Fact Sheet

United States Nuclear Regulatory Commission
Office of Public Affairs
Washington DC 20555
Telephone: 301/415-8200 E-mail: opa@nrc.gov

Power Uprates for Nuclear Plants

Background

Utilities have been using power uprates since the 1970s as a way to increase the power output of their nuclear plants. As of April 2003, the NRC has completed 92 such reviews resulting in a gain of approximately 12,067 MWt (megawatts thermal) or 4,022 MWe (megawatts electric) at existing plants (see Table 1). Collectively, an equivalent of more than three nuclear power plant units has been gained through implementation of power uprates at existing plants. NRC licensees have indicated they plan to ask for power uprates over the next five years, that if approved, would add another 6,809 MWt (2,270 MWe) to the nation's generating capacity.

Discussion

To increase the power output of a reactor, typically a more highly enriched uranium fuel is added. This enables the reactor to produce more thermal energy and therefore more steam, driving a turbine generator to produce electricity. In order to accomplish this, components such as pipes, valves, pumps, heat exchangers, electrical transformers and generators, must be able to accommodate the conditions that would exist at the higher power level. For example, a higher power level usually involves higher steam and water flow through the systems used in converting the thermal power into electric power. These systems must be capable of accommodating the higher flows.

In some instances, licensees will modify and/or replace components in order to accommodate a higher power level. Depending on the desired increase in power level and original equipment design, this can involve major and costly modifications to the plant such as the replacement of main turbines. All of these factors must be analyzed by the licensee as part of a request for a power uprate, which is accomplished by amending the plant's operating license. The analyses must demonstrate that the proposed new configuration remains safe and that measures continue to be in place to protect the health and safety of the public. These analyses are reviewed by the NRC before a request for a power uprate is approved.

Power uprates can be classified in three categories: (1) measurement uncertainty recapture power uprates, (2) stretch power uprates, and (3) extended power uprates.

1) Measurement uncertainty recapture power uprates are power increases less than two percent and are achieved by using enhanced techniques for calculating reactor power. This involves the use of state-of-the-art devices to more precisely measure feedwater flow which is used to calculate reactor power. More precise measurements reduce the degree of uncertainty in the power level which is used by analysts to predict the ability of the reactor to be safely shut down under some accident conditions.

2) Stretch power uprates are typically on the order of up to seven percent and usually involve changes to instrumentation settings. Stretch power uprates generally do not involve major plant modifications. This is especially true for boiling-water reactor plants. In some limited cases where plant equipment was operated near capacity prior to the power uprate, more substantial changes may be required.

3) Extended power uprates are usually greater than stretch power uprates and have been approved for increases as high as 20 percent. Extended power uprates usually require significant modifications to major pieces of plant equipment such as the high pressure turbines, condensate pumps and motors, main generators, and/or transformers.

Review Process

Power uprates are submitted to NRC as license amendment requests. The applications and reviews are complex and involve many areas of NRC including various technical divisions of the Office of Nuclear Reactor Regulation and the Office of the General Counsel. Some reviews may also involve the Office of Nuclear Regulatory Research and the Advisory Committee on Reactor Safeguards. In evaluating a power uprate request, NRC reviews data and accident analyses submitted by a licensee to confirm that the plant can operate safely at the higher power level. Reviews of power uprate requests are a high priority and are therefore, being conducted on accelerated schedules.

Regulatory Issue Summary (RIS) 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications," dated January 31, 2002, covers analyses of the effect of the power uprate on things such as electrical equipment, major plant systems, and emergency operating procedures. The RIS outlines the staff's information needs for reviewing measurement uncertainty recapture power uprate applications and is intended to result in a more efficient and effective review process. Standardization of licensee's submittals, improvements in the quality of submittals, and more focused reviews by the staff could improve the timeliness of power uprate reviews.

Based on results of its industry survey, NRC expects to receive only four stretch power uprates over the next five years. Therefore, NRC's efforts for improving the power uprate application and review processes initially focused on measurement uncertainty and extended power uprates. Efficiencies gained there will be applied to improve the stretch power uprate review process.

Reviews of extended power uprate applications were initially estimated to take up to 18 months, but have been completed more quickly. The Duane Arnold, Dresden 2 and 3, and Quad Cities 1 and 2 extended power uprates were completed in just under 12 months. This included coordination and review with the NRC's Advisory Committee for Reactor Safeguards -- an independent panel of technical experts from diverse fields that advises the Commission.

To keep the public informed of its activities, NRC publishes a notice in the *Federal Register* (1) when it receives a request from a licensee for a power uprate, giving the public the opportunity to request a hearing; (2) after a finding of no significant environmental impact is made, if applicable; and (3) if a power uprate is approved. A press release is also issued if a power uprate is approved.

Current Status

Plant-Specific Applications Under Review
The NRC usually has several applications for power uprates under review at any given time. An updated list of applications under review can be found on the NRC's Web site at this address: http://www.nrc.gov/reactors/operating/licensing/power-uprates/pending-applications.html .

Future Actions

Licensees have told NRC they plan to submit 35 power uprate applications in the next five years as follows:

- 18 extended power uprates
- 4 stretch power uprates
- 13 measurement uncertainty recapture power uprates

Based on the information provided, planned power uprates are expected to result in an increase of about 6809 MWt. An updated list of anticipated future applications can be found on the NRC's Web site at this address:
http://www.nrc.gov/reactors/operating/licensing/power-uprates/expected-applications.html .

Tables

- Table 1 - Approved Power Uprates as of March 2003
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- Table 3 - Expected Future Submittals for Power Uprates as of March 2003

Table 1 - Approved Power Uprates as of March 2003

(TYPE -- S = Stretch; E = Extended; MU = Measurement Uncertainty Recapture)

NO.	Plant	% Uprate	Mwt	Year Approved	TYPE
1	Calvert Cliffs 1	5.5	140	1977	S
2	Calvert Cliffs 2	5.5	140	1977	S
3	Millstone 2	5	140	1979	S
4	H. B. Robinson	4.5	100	1979	S
5	Fort Calhoun	5.6	80	1980	S
6	St. Lucie 1	5.5	140	1981	S
7	St. Lucie 2	5.5	140	1985	S
8	Duane Arnold	4.1	65	1985	S
9	Salem 1	2	73	1986	S
10	North Anna 1	4.2	118	1986	S
11	North Anna 2	4.2	118	1986	S
12	Callaway	4.5	154	1988	S
13	TMI-1	1.3	33	1988	S
14	Fermi 2	4	137	1992	S
15	Vogtle 1	4.5	154	1993	S
16	Vogtle 2	4.5	154	1993	S
17	Wolf Creek	4.5	154	1993	S
18	Susquehanna 2	4.5	148	1994	S
19	Peach Bottom 2	5	165	1994	S
20	Limerick 2	5	165	1995	S
21	Susquehanna 1	4.5	148	1995	S
22	Nine Mile Point 2	4.3	144	1995	S
23	WNP-2	4.9	163	1995	S
24	Peach Bottom 3	5	165	1995	S
25	Surry 1	4.3	105	1995	S
26	Surry 2	4.3	105	1995	S
27	Hatch 1	5	122	1995	S
28	Hatch 2	5	122	1995	S
29	Limerick 1	5	165	1996	S

30	V. C. Summer	4.5	125	1996	S
31	Palo Verde 1	2	76	1996	S
32	Palo Verde 2	2	76	1996	S
33	Palo Verde 3	2	76	1996	S
34	Turkey Point 3	4.5	100	1996	S
35	Turkey Point 4	4.5	100	1996	S
36	Brunswick 1	5	122	1996	S
37	Brunswick 2	5	122	1996	S
38	Fitzpatrick	4	100	1996	S
39	Farley 1	5	138	1998	S
40	Farley 2	5	138	1998	S
41	Browns Ferry 2	5	164	1998	S
42	Browns Ferry 3	5	164	1998	S
43	Monticello	6.3	105	1998	E
44	Hatch 1	8	205	1998	E
45	Hatch 2	8	205	1998	E
46	Comanche Peak 2	1	34	1999	MU
47	LaSalle 1	5	166	2000	S
48	LaSalle 2	5	166	2000	S
49	Perry	5	178	2000	S
50	River Bend	5	145	2000	S
51	Diablo Canyon 1	2	73	2000	S
52	Watts Bar	1.4	48	2001	MU
53	Byron 1	5	170	2001	S
54	Byron 2	5	170	2001	S
55	Braidwood 1	5	170	2001	S
56	Braidwood 2	5	170	2001	S
57	Salem 1	1.4	48	2001	MU
58	Salem 2	1.4	48	2001	MU
59	San Onofre 2	1.4	48	2001	MU
60	San Onofre 3	1.4	48	2001	MU
61	Susquehanna 1	1.4	48	2001	MU

62	Susquehanna 2	1.4	48	2001	MU
63	Hope Creek	1.4	46	2001	MU
64	Beaver Valley 1	1.4	37	2001	MU
65	Beaver Valley 2	1.4	37	2001	MU
66	Shearon Harris	4.5	138	2001	S
67	Comanche Peak 1	1.4	47	2001	MU
68	Comanche Peak 2	0.4	13	2001	MU
69	Duane Arnold	15.3	248	2001	E
70	Dresden 2	17	430	2001	E
71	Dresden 3	17	430	2001	E
72	Quad Cities 1	17.8	446	2001	E
73	Quad Cities 2	17.8	446	2001	E
74	Waterford 3	1.5	51	2002	MU
75	Clinton	20	579	2002	E
76	South Texas 1	1.4	53	2002	MU
77	South Texas 2	1.4	53	2002	MU
78	ANO-2	7.5	211	2002	E
79	Sequoyah 1	1.3	44	2002	MU
80	Sequoyah 2	1.3	44	2002	MU
81	Brunswick 1	15	365	2002	E
82	Brunswick 2	15	365	2002	E
83	Grand Gulf	1.7	65	2002	MU
84	H. B. Robinson	1.7	39	2002	MU
85	Peach Bottom 2	1.62	56	2002	MU
86	Peach Bottom 3	1.62	56	2002	MU
87	Indian Point 3	1.4	42.4	2002	MU
88	Point Beach 1	1.4	21.5	2002	MU
89	Point Beach 2	1.4	21.5	2002	MU
90	Crystal River 3	0.9	24	2002	S
91	D.C. Cook 1	1.66	54	2002	MU
92	River Bend	1.7	52	2003	MU

Table 2 - Power Uprates Currently Under Review as of March 2003

(TYPE -- S = Stretch; E = Extended; MU = Measurement Uncertainty Recapture)

No.	Plant	% Uprate	MWt	Submittal Date	Projected Completion Date	Type
1	Davis-Besse	1.63	45	10/12/01	TBD	MU
2	Palo Verde 2	2.9	114	12/21/01	June 2003	S
3	Pilgrim	1.5	30	07/05/02	April 2003	MU
4	D.C. Cook 2	1.66	54	11/15/02	May 2003	MU
5	Indian Point 2	1.4	42.4	12/12/02	June 2003	MU
6	Hatch 1	1.5	41	12/24/02	June 2003	MU
7	Hatch 2	1.5	41	12/24/02	June 2003	MU
8	Kewaunee	1.4	23	01/13/03	July 2003	MU

Table 3 - Expected Future Submittals for Power Uprates as of March 2003

Fiscal Year	Total Uprates Expected	Measurement Uncertainty Recapture Uprates	Stretch Power Uprates	Extended Power Uprates	Megawatts Thermal	Approximate Megawatts Electric
2003	10	2	1	7	2801	934
2004	10	3	3	4	1962	654
2005	5	2	0	3	481	160
2006	6	6	0	0	279	93
2007	4	0	0	4	1286	429
TOTAL	**35**	**13**	**4**	**18**	**6809**	**2270**

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