanna-1	-5.04
2.	Robinson-2	+8.56	28.	Vogtle-2	+1.54	54.	FitzPatrick	-1.38	80.	Point Beach-2	-5.11
3.	Palo Verde-2	+6.34	29.	Millstone-3	+1.42	55.	Indian Point-3	-1.40	81.	Brunswick-2	-6.03
4.	Browns Ferry-1	+5.86	30.	Dresden-2	+1.36	56.	Cooper	-1.45	82.	Palisades	-6.31
5.	Davis-Besse	+5.58	31.	Hatch-2	+1.30	57.	Vermont Yankee	-1.57	83.	Surry-2	-6.71
6.	Hatch-1	+5.39	32.	Clinton	+1.15	58.	Harris-1	-1.72	84.	Waterford-3	-6.76
7.	Oyster Creek	+5.18	33.	Millstone-2	+1.13	59.	Salem-1	-1.75	85.	North Anna-1	-7.19
8.	Farley-1	+5.10	34.	Salem-2	+1.05	60.	Prairie Island-1	-1.84	86.	ANO-1	-7.90
9.	Browns Ferry-3	+4.75	35.	Oconee-3	+1.03	61.	Browns Ferry-2	-2.67	87.	Nine Mile Point-1	-8.31
10.	Dresden-3	+4.57	36.	Beaver Valley-2	+0.99	62.	Ginna	-2.74	88.	Columbia	-8.38
11.	Diablo Canyon-2	+4.37	37.	Vogtle-1	+0.73	63.	McGuire-2	-2.99	89.	Pilgrim	-10.44
12.	Cook-2	+4.36	38.	Point Beach-1	+0.71	64.	Comanche Peak-2	-3.05	90.	St. Lucie-1	-12.73
13.	Indian Point-2	+4.18	39.	Oconee-2	+0.26	65.	Nine Mile Point-2	-3.07	91.	Turkey Point-4	-12.76
14.	Farley-2	+4.12	40.	Sequoyah-1	+0.01	66.	LaSalle-2	-3.18	92.	Fermi-2	-13.53
15.	Diablo Canyon-1	+3.72	41.	North Anna-2*	0.00	67.	Peach Bottom-3	-3.28	93.	St. Lucie-2	-13.61
16.	Quad Cities-1	+3.33	42.	Calvert Cliffs-1	-0.07	68.	ANO-2	-3.54	94.	Wolf Creek	-14.90
17.	Brunswick-1	+2.94	43.	Catawba-2	-0.12	69.	Sequoyah-2	-3.57	95.	Susquehanna-2	-14.93
18.	McGuire-1	+2.89	44.	Surry-1	-0.13	70.	Limerick-2	-3.74	96.	Turkey Point-3	-15.40
19.	LaSalle-1	+2.51	45.	Catawba-1	-0.13	71.	Hope Creek	-3.76	97.	Monticello	-15.65
20.	Braidwood-1	+2.46	46.	Braidwood-2	-0.14	72.	Perry	-4.13	98.	Prairie Island-2	-16.43
21.	Three Mile Island-1	+2.40	47.	South Texas-1	-0.26	73.	Comanche Peak-1	-4.27	99.	Kewaunee	-20.19
22.	Arnold	+2.28	48.	Callaway	-0.45	74.	Calvert Cliffs-2	-4.47	100.	South Texas-2	-21.00
23.	Peach Bottom-2	+2.15	49.	Quad Cities-2	-0.86	75.	Byron-2	-4.51	101.	San Onofre-2	-41.88
24.	River Bend-1	+2.11	50.	Beaver Valley-1	-1.03	76.	Byron-1	-4.78	102.	San Onofre-3	-49.46
25.	Summer-1	+2.11	51.	Limerick-1	-1.19	77.	Grand Gulf-1	-4.79	103.	Crystal River-3	-54.76
26.	Palo Verde-3	+2.03	52.	Watts Bar-1	-1.35	78.	Seabrook	-4.96	104.	Fort Calhoun	-77.31

* The change for North Anna-2 is negative (-0.00275) but rounding presents it above as zero.

percent. In 2008–2010, it was 89.67 percent. The medians for every three-year period back to 1975–1977 are included in Fig. 1, which shows fairly clearly the improvement in nuclear power performance in the United States.

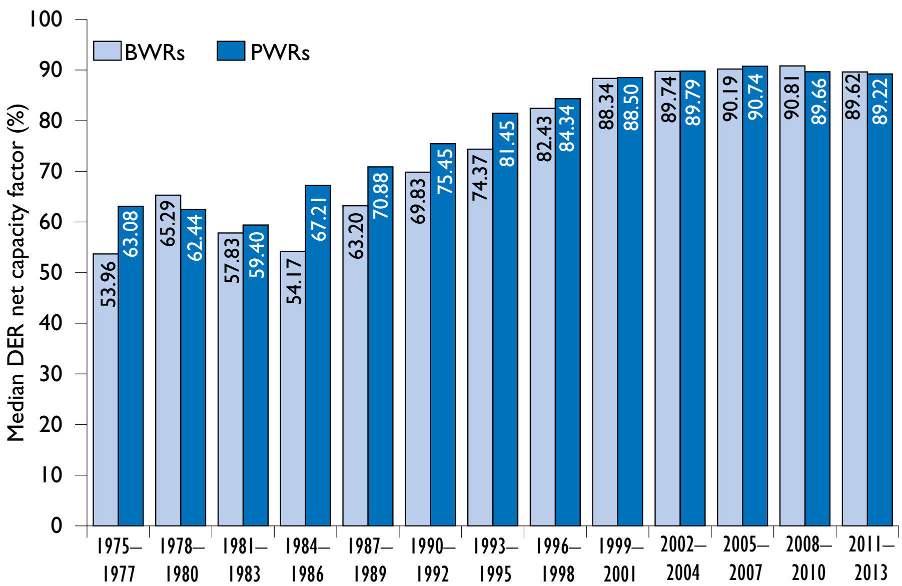

Fig. 2: Reactors by type. In the most recent three-year period, the median capacity factor for both pressurized water reactors and boiling water reactors declined. But while all four of the closed reactors and the long-idled Fort Calhoun are PWRs, the drop in the BWR median capacity factor was greater, 1.19 percentage points as opposed to 0.44. This may be attributable to the effects of refueling outages among the 35 BWRs and the larger number of PWRs (69, initially). If the four closed reactors were excluded, the 65 remaining PWRs would have median capacity factors of 89.71 in 2011–2013 and 89.68 in 2008–2010. This could actually be read as a slight improvement in the latest three-year period, but it is perhaps more reasonably read as no change.

For the 104 reactors, the other 2011–2013 statistics are as follows (with 2008–2010 stats given in parentheses): average, 86.03 (89.35); top quartile, 92.32 (92.95); bottom quartile, 84.64 (87.07).

Among the 69 pressurized water reactors, the 2011–2013 median was 89.22 percent, compared with 89.66 in 2008–2010. Following the same pattern above for comparing the two three-year periods, the 2011–2013 average was 85.18 (89.10), the top quartile was 92.47 (92.34), and the bottom quartile was 84.53 (87.37). For the 35 boiling water reactors, the median was 89.62 (90.81), the average was 87.70 (89.85), the top quartile was 92.18 (94.17), and the bottom quartile was 84.59 (86.37). The long-term trends for both reactor types are shown in Fig. 2.

Before now, this survey has run the risk of deluging the reader with numbers and attempting to find meaning in what may be differences too small to matter. Sad to say, this situation may get worse. In the main database, we have continued to include the four reactors that have been declared by their owners to be no longer operable, but as noted above, we have also worked with only the 100 still-operable reactors. Following are the 2011–2013 (and 2008–2010) stats for those 100 reactors: median, 89.67 (89.71); top quartile, 92.47 (93.06); bottom quartile, 85.46 (87.27); average, 87.98 (89.86). The astute reader will observe that the differences between the 104-reactor numbers and the 100-reactor numbers are less than a percentage point, except in the case of the 2011–2013 average, which shows the effect of downtime at the closed reactors.

Aside from dips in the two-point range for the bottom quartile and the average, the performance of these 100 reactors was on the whole pretty nearly the same in 2011–

2013 as it was in 2008–2010. Those two-point dips are probably not significant either. As Fig. 3 shows, the bottom quartile had been roughly at that level in 1999–2001, when fleet-wide performance followed a long climb with what appears to be a plateau. On that basis, we will not thrash around any longer in great detail (in this survey) with the data set of still-operable reactors. In the long term, this would be a moving target anyway, because Vermont Yankee is in its final year of operation (according to Entergy's announced plans). Thus, after 2014 there would be 99 operable reactors, which could return to 100 the following year if Watts Bar-2 starts up on its current schedule. For now, it can be assumed that when a number is given for all 104 reactors, it would probably be a little better for the still-operable reactors.

Multiunit sites, listed in Table III, had a median factor in 2011–2013 of 89.73 percent, down from 90.63 among the same 36 plants in 2008–2010. As has usually been the case through the years, the overall performance of multiunit sites was somewhat better than that of single-unit sites. The median factor of the 28 single units was 85.69 in 2011–2013. Crystal River-3 and Fort Calhoun had more of an effect on this group than they did on larger groups, leading to an average factor of 80.44 among the single units.

There's no one perfect way to present data, and we try to be flexible and to not be stodgy about rules, but there is one thing we firmly believe: A table's footnote should not be larger than the table itself. For that reason, we have two versions of Table IV, mainly to accommodate the Exelon-Constellation and Duke-Progress mergers. Table IV-A includes the two merged companies (with Fort Calhoun also included for Exelon, which operates the plant). Table IV-B lists the four premerger companies (without Fort Calhoun). This eliminates the footnote completely. You're welcome. And if you want to know the factors of the premerger Progress and the post-merger Duke, without Crystal River-3, they were 85.41 and 88.35, respectively.

The owner-operator data could be sliced even further, of course. Entergy, Dominion, and FPL operate both rate-regulated and merchant fleets. Exelon, before the latest merger, could be de-merged back to show the fleets that had once belonged to Commonwealth Edison and PECO. Fleet operation could be compared to non-fleet operation. Our general belief is that such number

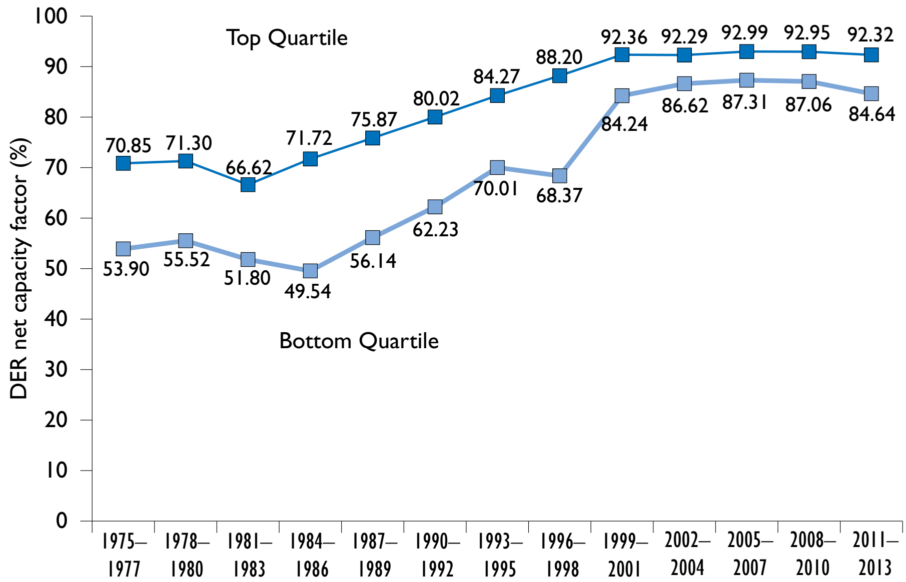

Fig. 3: All reactors, top and bottom quartiles. The capacity factor improvement of the bottom quartile, to within six points of the top quartile, appears to have ended, at least for now. As in Fig. 1, however, there is a continuation of what looks like a plateau covering the last five periods. The data shown here are for all 104 reactors. For the 100 still considered operable at the end of 2013, the top quartile was 92.47 in 2011–2013, down from 93.06 in 2008–2010; the bottom quartile was 85.46 in 2011–2013, down from 87.27 in 2008–2010.

Table III. DER Net Capacity Factor of Multireactor Sites[1]

Rank	Site	Factor	Owner	Rank	Site	Factor	Owner
1.	Dresden	97.79	Exelon	19.	Nine Mile Point	89.55	Exelon
2.	Quad Cities	96.47	Exelon	20.	Limerick	89.14	Exelon
3.	Farley	96.30	Southern	21.	Cook	89.12	IMP
4.	Comanche Peak	94.97	Luminant	22.	Oconee	88.70	Duke
5.	Calvert Cliffs	94.95	Exelon	23.	Hatch	88.61	Southern
6.	Braidwood	94.54	Exelon	24.	McGuire	88.44	Duke
7.	Vogtle	93.29	Southern	25.	Browns Ferry	87.95	TVA
8.	LaSalle	93.05	Exelon	26.	Sequoyah	87.67	TVA
9.	Peach Bottom	93.03	Exelon	27.	South Texas	86.86	STPNOC
10.	Indian Point	92.92	Entergy	28.	North Anna	86.00	Dominion
11.	Catawba	92.60	Duke	29.	Point Beach	85.41	FPL
12.	Surry	92.30	Dominion	30.	ANO	84.19	Entergy
13.	Beaver Valley	92.11	FENOC	31.	Brunswick	83.93	Duke
14.	Byron	91.01	Exelon	32.	Prairie Island	80.07	NSP
15.	Hope Creek/Salem	90.57	PSEG	33.	Susquehanna	79.19	PPL
16.	Diablo Canyon	90.55	PG&E	34.	St. Lucie	74.39	FPL
17.	Millstone	90.44	Dominion	35.	Turkey Point	74.01	FPL
18.	Palo Verde	89.88	APS	36.	San Onofre	33.48	SCE

[1] Because Nine Mile Point and FitzPatrick have different owners, Nine Mile Point is listed here as a multireactor site, but FitzPatrick is not included, even though the plants are on adjacent properties; combined, Nine Mile Point and FitzPatrick would have a 2011–2013 factor of 90.89. Hope Creek and Salem are treated as a single site because they are adjacent and have the same owner; the two-reactor Salem had a 2011–2013 factor of 90.66.

Table IV-A. DER Net Capacity Factors of Owners or Operators of More Than One Site, Including Mergers and Contracts[1]

Rank	Owner/Operator	Factor
1.	Southern Nuclear	92.73
2.	Exelon Generation	91.14
3.	FirstEnergy Nuclear	88.21
4.	Dominion Generation	87.90
5.	TVA Nuclear	87.81
6.	Entergy Nuclear	87.77
7.	Duke Energy	81.94
8.	FPL/NextEra	79.75
9.	Northern States Power-Minnesota	76.98

[1] Entergy has been the contract operator of Cooper since 2003; Exelon became the contract operator of Fort Calhoun in 2012.

Table IV-B. DER Net Capacity Factors of Owners or Operators of More Than One Site, Excluding Mergers and Without Contracts

Rank	Owner/Operator	Factor
1.	Exelon Generation	93.25
2.	Southern Nuclear	92.73
3.	Constellation Energy	91.89
4.	Duke Energy	89.84
5.	FirstEnergy Nuclear	88.21
6.	Entergy Nuclear	87.92
7.	Dominion Generation	87.90
8.	TVA Nuclear	87.81
9.	FPL/NextEra	79.75
10.	Northern States Power-Minnesota	76.98
11.	Progress Energy	69.27

crunching may be highly rigorous, but it risks becoming meaningless as sample sizes are made ever smaller. Thus, we leave further data-wrangling as an exercise for the reader. Anyone can access the four quarterly data compilations for 2013 through the ADAMS document retrieval system at

Even though the numerical changes are relatively small and overall performance remains strong, there may be a downward trend in capacity factors.

<www.nrc.gov>, with searches for the following accession numbers: ML13134A394, ML13205A304, ML13295A670, and ML 14024A465. Have fun!

Even though the numerical changes are relatively small and overall performance remains strong, there may be a downward trend in capacity factors, and this should not be shrugged off because of its apparently minimal effect thus far. For the fourth year in a row, a majority of reactors had lower capacity factors in the most recent three-year period than in the previous three-year period. The closed reactors have something to do with this, as does a tendency for uprated reactors to take perhaps more time than was intended to reach and remain at their new peak power levels. The 2011–2013 period also includes the entire post-Fukushima era, and some of the early lessons-learned tasks may have added some downtime.

It should also be remembered, however, that capacity is not the only measure of plant performance. The 2013 statistics compiled by the World Association of Nuclear Operators had not been released at this writing, but for the past several years they have shown overall improvement in the areas tracked (such as safety system performance, forced loss rate, and industrial safety), or a general leveling off near, or better than, goals that were set in the past (and those goals were usually made more stringent after earlier goals were reached). To a great extent, these improvements and plateaus occurred in the same time frames as the improvement and plateau in capacity factors.

Tracking the uprates

One fairly depressing way to look at the four reactor closures is that the United States now has 3,534 MWe less capacity in its nuclear fleet. While true, this may be somewhat misleading, because Kewaunee is the only reactor that closed while fully operable. Even if their owners had remained determined to bring back Crystal River-3 and San Onofre-2 and -3, those reactors would not have produced much electricity any time soon.

In the rest of the fleet, however, extra capacity was officially declared to be attainable during 2013 at several reactors as a result of DER revisions. In some cases, the new ratings reflect power uprates. In others, designers and operators have been able to increase electrical output within their existing license limits for thermal power. In still others, the peak power levels have been reduced. The latter group includes Dominion's Millstone-2 (now 877.2 MWe, down from 883.5 MWe) and Duke's McGuire-1 and -2 (now 1,166 MWe and 1,170 MWe, respectively, each down from 1,180 MWe). We are accepting these downward revisions because these licensees do not make a habit of tinkering with their ratings. We use DER because it is generally not subject to frequent changes.

The 10 reactors with higher ratings effective during 2013 include all four Florida units of FPL Group. St. Lucie-1 and -2 are now at 1,062 MWe and 1,074 MWe, up from 1,003 MWe and 862 MWe, respectively (Unit 1's rating has been raised in stages, starting from about the same level as Unit 2's). Turkey Point-3 and -4 are now at 831 MWe and 840 MWe, each up from 720 MWe. Unfortunately, these reactors did not immediately zoom up to their new peak power levels and stay there; they are near the bottom of Table I.

Also now with higher peaks are Exelon's Dresden-2 (894 MWe, up from 867 MWe) and -3 (879 MWe, up from 867 MWe) and Peach Bottom-2 (1,179 MWe, up from 1,138 MWe); Duke's Robinson-2 (795 MWe, up from 765 MWe); and, surely setting a new record for precision, TVA's Sequoyah -1 (1,184.37 MWe, up from 1,173 MWe) and -2 (1,177.46 MWe, up from 1,151 MWe). Among the 13 reactors with new ratings, there is a net gain of 619.53 MWe. That would mean something, of course, if the reactors could operate at their higher levels routinely.

We continue to note that three reactors have never had their DERs raised to account for much-earlier power uprates: Calvert Cliffs-1 and -2, and FitzPatrick. Perhaps the new ownership of Calvert Cliffs (the Exelon-Constellation merger) will examine this situation and take appropriate action. Entergy, FitzPatrick's owner, has not only never adjusted the rating of the reactor, but has not yet reflected the large power uprate at Grand Gulf-1 in its DER despite its having operated for more than a year with its uprate range available. Grand Gulf-1 is now capable of more power generation than any other reactor in the United States and would probably have a DER well above 1,400 MWe. As we have done for lo these many years, we await further developments.

A justified existence

Commercial nuclear power began as just another generating option for large utilities that controlled most aspects of their businesses, from energy production to end-product delivery. Then came fragmentation, deregulation, and the emergence of nuclear electricity production as something of a separate enterprise. It is almost certainly true that the latter has been worthwhile. Those who didn't understand that Nuclear Is Different sold their reactors to those who did, and the technology entered what could be thought of as a golden age. The same reactors that were included in rate bases with anticipated capacity factors of 65 percent have far outperformed those expectations as they progressed through mid-life. Nuclear professionals have found ways to share vital information and best practices without running afoul of antitrust laws or restrictions on proprietary information. As a result, strong performance has become possible at essentially every licensed power reactor.

It appears now, however, that this golden age may have come at a golden cost. The end of the all-embracing utility has meant that reactor licensees that are now proficient at producing abundant, economical electricity must find ways to make grid operators take it and send it to end users. We will not characterize grid operators as clueless, short-sighted, or worse, but it does appear that they have their own priorities and don't much care how Different Nuclear Is. Renewable portfolio standards enter into decisions on what power is made available when, and in what priority. This can push nuclear power into low or negative pricing and lead Exelon and its ilk to consider their options.

As it happens, wind turbine owners routinely grumble about grid operators' allocations, so there probably isn't some grand conspiracy to use renewables to undermine nuclear power. This doesn't change the fact that certain conditions are currently not favorable for power reactors, but the story may not be over yet. The United States is essentially ready now to export liquefied methane, which figures to reap more profit when sold to European customers than on the U.S. market. This could draw down the current bountiful supply of domestic methane and raise its price sooner than had been expected. Developments such as that are outside the influence of nuclear professionals, who can only keep doing what they do and hope that it still has value.