U.S. capacity factors: Still on the rise

BY E. MICHAEL BLAKE

Of the United States' 104 licensed power reactors, 102 are now in the "good performer" category, and boiling water reactors are now performing as well as pressurized water reactors.

IN 1995, SOMEBODY wrote that "Ever since the late 1980s," he had "cautioned that the rate of improvement shown by power reactors over the previous decade could not continue indefinitely, and that most of the reactors making gains in performance would probably level off, and that they probably should be congratulated if they maintained their new, high capacity factors. The author of this article still believes that this will happen eventually—but it certainly hasn't happened yet."

Actually, that passage appeared in this magazine. Actually, the author of that article is writing this one. Actually, while the past nine years may make the author look like an imbecile for not forecasting the continued rise in performance, please note that an escape hatch was provided: that the leveling-off would occur *eventually*, and that it had not happened yet. Actually, that long ago, did anyone really think that the existing fleet of light-water reactors in the United States would continue to set new records, and break them all over again, for several more years?

After a hiatus of eight years, *Nuclear News* has resumed its survey of three-year capacity factors of power reactors in the United States, and while the overall finding—that performance throughout the industry is now at the highest level it has ever experienced—is not exactly news to anyone who has been involved in the industry over the past several years, this particular breakdown of the data shows how far power reactors have continued to progress since the earlier *NN* surveys. This survey also brings to light a development that may not have received wide notice: boiling water reactors, which since the early 1980s had on average lagged 5 to 10 points behind pressurized water reactors, have closed the gap, and in the three-year period of 2001 through 2003, actually pulled ahead of PWRs in median capacity factor.

Here are the results of the survey in brief:

The median three-year design electrical rating (DER) net capacity factor of the 104 operating power reactors in 2001 through 2003 was 89.66 percent. The median factor in 1992–94 (of the 102 reactors operating then and still in service now) was 77 percent; in 1989–91 (97 reactors) it was 70.78; in 1986–88 (77 reactors), it was 67 percent. (The three-year statistics described in this article are computed from annual DERs and electricity generation reported by utilities to the Nuclear Regulatory Commission.)

In 2001–03, 102 of the 104 reactors (98.08 percent) had three-year factors above 70 percent, with the other two (1.92 percent) having factors below 50 percent. In 1992–94, 75 of the 102 reactors (73.53 percent) had factors over 70, with 9 (8.82 percent) below 50; in 1989–91, 51 of 97 (52.58 percent) were over 70, and 10 (10.31 percent) were below 50; in 1986–88, 35 of 77 (45.46 percent) were above 70, with 17 (22.08 percent) below 50.

The median factor among the 35 BWRs was 90.36 percent in 2001–03, up from 72.54 in 1992–94, 65.16 among 34 BWRs in 1989–91, and 58.90 among 27 BWRs in 1986–88.

The median factor among the 69 PWRs was 89.53 percent in 2001–2003, up from 79.41 among 67 PWRs in 1992–94, 71.30 among 63 PWRs in 1989–91, and 70.90 among 50 PWRs in 1986–88.

A closer comparison of PWRs and BWRs in 2001–03 shows not only that the medians of the two groups were fairly close (89.53 and 90.36, respectively), but that the distribution was fairly even throughout both groups. The first quartile of the BWRs was 93.22, with 91.81 for the PWRs. The third quartile of the PWRs was 86.16, with 86.01 for the BWRs.

To gain some perspective on how the entire industry has advanced, note this: In 1992–94, the industry's best three-year period up until then, 13 units had capacity factors of 85 percent or better. In 2001–03, 85 of the 102 reactors operating throughout both periods reached or exceeded 85 percent.

"Good" and "poor" performers

Because of constraints on time (to gather and analyze data) and space (to present the results here), this year's survey will be less ambitious than the ones that appeared here annually from 1983 through 1996. While the data are probably more meaningful if put in a full historical context, tracing capacity factors through as many consecutive three-year periods as possible, *NN* has thus far gathered usable data only for the most recent three calendar years. (See the box on page 27 for an explanation of how the data were gathered.) In the comparisons above, a six-year gap was left, but in the accompanying charts, approximate data gathered from a variety of other sources are used to provide at least a rough idea of how the industry progressed through the otherwise omitted three-year periods (1995–97 and 1998–2000). Please note that the numbers plugged in here are not precise, though they seem reasonable enough to make the point about the industry's overall improvement. *NN* plans to have usable data for all years in time for next year's article (if there is one), based on 2002–04 and the previous three-year periods.

What may be the most remarkable aspect of this steady upward climb—and one that might easily be taken for granted by the people in the nuclear community who have brought it about—is that it has been done with essentially the same reactors that have been in service all along, some of which, frankly, spent many, many years as

TABLE I.
2001–03 DER NET CAPACITY FACTORS OF INDIVIDUAL REACTORS

Rank	Reactor	Factor[1]	Design Electrical Rating (DER), MWe[2]	Type	Operator[3]
1.	ANO-2	99.49	912	PWR	Entergy
2.	San Onofre-2	98.56	1070	PWR	SCE
3.	Braidwood-1	98.41	1187	PWR	Exelon
4.	Byron-2	98.14	1155	PWR	Exelon
5.	Byron-1	97.17	1187	PWR	Exelon
6.	Ginna	97.14	470	PWR	RG&E
7.	St. Lucie-1	96.89	830	PWR	FP&L
8.	Browns Ferry-3	96.45	1120	BWR	TVA
9.	Braidwood-2	96.37	1155	PWR	Exelon
10.	FitzPatrick	96.30	816	BWR	Entergy
11.	Limerick-1	95.46	1191	BWR	Exelon
12.	River Bend	95.28	966	BWR	Entergy
13.	Clinton[4]	94.17	1062	BWR	AmerGen
14.	Indian Point-3	94.11	979	PWR	Entergy
15.	LaSalle-1	94.03	1154	BWR	Exelon
16.	Grand Gulf	94.02	1250	BWR	Entergy
17.	Brunswick-1	93.65	895	BWR	Progress
18.	Catawba-2	93.27	1145	PWR	Duke
19.	Hatch-1	93.22	870	BWR	Southern
20.	Beaver Valley-2	93.00	836	PWR	FirstEnergy
21.	Crystal River-3	92.86	860	PWR	Progress
22.	Peach Bottom-2	92.80	1138	BWR	Exelon
23.	Limerick-2	92.75	1191	BWR	Exelon
24.	Waterford-3	92.68	1104	PWR	Entergy
25.	Turkey Point-4	92.60	720	PWR	FP&L
26.	Robinson-2	92.60	765	PWR	Progress
27.	Peach Bottom-3	92.06	1138	BWR	Exelon
28.	Susquehanna-1	92.04	1115	BWR	PPL
29.	Wolf Creek	91.97	1170	PWR	WCNOC
30.	Catawba-1	91.84	1145	PWR	Duke
31.	St. Lucie-2	91.79	830	PWR	FP&L
32.	Vogtle-1	91.78	1169	PWR	Southern
33.	Vermont Yankee	91.69	522	BWR	Entergy
34.	Dresden-2	91.68	867	BWR	Exelon
35.	North Anna-1	91.48	907	PWR	Dominion
36.	Indian Point-2	91.39	993	PWR	Entergy
37.	Surry-2	91.06	788	PWR	Dominion
38.	Prairie Island-2	90.93	536	PWR	NMC
39.	Turkey Point-3	90.83	720	PWR	FP&L
40.	Pilgrim	90.83	711	BWR	Entergy
41.	Oyster Creek	90.82	650	BWR	AmerGen
42.	ANO-1	90.60	850	PWR	Entergy
43.	Seabrook	90.36	1148	PWR	FPL
44.	Hatch-2	90.36	908	BWR	Southern
45.	LaSalle-2	90.31	1154	BWR	Exelon
46.	Diablo Canyon-1	90.25	1103	PWR	PG&E
47.	Farley-1	90.08	854	PWR	Southern
48.	Quad Cities-2	89.93	867	BWR	Exelon
49.	Dresden-3	89.89	867	BWR	Exelon
50.	Vogtle-2	89.88	1169	PWR	Southern
51.	Palo Verde-1	89.80	1265	PWR	APS
52.	McGuire-2	89.71	1180	PWR	Duke
53.	Oconee-2	89.60	886	PWR	Duke
54.	Watts Bar-1	89.56	1155	PWR	TVA
55.	Palo Verde-3	89.55	1269	PWR	APS
56.	Prairie Island-1	89.53	536	PWR	NMC
57.	Surry-1	89.39	788	PWR	Dominion
58.	Nine Mile Point-2	89.34	1143.3	BWR	Constellation
59.	Calvert Cliffs-2	89.34	845	PWR	Constellation
60.	McGuire-1	89.32	1180	PWR	Duke
61.	Quad Cities-1	89.31	867	BWR	Exelon
62.	Susquehanna-2	88.90	1182	BWR	PPL
63.	Brunswick-2	88.87	935	BWR	Progress
64.	Millstone-3	88.80	1153.6	PWR	Dominion
65.	Point Beach-2	88.75	522	PWR	NMC
66.	Comanche Peak-2	88.66	1150	PWR	TXU
67.	Point Beach-1	88.46	522	PWR	NMC
68.	Calvert Cliffs-1	88.41	845	PWR	Constellation
69.	Sequoyah-2	88.17	1160	PWR	TVA
70.	Three Mile Island-1	87.98	819	PWR	AmerGen
71.	Salem-2	87.62	1131	PWR	PSEG
72.	Browns Ferry-2	87.30	1120	BWR	TVA
73.	Diablo Canyon-2	87.29	1119	PWR	PG&E
74.	Farley-2	87.27	855	PWR	Southern
75.	Salem-1	87.13	1130	PWR	PSEG
76.	Sequoyah-1	86.77	1160	PWR	TVA
77.	Beaver Valley-1	86.43	835	PWR	FirstEnergy
78.	Fort Calhoun	86.31	478	PWR	OPPD
79.	Callaway	86.02	1171	PWR	AmerenUE
80.	Fermi-2	86.01	1150	BWR	Detroit
81.	Palo Verde-2	85.87	1265	PWR	APS
82.	Kewaunee	85.77	544	PWR	NMC
83.	Millstone-2	85.74	870	PWR	Dominion
84.	Comanche Peak-1	85.55	1150	PWR	TXU
85.	Monticello	85.74	600	BWR	NMC
86.	South Texas-1	85.39	1250.6	PWR	STP
87.	Hope Creek	85.16	1083	BWR	PSEG
88.	Nine Mile Point-1	84.69	613	BWR	Constellation
89.	Arnold	84.29	581.4	BWR	NMC
90.	Summer	84.06	972.7	PWR	SCE&G
91.	San Onofre-3	83.94	1080	PWR	SCE
92.	Harris	83.62	941.7	PWR	Progress
93.	Cook-1	82.51	1020	PWR	AEP
94.	Oconee-3	82.35	886	PWR	Duke
95.	Columbia	82.00	1153	BWR	Northwest
96.	South Texas-2	81.17	1250.6	PWR	STP
97.	Oconee-1	80.81	886	PWR	Duke
98.	Cook-2	79.65	1090	PWR	AEP
99.	Perry	79.34	1260	BWR	FirstEnergy
100.	North Anna-2	78.66	907	PWR	Dominion
101.	Cooper	78.34	778	BWR	NPPD
102.	Palisades	70.35	805	PWR	NMC
103.	Davis-Besse	36.26	906	PWR	FirstEnergy
104.	Browns Ferry-1	0.00	1065	BWR	TVA

[1] These figures are rounded off. There are no actual ties, though rounding may produce amounts that look the same, such as for Turkey Point-4 and Robinson-2.

[2] The rating shown is effective as of December 31, 2003; if a reactor's rating has changed during the three year-period, the capacity factor is computed with appropriate weighting.

[3] As of December 31, 2003. In most cases this also means the reactor's owner, but the plants listed for NMC are only operated, not owned, by Nuclear Management Company, LLC.

[4] After Clinton was uprated in 2002, AmerGen chose to refer to the reactor's rating as DER-gross, rather than DER-net. This is the only reactor to be rated this way. In this survey, the capacity factor is computed with gross electricity generation for the time after the uprating, and net generation before it.

mediocre to poor performers. Yes, Davis-Besse languishes near the bottom of Table I, in this survey's "poor performer" category (a three-year factor below 50 percent), and it has been in this category before. Still, its prolonged outage (which ended in March 2004, after the end of the survey period) is very much the exception these days. The only reactors that failed to reach this survey's "good performer" category (a three-year factor of 70 percent or better) are Davis-Besse and Browns Ferry-1 (which remains in this survey, because it is still a licensed reactor intended to resume service; it was shut down in 1985 and is being refurbished for restart by the Tennessee Valley Authority). Even Palisades, a longtime underachiever, returned from a long outage in 2001 and did well enough thereafter to post a factor of 70.35 percent for the three-year period.

The "good performer" and "poor performer" criteria, chosen for articles written during the 1980s, are maintained here even though they may seem outmoded; *NN* believes that keeping the criteria as they are allows for meaningful comparison of performance in one period with that in another. Still, it may not be reasonable to keep using the "good" and "poor" categories at all, regardless of the criteria chosen. When these articles began, good performers were cited as examples to be followed by management at other reactors, and specific practices were recounted both from reactors that were usually good performers, and reactors that had made the transition from poor to good. Since then, this kind of information exchange has been carried out on far wider scales through other venues (the Institute of Nuclear Power Operations, owners' groups, and so forth), and the results in Table I suggest that nobody really has to be shown how to keep a factor of 70 percent or better for more than three years. Even Davis-Besse operated for several years at high factors, before its recent outage.

Thus, in subsequent surveys, *NN* expects to stick to the numbers, aiming to compare each reactor's factor with its own earlier factors, and not make value judgments. Before leaving this topic, however, it may be worthwhile to make the following remark: Simply because the standard for all reactors' performance seems to have risen far beyond where it had been before, the impulse to grade on a curve should not lead anyone to conclude that a three-year factor of about 80 percent, give or take a couple points, is a failure. It is good to shorten outages, when feasible, and where there is extra spending to achieve higher output, higher output certainly should be delivered. But let's not be ridiculous.

Concerning the data, and what was done with it

One reason the *NN* series of capacity factor surveys ended when it did, after the May 1996 issue, was that the prime source of data was terminated. At the end of 1995, the Nuclear Regulatory Commission ceased publication of NUREG-0020, its monthly compilation of power reactor performance data. Each licensee had been required to provide the data to the agency, which then gathered it all in what was known throughout the industry as "The Gray Book," after the color of the cardstock in which it was bound—but because much of the data concerned electricity generation, the NRC decided that such matters were not within its regulatory mission. This meant that there was no longer a single source of information, available to the public at no charge, with standardized generation statistics from every licensed power reactor.

In due course, however, the NRC rethought its decision. In 1997 the agency issued a generic letter, SECY 97-02, in which it sought to resume the flow of operational data from licensees to the agency, on a routine monthly basis. The data requested included, among others, the reactor's monthly net electricity generation and its design electrical rating (DER). When this data flow from the licensees to the NRC resumed, however, the NRC did not restore the flow from the NRC to the public: The Gray Book was not revived.

Still, the data sent by the licensees is not actively withheld from the public, and in late 1999 it became possible to see the licensees' monthly reports again without physically visiting the Public Document Room at NRC headquarters. The NRC launched its ADAMS online document retrieval system, and began including the monthly operating reports. Persistent ADAMS searches by the author have provided the equivalent of Gray Book data for all licensed plants from 2000 onward, with sporadic data from before 2000. Because this survey was assembled in about three weeks, there was not enough time to track down equally usable data for 1996 through 1999, and thus the data from 2001–03 are not formally compared with those for 1995–97 and 1998–2000. *NN* plans to fill in the gaps with usable data in time for next year's capacity factor survey.

This survey uses DER net capacity factor over a three-calendar-year period as its measure of sustained performance by a power reactor. The factor is computed as follows: Net generated electricity is divided by the product of the reactor's DER and the number of hours in the three-year period. Rather than take averages (which could give undue weight to larger reactors), this survey looks at the median within a group of capacity factors, and charts progress by tracking the median through successive three-year periods. This survey also tracks how many reactors have factors of 70 percent or more, and how many have factors below 50 percent—groups traditionally referred to here as "good performers" and "poor performers," respectively.—*E.M.B.*

Fewer reactors, more capacity

For the most part, the lofty numbers in Table I have been achieved despite the fact that several of the reactors have been uprated, so that the plant must generate even more electricity than it had before just to maintain the same capacity factor. In the nine years from the start of 1995 through the end of 2003, 49 reactors have reflected uprates in higher design electrical ratings, totaling 2765 MWe among the 102 units in operation at the time, and still operating now. This is a 2.89 percent increase over the whole fleet, nationwide.

It should be noted that not all of the power uprates approved by the NRC and carried out by utilities have been reflected in the reactors' design electrical ratings, which has the effect of perhaps making the capacity factors of a few reactors look better than they really are. (*NN* has always maintained that DER is the most reliable measure of whether a plant is doing what it was intended to do—generate electricity in a quantity that justifies its inclusion in a [pardon the outmoded term] rate base, and thus return its investment.) It appears that the costs of the uprates have been passed along to electricity customers, and thus what the plant can do with its uprate is not a bonus, but yet another increment of generating capacity with its own attached costs. Following are the uprated units that have not changed their DERs: All four of Dominion Energy's original reactors (both North Anna units, uprated 4.2 percent of thermal power each, in 1986, and both Surry units, uprated 4.3 percent each in 1995); AmerenUE's Callaway (4.5 percent, 1988); Wolf Creek Nuclear Operating Corporation's Wolf Creek (4.5 percent, 1993); and Entergy's FitzPatrick (4 percent, 1996) and ANO-2 (7.5 percent, 2002).

Continued

TABLE II.
DER NET CAPACITY FACTORS OF MULTI-UNIT SITES[1]

Rank	Plant	Factor	Operator	Rank	Plant	Factor	Operator
1.	Byron	97.65	Exelon	19.	Quad Cities	89.62	Exelon
2.	Braidwood	97.40	Exelon	20.	McGuire	89.51	Duke
3.	ANO	95.20	Entergy	21.	Calvert Cliffs	88.87	Constellation
4.	St. Lucie	94.34	FP&L	22.	Diablo Canyon	88.76	PG&E
5.	Limerick	94.11	Exelon	23.	Farley	88.68	Southern
6.	Catawba	92.56	Duke	24.	Point Beach	88.60	NMC
7.	Peach Bottom	92.43	Exelon	25.	Palo Verde	88.41	APS
8.	LaSalle	92.17	Exelon	26.	Nine Mile Point	87.72	Constellation
9.	Hatch	91.78	Southern	27.	Millstone	87.49	Dominion
10.	Turkey Point	91.72	FP&L	28.	Sequoyah	87.47	TVA
11.	Brunswick	91.26	Progress	29.	Comanche Peak	87.11	TXU
12.	San Onofre	91.22	SCE	30.	Salem/Hope Creek	86.66	PSE&G
13.	Vogtle	90.83	Southern	31.	North Anna	85.07	Dominion
14.	Dresden	90.80	Exelon	32.	Oconee	84.25	Duke
15.	Susquehanna	90.46	PPL	33.	South Texas	83.28	STP
16.	Prairie Island	90.23	NMC	34.	Cook	81.04	AEP
17.	Surry	90.22	Dominion	35.	Browns Ferry	62.27	TVA
18.	Beaver Valley	89.72	FirstEnergy				

[1] Because Nine Mile Point and FitzPatrick have different owners, Nine Mile Point is counted here as a multi-unit site but FitzPatrick is not included, even though the plants are on adjacent properties; if taken together, Nine Mile Point and FitzPatrick would have a combined 2001–03 factor of 90.44. Salem and Hope Creek are treated as a single site, because they are adjacent and have the same owner; the two-unit Salem had a 2001–03 factor of 87.38. Indian Point is not included here, because until recently the two units had different owners; as of the end of 2003, Entergy had not owned both units for three full calendar years. The 2001–03 factor for both Indian Point units combined is 92.74, which would be in sixth place on Table II.

During the years without *NN* surveys, six reactors closed: Big Rock Point, Haddam Neck, Maine Yankee, Millstone-1, and both Zion units. (The uprates at the surviving units can perhaps be thought of as replacing Zion and Millstone-1.) For this survey, these six have been removed from the data sets from the earlier surveys, so that the current reactors are, for the most part, compared only with their own past performance. The newest reactors have not been in service in all of the time periods considered here, but the end of the construction era (of the current generation of reactors) means that even after the six-year gap is bridged, there were nearly as many reactors operating then as now (102 in 1992–94 and 98 in 1989–91, with the first real drop-off in 1986–88, when 77 of today's reactors were in the database). *NN* could show data all the way back to 1971–73, but only four reactors operating then are still operating now, so the data would be meaningful only for those individual reactors.

Because *NN* has only approximate data for 1998–2000 and 1995–97, there will not be a formal comparison of the 2001–03 data to those previous periods. Beyond the approximations shown in the graphs, *NN* is willing to state that it appears that 56 reactors had higher factors in 2001–03 than they had in 1998–2000, while 29 seem to have had lower factors, and the other 19 are too close to call, based on the error margin *NN* believes to exist in the 1998–2000 guesses. Also, while *NN* tries not to compare three-year periods that overlap, it can be noted that the data for 2000–02, which *NN* considers reliable, are very close to those for 2001–03, so performance may indeed be leveling off now (or it may not). In fact, the median capacity factor for all units, and also for PWRs and BWRs as groups, is slightly lower in 2001–03 than in 2000–02 (by about 0.2 percent). The number of units above 70 percent, however, is higher in 2001–03 (102 units, compared to 97 in 2000–02), so *NN* considers the overall profile of the industry to be better in 2001–03 than it was in 2000–02, which makes it the best three-year period in the

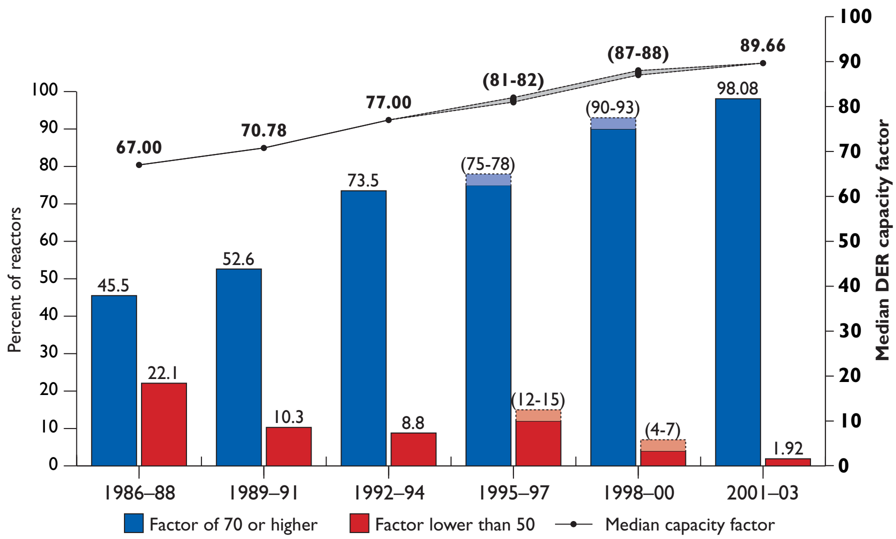

Fig. 1: All reactors. The bar chart shows, for each three-year period, the percentage of reactors with capacity factors of 70 percent or more, and the percentage with factors lower than 50 percent; the scale is the vertical along the left side. Over time, the left-side bar has nearly reached unity, and the right-side bar has almost vanished. The points on the line tracks the median capacity factor of the whole group in each period; the scale is the vertical along the right side. In the three-year periods before the ones shown here, the median had never been as high as 65 percent. We do not have precise data for the three-year periods 1995–97 and 1998–2000, but we are reasonably confident that our approximate data fit into the specified ranges. Only reactors now operating are included here, and over the time periods shown, their number hasn't changed much; there were 77 in 1986–88, and in the following periods there were 98, 102, 103, 104, and 104.

industry's history.

The median capacity factor of the 35 multi-unit sites (see Table II) is 89.72, so close to the median for all units as to make for essentially no difference. What *NN* finds especially noteworthy here is the huge improvement (compared to 1992–94 and all earlier periods) of the former Commonwealth Edison plants. This utility's merger into Exelon may have helped, but by finishing in first and second, Byron and Braidwood even outstripped the PECo plants now in Exelon (Limerick and Peach Bottom), with LaSalle and Dresden both in the top half and Quad Cities just below the middle.

Finally, the six-year gap in usable data led *NN* to compare the 2001–03 numbers for each individual plant to its own numbers for 1992–94 and earlier. Of the 102 plants that have operated for that long, 93 had higher capacity factors in 2001–03 than they had in any three-year period up to and including 1992–94. (This breaks down to 60 of the 67 PWRs, and 33 of the 35 BWRs.) Among the 33 multi-unit sites, the 2001–03 factor was higher at 32 sites than any of the factors at those sites through 1992–94.

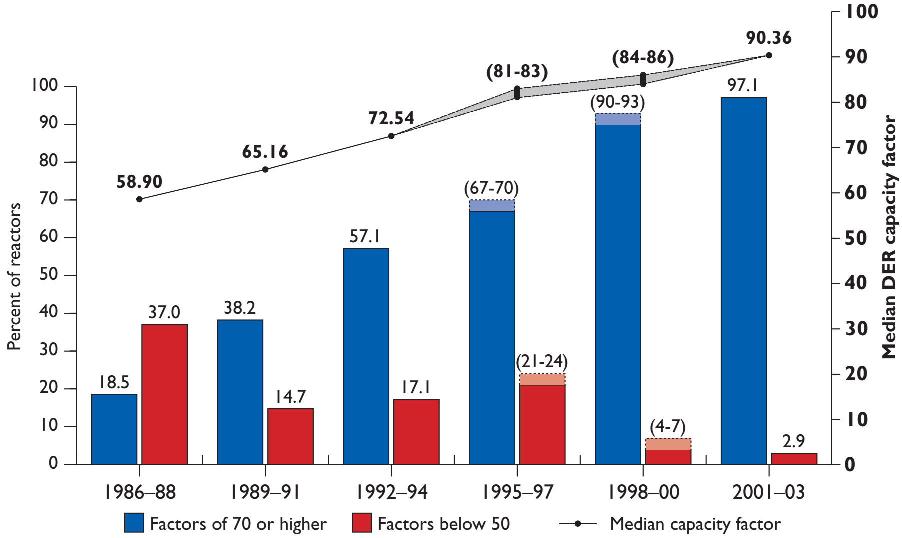

Fig. 2: Boiling Water Reactors. The arrangement is the same as in Fig. 1. This appears to be the biggest success story of all, with the median capacity factor rising by more than 30 percentage points and the bar chart changing from twice as many sub-50s as over-70s to nearly unanimous over-70s (with Browns Ferry-1 as the only exception). There were 27 BWRs in service in 1986–88, 34 in 1989–91, and 35 in every period since then.

Evolving the survey

There are surely several reasons for the continuing improvement in performance, perhaps among them owner/operator changes, risk-informed regulation, accumulated experience, instrumentation upgrades, etc. Indeed, developments such as these may lead to more meaningful breakdowns of the data than some of those used in past years. For instance, the old dividing lines used here to separate small, medium, and large reactors have in some cases been crossed by reactors that have been uprated, so it no longer seems reasonable to look at performance trends by reactor size. Also, average capacity factors by individual utilities would be garbled now by the ownership changes of a number of plants. And because there are only six operating reactors less than 12 years old, there does not seem to be anything significant to be gleaned by grouping the reactors by age.

Next year, however, some attempt will be made to look at trends within groups of reactors. Among the groups being considered: reactors that have changed ownership or operator (and those that have not); those that have already undergone license renewal (and those still in the pipeline); those that have gone through one or more of the three types of uprating (and those that have not been physically altered to that extent); performance before, and after, major equipment changeouts (steam generators, turbines, vessel heads, etc.). Whether it will be feasible to gather the extra data needed to do these analyses remains to be seen, so none of the above are promised.

Also next year, *NN* plans to assemble some kind of concise answer to the question begged by both the extremely high level of performance at several reactors, and by the near-universal improvement throughout the industry: How did this happen? Did the general atmosphere of electricity deregulation (still not a factor in all states) instill in managers an enterprise approach to nuclear generation? Did the utilities that have not sold their nuclear plants feel the need to perform better, perhaps to hold off acquisition attempts in the future? Did the evolution in the NRC's approach to oversight create opportunities for higher performance without adverse effects on safety and the environment? Anecdotally, all of these may be true, to some extent. But this is a survey that seeks to make conclusions from hard numbers. Perhaps next year there will be enough of the latter to arrive at the former. **NN**

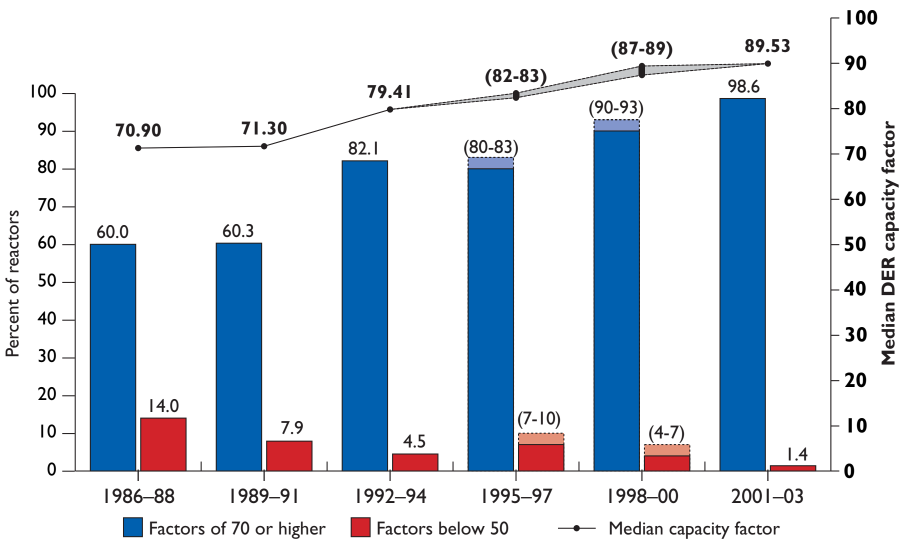

Fig. 3: Pressurized Water Reactors. The arrangement is the same as in Fig. 1. Although the median had improved in each period, there may have been a slight rise in poor performances in the mid-1990s (as there apparently was with BWRs), brought about by some prolonged outages; eight reactors were out of service for all of 1997, and others had low outputs then and in neighboring years. The numbers for 1998–2000 are not precise, but while the PWRs may have improved again in 2001–03, it was only slightly, and this group may be close to the highest level it can reasonably reach. There were 50 PWRs in service in 1986–88, 64 in 1989–91, 67 in 1992–94, 68 in 1995–97, and 69 in the last two periods.