U.S. capacity factors: A very small decline

by E. Michael Blake

The median capacity factor is less than a point lower than in the three previous periods, but the closure of Kewaunee and Crystal River-3 may signal a new era.

Kewaunee, a 574-MWe pressurized water reactor near Carlton, Wis., had a design electrical rating (DER) net capacity factor of 93.39 percent in the three-year period of 2010 through 2012. This was the 19th highest factor for that period among the 104 power reactors in the United States. As things stand now, however, the personnel at this reactor will not have the opportunity to continue this top-quartile performance. Dominion Generation has declared its intention to close Kewaunee this month, at the end of the current fueling cycle.

The closure of Kewaunee is one of several recent developments that may ultimately lead nuclear professionals to think of the first decade of this century as something of a golden age for nuclear power in the United States. This will be examined in more detail later, but readers are asked to keep some perspective. In the current decade, new power reactors are now in the safety-related construction phase, and operating reactors continue to perform at a level on par with that of the previous decade, and better than that of any earlier decade.

It cannot be denied that the closures of Kewaunee and Duke Energy's Crystal River-3 end a stretch of more than 14 years during which no reactors closed, a dormant one was restarted, and the economics of licensed power reactors seemed unassailable, thanks to license renewal, merchant operation, and a median capacity factor that reached 90 percent. There are also outages at Fort Calhoun and San Onofre that perhaps could have been prevented, and expenses are on the way for the entire fleet to meet Nuclear Regulatory Commission requirements related to lessons learned from the Fukushima Daiichi accident in March 2011. In the three-year period just completed, however, nuclear electricity production in the United States continued to be bountiful, and there is no reason to believe that this cannot continue for years into the future.

Among the 104 power reactors, the median DER net capacity factor in 2010–2012 was 89.56 percent, down about seven-tenths of a point from the 90.24 percent achieved in 2007–2009. It was also lower than the median in the two previous three-year periods, but by such a small amount that there is no apparent statistical significance. The median has been generally level since the start of the millennium, and it continues to be.

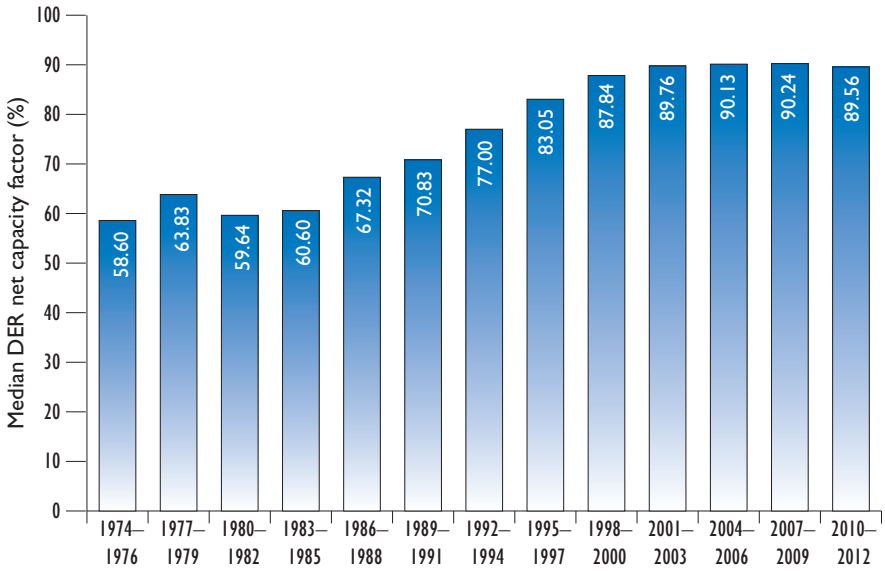

Fig. 1: All reactors. The median DER net capacity factor for the 104 licensed reactors came in less than one percentage point below the values of the three previous periods. Included are reactors that were operating or still considered operable at the end of 2012, which means that Crystal River-3 is in the database. There were 20 such reactors in 1974–1976, and in the succeeding periods there were 43, 53, 60, 77, 97, 102, 103, and in each of the last five, 104. If reactors now closed were included, the median would differ by more than one percentage point only in 1980–1982, when it was 57.57 percent.

The average capacity factor over the whole fleet has declined more noticeably, from 89.54 percent in 2007–2009 to 87.17 percent in 2010–2012, and it is here that the effects of the prolonged outages at Crystal River, Fort Calhoun, and San Onofre can be perceived. This survey, however, has always considered the median capacity factor to be a better indicator of fleet-wide performance than the average, because problems that cause extended downtime at one plant generally do not affect performance at other plants.

It is apparent from Table II, however, that performance cannot be generalized as isolated drop-offs at a very few plants and status-quo-or-better everywhere else. There were 40 reactors that had higher capacity factors in 2010–2012 than in 2007–2009, and 64 that had lower factors. Some of this can be attributed to when, and for how long, the reactors were undergoing refueling outages, but through just about all of the data for this survey, 2010–2012 performance came in lower than not only the previous three-year period, but also the two three-year periods before that one.

Again, however, it's important to maintain perspective: A drop of less than one percentage point was enough to show up as this much of a dip. This not only shows how close the fleet had probably been to an upper limit of performance, but how much the fleet had indeed leveled off up there. Also, power reactor licensees continue to raise their own bars as they implement power uprates, which (in most cases) increase their DERs, and sometimes require shakedown periods before steady operation can be established at the higher power levels.

Before we move on, however, one further

TABLE I.
2010–2012 DER NET CAPACITY FACTORS OF INDIVIDUAL REACTORS

Rank	Reactor	Factor[1]	Design Electrical Rating (DER), MWe[2]	Type	Owner[3]
1.	Quad Cities-1	100.46	866	BWR	Exelon
2.	Dresden-2	100.07	867	BWR	Exelon
3.	South Texas-1	98.75	1250.6	PWR	STPNOC
4.	Calvert Cliffs-2	96.88	845	PWR	Exelon
5.	Comanche Peak-2	96.53	1207	PWR	Luminant
6.	LaSalle-2	95.87	1178	BWR	Exelon
7.	Peach Bottom-3	95.85	1179	BWR	Exelon
8.	Comanche Peak-1	95.73	1218	PWR	Luminant
9.	Clinton	95.43	1062	BWR	Exelon
10.	Surry-1	95.28	874	PWR	Dominion
11.	Vogtle-2	95.02	1169	PWR	Southern
12.	Indian Point-3	94.94	1048	PWR	Entergy
13.	Braidwood-2	94.75	1155	PWR	Exelon
14.	Farley-1	94.69	854	PWR	Southern
15.	Three Mile Island-1	94.51	819	PWR	Exelon
16.	River Bend-1	93.89	967	BWR	Entergy
17.	Farley-2	93.79	855	PWR	Southern
18.	Catawba-2	93.51	1145	PWR	Duke
19.	Kewaunee	93.39	574	PWR	Dominion
20.	Dresden-3	93.36	867	BWR	Exelon
21.	Vogtle-1	93.27	1169	PWR	Southern
22.	Pilgrim	93.00	690	BWR	Entergy
23.	Beaver Valley-1	92.64	911	PWR	FENOC
24.	Diablo Canyon-2	92.62	1151	PWR	PG&E
25.	Byron-2	92.61	1155	PWR	Exelon
26.	Quad Cities-2	92.60	957.3	BWR	Exelon
27.	LaSalle-1	92.58	1178	BWR	Exelon
28.	Beaver Valley-2	92.56	904	PWR	FENOC
29.	Peach Bottom-2	92.48	1138	BWR	Exelon
30.	Palo Verde-2	92.29	1336	PWR	APS
31.	FitzPatrick	91.67	816	BWR	Entergy
32.	Calvert Cliffs-1	91.63	845	PWR	Exelon
33.	Hope Creek	91.54	1228.1	BWR	PSEG
34.	ANO-1	91.45	850	PWR	Entergy
35.	Millstone-3	91.25	1229	PWR	Dominion
36.	Catawba-1	91.02	1145	PWR	Duke
37.	Nine Mile Point-1	91.00	613	BWR	Exelon
38.	Vermont Yankee	90.86	617	BWR	Entergy
39.	Oconee-2	90.66	886	PWR	Duke
40.	Summer-1	90.66	972.7	PWR	SCE&G
41.	Braidwood-1	90.63	1187	PWR	Exelon
42.	Limerick-2	90.47	1205	BWR	Exelon
43.	Byron-1	90.45	1187	PWR	Exelon
44.	McGuire-1	90.31	1180	PWR	Duke
45.	Palo Verde-3	90.24	1334	PWR	APS
46.	Callaway	90.18	1228	PWR	Ameren
47.	Harris-1	90.08	941.7	PWR	Duke
48.	Ginna	90.08	585	PWR	Exelon
49.	Surry-2	90.06	874	PWR	Dominion
50.	Diablo Canyon-1	89.95	1138	PWR	PG&E
51.	Salem-2	89.86	1181	PWR	PSEG
52.	Salem-1	89.59	1169	PWR	PSEG
53.	Hatch-1	89.53	885	BWR	Southern
54.	ANO-2	89.51	1032	PWR	Entergy
55.	Oconee-3	89.22	886	PWR	Duke
56.	Cook-2	89.22	1107	PWR	IMP
57.	Perry	89.01	1268	BWR	FENOC
58.	Browns Ferry-2	88.73	1120	BWR	TVA
59.	Sequoyah-1	88.47	1173	PWR	TVA
60.	Indian Point-2	88.06	1035	PWR	Entergy
61.	Hatch-2	88.03	908	BWR	Southern
62.	Waterford-3	87.83	1173	PWR	Entergy
63.	Nine Mile Point-2	87.72	1299.9	BWR	Exelon
64.	Millstone-2	87.69	883.5	PWR	Dominion
65.	Watts Bar-1	87.08	1160	PWR	TVA
66.	Cook-1	86.79	1084	PWR	IMP
67.	Point Beach-1	86.76	615	PWR	FPL
68.	Brunswick-2	86.60	980	BWR	Duke
69.	Prairie Island-1	86.60	557	PWR	NSP
70.	Limerick-1	86.53	1205	BWR	Exelon
71.	Palo Verde-1	86.46	1333	PWR	APS
72.	North Anna-2	86.26	973	PWR	Dominion
73.	Browns Ferry-1	86.00	1120	BWR	TVA
74.	Turkey Point-4	85.93	720	PWR	FPL
75.	Oconee-1	85.87	886	PWR	Duke
76.	McGuire-2	85.82	1180	PWR	Duke
77.	Sequoyah-2	85.80	1151	PWR	TVA
78.	Cooper	85.75	815	BWR	NPPD
79.	Arnold	85.66	621.9	BWR	FPL
80.	Oyster Creek	85.52	650	BWR	Exelon
81.	Palisades	85.29	805	PWR	Entergy
82.	South Texas-2	84.46	1250.6	PWR	STPNOC
83.	Seabrook	83.65	1248	PWR	FPL
84.	Susquehanna-2	83.13	1287	BWR	PPL
85.	Prairie Island-2	82.93	557	PWR	NSP
86.	North Anna-1	82.87	973	PWR	Dominion
87.	Point Beach-2	82.72	615	PWR	FPL
88.	Brunswick-1	82.62	983	BWR	Duke
89.	Browns Ferry-3	82.51	1120	BWR	TVA
90.	Monticello	82.02	600	BWR	NSP
91.	Grand Gulf-1	81.23	1279	BWR	Entergy
92.	Wolf Creek	80.49	1200	PWR	WCNOC
93.	Davis-Besse	78.21	908	PWR	FENOC
94.	Columbia	77.09	1153	BWR	Northwest
95.	Robinson-2	76.28	765	PWR	Duke
96.	Susquehanna-1	76.14	1287	BWR	PPL
97.	St. Lucie-2	74.12	862	PWR	FPL
98.	Fermi-2	72.22	1150	BWR	DTE
99.	Turkey Point-3	72.12	720	PWR	FPL
100.	St. Lucie-1	72.05	1003	PWR	FPL
101.	San Onofre-2	59.89	1070	PWR	SCE
102.	San Onofre-3	56.00	1080	PWR	SCE
103.	Fort Calhoun	41.19	502	PWR	OPPD
104.	Crystal River-3	0.00	860	PWR	Duke

[1] These figures are rounded off. There are no ties. For example, Oconee-2 is in 39th, with 90.6619, and Summer-1 is in 40th, with 90.6551.

[2] This is the design electrical rating (DER) in megawatts (electric), effective as of December 31, 2012. 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, 2012. In most cases this also means the reactor's operator, but Entergy and Exelon are the contracted operators of Cooper and Fort Calhoun, respectively.

bringdown statistic should not be overlooked: In 2012, the fleet produced 770.68 TWh of electricity, down from 790.43 TWh in 2011 and 807.09 TWh in 2010. (This survey uses three-year periods as a better indicator of sustained performance than single years, but if you absolutely insist on panic, you could also note that 2012 was a leap year, when production could have been very slightly higher than in other years.)

The slight dip can also be seen when reactors are grouped by type. The 2010–2012 median among boiling water reactors was 89.01 percent, and for pressurized water reactors it was 89.86 percent. This ended a three-period (nine-year) stretch in which the BWR median was higher than the PWR median, but the difference is less than one point, as it had been in the previous three periods. The BWR average in 2010–2012, however, was 88.20 percent, compared to the PWR average of 86.65 percent. Unlike the median, the average shows the effects of the long outages at Crystal River-3, Fort Calhoun, and San Onofre-2 and -3, all of which are PWRs.

Perhaps the clearest indicator of the improvement of nuclear power as a whole during the century's first decade was in the bottom quartile of the whole sample (which lies between 78th and 79th place in Table I). The top quartile was approaching its peak as the previous century was ending, but the bottom quartile kept rising substantially after 2000, as shown in Fig. 3. In 2010–2012, the top quartile was 92.59 percent, and the bot-

TABLE II.
CAPACITY FACTOR CHANGE, 2007–2009 TO 2010–2012

Rank	Reactor	Change (percentage points)	Rank	Reactor	Change (percentage points)	Rank	Reactor	Change (percentage points)	Rank	Reactor	Change (percentage points)
1.	Cook-1	+33.64	27.	Oconee-2	+1.55	53.	Vermont Yankee	-1.31	79.	Braidwood-1	-4.87
2.	Browns Ferry-1	+12.76	28.	Cook-2	+1.35	54.	Byron-2	-1.40	80.	St. Lucie-2	-5.52
3.	Palo Verde-3	+11.49	29.	Beaver Valley-2	+1.29	55.	Catawba-1	-1.43	81.	Susquehanna-2	-5.94
4.	Perry	+9.90	30.	Calvert Cliffs-2	+1.18	56.	Monticello	-1.72	82.	Brunswick-1	-6.09
5.	River Bend-1	+9.68	31.	Millstone-3	+1.05	57.	Beaver Valley-1	-1.81	83.	FitzPatrick	-6.22
6.	Palo Verde-2	+9.51	32.	Prairie Island-1	+0.88	58.	North Anna-2	-1.87	84.	Nine Mile Point-2	-6.38
7.	Diablo Canyon-2	+9.10	33.	Limerick-2	+0.67	59.	Sequoyah-1	-1.90	85.	Indian Point-2	-6.89
8.	Quad Cities-1	+7.01	34.	Oconee-1	+0.59	60.	Columbia	-2.08	86.	Surry-2	-6.94
9.	Hatch-2	+6.61	35.	ANO-1	+0.55	61.	Hope Creek	-2.16	87.	Grand Gulf-1	-7.33
10.	McGuire-1	+6.52	36.	Salem-2	+0.43	62.	Cooper	-2.27	88.	Limerick-1	-7.44
11.	Vogtle-2	+6.48	37.	Callaway	+0.37	63.	Dresden-3	-2.41	89.	Point Beach-2	-7.86
12.	Dresden-2	+6.47	38.	Surry-1	+0.32	64.	Nine Mile Point-1	-2.48	90.	Calvert Cliffs-1	-8.86
13.	Indian Point-3	+5.08	39.	Comanche Peak-1	+0.20	65.	Turkey Point-4	-2.49	91.	Wolf Creek	-9.33
14.	Browns Ferry-2	+4.39	40.	Clinton	+0.12	66.	Waterford-3	-2.66	92.	Prairie Island-2	-10.53
15.	Peach Bottom-3	+3.81	41.	Diablo Canyon-1	-0.04	67.	Ginna	-3.00	93.	North Anna-1	-11.04
16.	Kewaunee	+3.80	42.	Palo Verde-1	-0.20	68.	Watts Bar-1	-3.10	94.	Robinson-2	-11.38
17.	Brunswick-2	+3.57	43.	Braidwood-2	-0.23	69.	Peach Bottom-2	-3.21	95.	Fermi-2	-11.63
18.	Farley-1	+3.33	44.	Comanche Peak-2	-0.42	70.	Salem-1	-3.27	96.	South Texas-2	-14.04
19.	Pilgrim	+2.73	45.	LaSalle-1	-0.48	71.	Quad Cities-2	-3.30	97.	Susquehanna-1	-15.06
20.	Summer-1	+2.60	46.	Oyster Creek	-0.58	72.	McGuire-2	-3.41	98.	Turkey Point-3	-15.20
21.	LaSalle-2	+2.52	47.	South Texas-1	-0.62	73.	Palisades	-3.43	99.	Davis-Besse	-15.35
22.	Catawba-2	+2.33	48.	Millstone-2	-0.87	74.	Byron-1	-3.61	100.	St. Lucie-1	-18.79
23.	Three Mile Island-1	+2.13	49.	ANO-2	-0.92	75.	Arnold	-3.76	101.	San Onofre-2	-21.37
24.	Farley-2	+2.06	50.	Oconee-3	-0.94	76.	Browns Ferry-3	-4.09	102.	San Onofre-3	-32.99
25.	Vogtle-1	+1.74	51.	Hatch-1	-1.21	77.	Seabrook	-4.62	103.	Fort Calhoun	-47.35
26.	Point Beach-1	+1.72	52.	Harris-1	-1.26	78.	Sequoyah-2	-4.82	104.	Crystal River-3	-84.26

tom quartile was 85.71 percent. The latter declined by more than two points from the 2007–2009 mark but remains in the range of the previous three periods.

Multireactor sites (listed in Table III) had a median capacity factor of 90.05 percent in 2010–2012, down from 90.83 percent in 2007–2009 (stop me if you've heard this before). Single-unit sites had a median of 86.42 percent in 2010–2012, compared to 89.07 percent in 2007–2009 (a drop of more than two and a half points.) The median for multisite owners was actually higher in 2010–2012 (89.31 percent) than in 2007–2009 (88.78 percent).

How all of this is done

As always, we feel the need to explain what this survey is and how it is carried out. Every year, *Nuclear News* examines the productivity of power reactors in the United States by computing their capacity factors over the previous three years, a period chosen because it can indicate sustained performance. We use net electrical output and each reactor's DER because in our view, that metric most accurately shows the reactor's capability. The raw data on electricity production and DER come from the NRC's fourth-quarter compilation of monthly operating reports on the reactors.

While we consider DER to be preferable to maximum dependable capacity, DER is hardly static. We believe that a rating should be raised when a reactor has undergone a power uprate, although we follow the owner/operator's lead. We also accept that it can take a while for the owner/operator to work out exactly what an uprated reactor's new electrical rating is. When the NRC approves an uprate, the raised limit is that of the reactor's thermal output, and how that translates to the electrical peak can be influenced by a number of factors.

As 2012 ended, Entergy was still applying the uprate to Grand Gulf-1, so we continue to use its old rating of 1279 MWe. Florida Power & Light Company has set a new rating for St. Lucie-1, but has not yet done so for St. Lucie-2; both of those units and Turkey Point-3 and -4 have been approved for extended power uprates. Last year, Wolf Creek's rating was raised from 1170 MWe to 1223 MWe to reflect an earlier uprate; Wolf Creek Nuclear Operating Corporation has revised the rating to 1200 MWe, which we consider acceptable. In general, however, we do not condone frequent tweaking of a DER by an owner/operator.

During 2012, ratings were raised (because of uprates, heat rate improvements, or

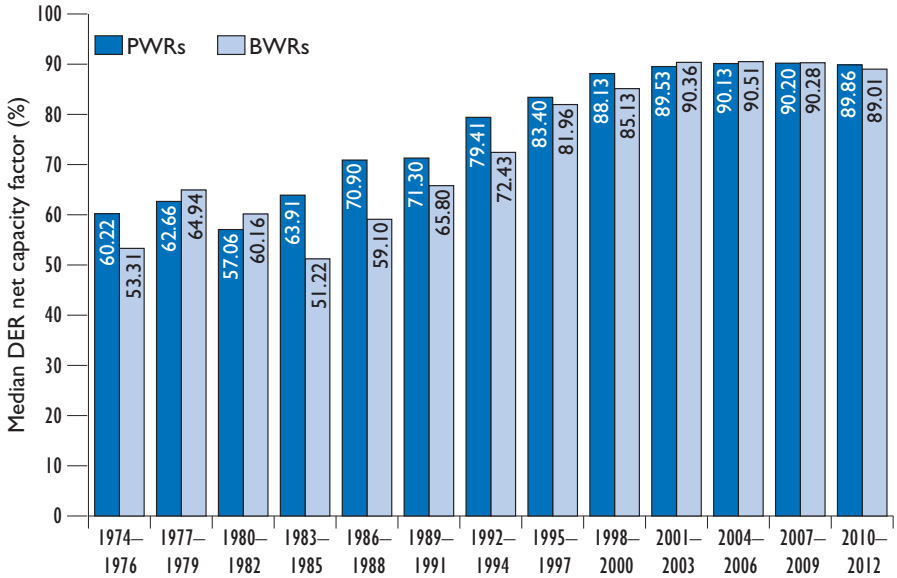

Fig. 2: Reactors by type. In the previous three periods, the boiling water reactor median was slightly higher than the median for pressurized water reactors, but in 2010–2012, the PWRs came out on top by less than a percentage point, which has been the difference between these two medians for more than a decade. If reactors now closed were included, only one median would differ by more than two points from those shown above: PWRs in 1974–1976, which would have been 63.67 percent.

other innovations) at the following reactors: Limerick-1 and -2, each to 1205 MWe from 1191 MWe; Nine Mile Point-2, to 1299.9 MWe from 1143.3 MWe; North Anna-1 and -2, each to 973 MWe from 913 MWe; Peach Bottom-3, to 1179 MWe from 1138 MWe; St. Lucie-1, to 1003 MWe from 856 MWe; St. Lucie-2, to 862 MWe from 856 MWe; Surry-1 and -2, each to 874 MWe from 788 MWe; and Watts Bar-1, to 1160 MWe from 1155 MWe. In effect, this raises the nation's (peak, theoretical) nuclear generating capacity by 695.6 MWe.

We take special notice of the revisions at North Anna and Surry, because for years this survey has called attention to the fact that uprates approved for North Anna in 1986 and Surry in 1995 had not been reflected in the reactors' DER. Because this step has now been taken, Dominion Generation is now out of our spotlight. Other owner/operators have been similarly chided over the years, but gradually nearly all of them have come into line. The last longtime laggards are Calvert Cliffs-1 and -2 (now part of the Exelon fleet after the merger with Constellation) and Entergy's FitzPatrick. In looking at the statistics for these reactors, readers should consider whether their capacity factors ought to be a few points lower (because perhaps their ratings should be higher). The fact that Quad Cities-1 and Dresden-2 have posted factors over 100 percent in Table I suggests that the extended uprates of a few years ago at these reactors may not be fully reflected in their DERs. The higher factor at Quad Cities-2, adopted by Exelon at the start of 2011, might be more representative of the capability of the Quad Cities-1 and -2/Dresden-2 and -3 hardware.

The announcements that Crystal River-3 will not be repaired and restarted and that Kewaunee will cease operation raise for us the question of which reactors should be included in the survey. The decade-plus of stability in our data set is coming to an end, and future surveys will become messier as we make judgment calls on who's in, who's out, whether to count fractions of three-year periods, and so forth. For the survey of 2010–2012, however, we are dictating that all 104 reactors be included. Crystal River -3 generated no electricity during the period, but the formal announcement that it would not restart came in February 2013. As things stand at this writing, Kewaunee may have stopped for good by the time this magazine goes to press, but it was still in service at the end of 2012 and beyond. Thus, both reactors are included in the current survey. We continued to include Browns Ferry-1 during its 22-year outage because TVA never gave up the license.

The Exelon-Constellation merger and the Duke-Progress merger both closed during 2012, and as of year-end, the integration processes were still ongoing. For this survey, we are treating Constellation and Progress as separate companies, with their own listings in Table IV. Exelon also became the operator of Fort Calhoun during 2012, so this survey is not including Fort Calhoun as Exelon-operated over the three-year period.

TABLE III.
DER NET CAPACITY FACTOR OF MULTIREACTOR SITES[1]

Rank	Site	Factor	Owner	Rank	Site	Factor	Owner
1.	Dresden	96.72	Exelon	19.	Millstone	89.76	Dominion
2.	Quad Cities	96.39	Exelon	20.	Palo Verde	89.66	APS
3.	Comanche Peak	96.13	Luminant	21.	Nine Mile Point	88.85	Exelon
4.	Calvert Cliffs	94.25	Exelon	22.	Hatch	88.77	Southern
5.	Farley	94.24	Southern	23.	Oconee	88.58	Duke
6.	LaSalle	94.22	Exelon	24.	Limerick	88.50	Exelon
7.	Peach Bottom	94.17	Exelon	25.	McGuire	88.06	Duke
8.	Vogtle	94.14	Southern	26.	Cook	88.02	IMP
9.	Surry	92.67	Dominion	27.	Sequoyah	87.15	TVA
10.	Braidwood	92.66	Exelon	28.	Browns Ferry	85.75	TVA
11.	Beaver Valley	92.60	FENOC	29.	Prairie Island	84.77	NSP
12.	Catawba	92.27	Duke	30.	Point Beach	84.71	FPL
13.	South Texas	91.61	STPNOC	31.	Brunswick	84.61	Duke
14.	Indian Point	91.52	Entergy	32.	North Anna	84.57	Dominion
15.	Byron	91.51	Exelon	33.	Susquehanna	79.60	PPL
16.	Diablo Canyon	91.29	PG&E	34.	Turkey Point	79.03	FPL
17.	ANO	90.39	Entergy	35.	St. Lucie	73.08	FPL
18.	Hope Creek/Salem	90.35	PSEG	36.	San Onofre	57.94	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 2010–2012 factor of 89.74. 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 2010–2012 factor of 89.73.

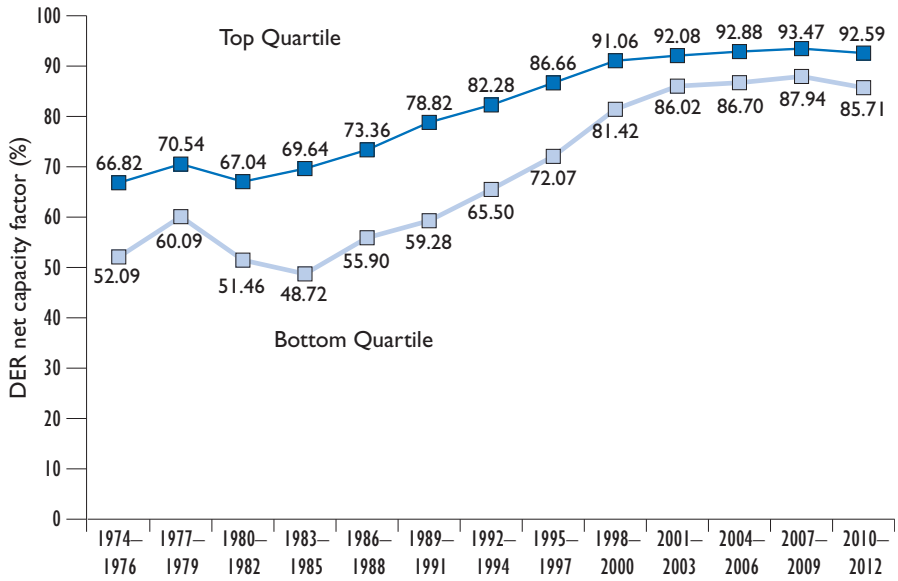

Fig. 3: All reactors, top and bottom quartiles. Perhaps the clearest indicator of the improvement of the fleet as a whole is in the rise of the bottom quartile. In roughly 20 years, it went from more than 20 points below the top quartile to within six points, slipping only slightly in the most recent period. If reactors now closed were included, the only amounts that would differ by more than two percentage points would be the bottom quartiles in 1989–1991 (57.08 percent) and 1995–1997 (68.18 percent).

Data for the fifth decade

For the first time, license renewal can be fully expressed in this survey, at least for two reactors. Oyster Creek and Nine Mile Point -1, the former owned by Exelon and the latter acquired by Exelon through its merger with Constellation, have become the first power reactors to complete three calendar years of operation after 40 years of commercial service. There is no great significance in their having crossed the threshold. Oyster Creek's capacity factor, 85.52 percent, was down about 0.58 points from its factor in 2007–2009. Nine Mile Point-1 declined by about two and a half points, but at 91 percent, its 2010–2012 factor was above the median.

There continues to be no sign that the oldest reactors are unable to maintain the kind of performance achieved by newer units. In any case, "newer" is a relative term, as virtually every reactor has been in commercial operation for at least 20 years. Aging management is a process that begins long before a reactor enters its license renewal period, and with the exception of San

TABLE IV.
DER NET CAPACITY FACTORS
OF OWNERS OR OPERATORS
OF MORE THAN ONE SITE[1]

Rank	Owner/Operator	Factor
1.	Exelon Generation	93.11
2.	Southern Nuclear	92.52
3.	Constellation Energy	91.28
4.	Duke Energy	89.57
5.	Entergy Nuclear	89.42
6.	Dominion Generation	89.31
7.	FirstEnergy Nuclear	88.19
8.	TVA Nuclear	86.45
9.	Northern States Power–Minnesota	83.79
10.	FPL/NextEra	80.01
11.	Progress Energy	68.28

[1] Entergy is the contract operator of Cooper, but not its owner. Entergy with Cooper is 89.16.

Onofre, the changeout of major plant components has been viewed as enhancing operation.

Elsewhere in this issue is a feature article on the Department of Energy's LWR Sustainability Program (see page 47), which, among other things, seeks to address whether an operating reactor can reasonably expect to seek and use a second license renewal period, extending its total operating time to 80 years. This may be a moot point for at least one of the two reactors in the vanguard. Exelon has stated that rather than bear the expense of additional cooling equipment, it intends to close Oyster Creek in 2019, at the halfway point of its current renewal period. Years ago, Constellation had begun to explore the feasibility of second license renewals for Nine Mile Point-1 and Ginna (which is only a few months newer than Oyster Creek and Nine Mile Point-1), looking at application dates around 2019. This was envisioned as something of a pilot project, having some involvement with the sustainability program. Whether the merger with Exelon has affected this effort is not yet known.

A brave new world?

It may turn out that 2013 will mark the start of a new era for nuclear power in the United States with the end of two presumed near certainties: that all 104 reactors would operate indefinitely, and that new reactors would never get as far as safety-related construction. Statistical messiness was going to afflict this survey eventually anyway, if nothing more happened than the completion of TVA Nuclear's Watts Bar-2 in 2015 or 2016. Old reactors can and will close, while new reactors seem ever more likely to open.

The relatively low production of nuclear electricity in 2012 may be a single occurrence, especially if San Onofre-2 and Fort Calhoun are restarted, as hoped by their owners. But the 800-TWh-plus output of earlier years may be out of reach for a while. Not only will Crystal River-3 never generate electricity again, but Kewaunee's closure will take away more capacity than Fort Calhoun's restart can add. Also, the larger-scale plant modifications that will be required as a result of lessons learned from Fukushima Daiichi not only have uncertain costs, but no clear indication of how much downtime will be needed for implementation (or when it will occur). Even when adjusted for the reactors that will leave the database, the median capacity factor over the next few years may continue to fall short of 90 percent.

Crystal River-3 is probably not part of a trend, as there were issues with the containment repair work, and the post-merger ownership brought a new perspective on whether continued expense was worthwhile. Kewaunee, a smaller reactor in a merchant environment, is more likely to represent the conditions being faced by similar reactors in an environment where natural gas–generated electricity is, at least for now, relatively cheap.

The Nuclear Energy Institute recently addressed Wall Street analysts and insisted that nuclear power's "value proposition" (a phrase one uses when talking to Wall Street analysts) remains strong. And however much conditions may have changed, there are 102 reactors (at this writing) that are still holding on to their operating licenses. NN