

Online Appendix

Deregulation and Investment in Generation Capacity: Evidence from Nuclear Power Uprates in the United States

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Online Appendix A: Three Types of Nuclear Uprates

Measurement uncertainty recaptures (MURs)

MURs involve a less than 2 percent of increase in power output, achieved by replacing traditional flow meters with ultrasonic flow measurement devices to more precisely measure feedwater flow (which is used to calculate reactor power and is directly proportional to thermal power level). In early 1990s, several groups of partner utilities and equipment vendors began development of ultrasonic flow measurement technologies that enable significantly more accurate and stable measurement of feedwater flow than traditional flow meters. Consequently the NRC has supported MUR power uprates by allowing reactors with ultrasonic flow measurement devices to reduce measurement uncertainty margin from 2 to around 0.6 percent.

Comanche Peak Unit 2 (a Westinghouse 4-Loop PWR) in Texas submitted the first MUR application in 1998 (U.S. NRC, 1999). As of September 12, 2013, 63 MUR applications (16 for BWRs and 47 for PWRs) have been submitted to the NRC, resulting in a cumulative 2,875.6 MWt of additional reactor thermal power capacity in the U.S. nuclear fleet.

Stretch power uprates (SPUs)

SPUs typically achieve up to a 7 percent increase in thermal power level, usually by taking advantage of design margins that were previously built into reactors but have become too conservative with current technologies (Thomas, 2009). The original licensed thermal level of a reactor is based on the vendor guaranteed power level, which is different from the design power level (the difference is often referred to as "stretch power"). Since it is the design power level that determines the specifications for major nuclear steam supply system (NSSS) equipments, increasing the rated thermal power limit does not violate the design parameters of the NSSS equipment, nor significantly impacts its reliability (U.S. NRC, 1992). SPUs focus on changes to operating procedures, technical specifications and instrumentation set points, and generally involve only moderate equipment replacement. The percentage power increase that a SPU can achieve depends on the particulars of a reactor's design (Hansen, 2007).

In 1977, the NRC approved the first two SPU applications for Calvert Cliffs Unit 1 and 2 in Maryland. As of September 12, 2013, 22 SPU applications for BWRs and 42 for PWRs have been submitted to the NRC, totaling an additional 8,475.2 MWt of reactor thermal power.

Extended power uprates (EPUs)

EPUs can achieve up to a 20 percent increase in the thermal power level, and require significant modifications to major BOP equipments such as high pressure turbines, condensate pumps and motors, main generators and transformers. They also involve advanced fuel designs developed to eliminate "early burnout" and are less vulnerable to vibration and fretting (Hansen, 2007; Thomas, 2009). An EPU can also be combined with a maintenance upgrade and/or a license extension, to not only allow cost sharing but make the EPU more attractive financially because of a longer plant life. Future outage risks can also be reduced with upgrading and modification in major equipments (Fabian, 2005; Thomas, 2009).

However, EPUs, even with major plant modifications, are not risk free. Increased thermal output leads to greater thermal input into the plant systems and components, potentially accelerating degradation in pipes and other components and adding burden on pumps, bearings, and seals (Thomas, 2009). Increased mass flow might raise flow-induced vibration levels in the systems and components to unacceptable levels or change the frequency of the exciting forces.¹ Furthermore, BOP component replacements are generally larger and heavier, and structures supporting these components often need to be strengthened. Therefore, it is both costly (often in hundreds of million dollars) and challenging for a reactor to perform an EPU. Even side-by-side “identical” plants often require separate plans for the same EPU (Thomas, 2009).

GE Nuclear Energy first initiated its “extended” power uprate program in 1995 to support BWRs to achieve between 5 and 20 percent of power uprates (U.S. NRC, 1998). The Monticello Nuclear Generating Plant in Minnesota was the first BWR plant (GE/3) that requested an EPU, amounting to an increase of about 6.3 percent in power level (approved by the NRC in 1998). As of September 12, 2013, 23 EPU applications for BWRs and 11 for PWRs have been applied to the NRC, adding 12,197 MWt of reactor thermal power.

¹ For example, increased steam flow created an unexpected acoustic resonance at Quad Cities Units 1&2 in Illinois (GE/3 BWRs; 17.8% EPU approved by the NRC in 2001), causing damage to the steam dryer.

Online Appendix B: Data Description

We focus on power uprates applications submitted to the NRC between 1991 and 2012, by nuclear reactors owned by investor-owned-utilities (IOUs) or independent power producers (IPPs).² We choose year 1991 as the starting year for our analysis, since information on some control variables used in our analyses, such as the yearly electricity sale at the state level was not available until 1990. Also prior to 1991 the U.S. nuclear industry had not been very active in performing power uprates: only 14 SPUs had been applied for as of the end of 1990.

There are 104 nuclear reactors in the U.S. We exclude eight reactors that are either exclusively or majorly owned by federal, state, municipal agencies, or electric cooperatives. Five Reactors owned by a diverse mix of an investor-owned utility, electric cooperatives, and municipality groups with the ownership of investor-owned utilities less than 50% are also excluded.³ Out of the remaining 91 reactors,⁴ only 3 had the same type of uprate application more than once, due to plant-specific circumstances, which are likely outliers.⁵ These three reactors are also excluded in our analyses (the results are similar if they are included). Thus we focus on the 88 investor-owned reactors that did not apply for the same type of power uprate more than once.

We use power uprate applications rather than approved uprates by the NRC, due to the lag between filing applications by nuclear plants and NRC approval. Almost all the power uprate applications in the data have been approved by the NRC without significant modification to requested amount of uprates; the only exceptions are two cases where nuclear plants decided to withdraw or put on hold uprate applications: (1) one EPU application in Crystal River plant (filed in June, 2011) had been withdrawn by the applicant since the plant owner decided to permanently shut down the reactor; (2) three MUR applications in Oconee plant (filed in September, 2011) are on hold per request of applicant. Both Crystal River plant and Oconee plants are regulated.

The data contains information on the date of application to the NRC for each power uprate, allowing us to determine the year that the application was submitted.

The detailed information about nuclear reactors' Power Urate applications and Operating License Renewal applications is included in Table B1.

² Information of power uprates applications (including both approved and pending) is publicly available from the NRC website: "Approved Applications for Power Uprates." <http://www.nrc.gov/reactors/operating/licensing/power-uprates/status-power-apps/approved-applications.html>; and "Pending Applications for Power Uprates." <http://www.nrc.gov/reactors/operating/licensing/power-uprates/status-power-apps/pending-applications.html>.

³ Plant ownership is based on information from federal or state agencies, and SEC filings of reactors involved.

⁴ These 91 reactors submitted to the NRC a total of 132 power uprate applications between 1991 and 2012.

⁵ The owners of these three reactors applied for a same type of uprate twice, include: (1) Monticello (GE/3) in Minnesota, which had two EPU applications in 1996 and 2008 respectively. As the pilot plant for General Electric Nuclear Energy EPU program in mid-1990s, Owners of Monticello requested the first ever EPU in 1996, and thus later decided to seek another EPU in 2008; (2) Comanche Peak Unit 2 (Westinghouse 4-Loop), which had two MUR applications. The reactor was the pilot reactor that its owner submitted the first ever MUR application to the NRC in 1998. After the first MUR application (one percent increase) was approved by the NRC in 1999, the owners submitted the second MUR application (0.4 percent) in 2001; (3) Crystal River Unit 3 (Babcock & Wilcox), which had two SPU applications. After the first SPU in 1981, the plant owner, with better understanding of plant operation, decided to exploit another SPU potential in 2002, requesting a minimal 0.9 percent increase in thermal power.

Table B1: US Nuclear Power Reactors and its Power Uprates/Operating License Renewal Applications

Power Reactor			Power Uprates					Operating License Renewal		
State	Name	Type	Type	%	MWt	Application Date	Approval Date	Application Date	Renewal Date	Expiration Date
AL	Joseph M. Farley 1	PWR	S	5.0	138.0	02/14/97	04/29/98	09/15/03	05/12/05	06/25/37
	Joseph M. Farley 2	PWR	S	5.0	138.0	02/14/97	04/29/98	09/15/03	05/12/05	03/31/41
AR	Arkansas Nuclear One 1	PWR						02/01/00	06/20/01	05/20/34
	Arkansas Nuclear One 2	PWR	E	7.5	211.0	12/19/00	04/24/02	10/15/03	06/30/05	07/17/38
CA	Diablo Canyon 1	PWR	S	2.0	73.0	12/31/99	10/26/00	11/24/09	Under review	11/02/24
	Diablo Canyon 2	PWR						11/24/09	Under review	08/26/25
	San Onofre 2	PWR	MU	1.4	48.0	04/03/01	07/06/01			*
	San Onofre 3	PWR	MU	1.4	48.0	04/03/01	07/06/01			*
CT	Millstone 2	PWR	S	5.0	140.0	#	06/25/79	01/22/04	11/28/05	07/31/35
	Millstone 3	PWR	S	7.0	239.0	07/13/07	08/12/08	01/22/04	11/28/05	11/25/45
FL	Crystal River 3	PWR	S	3.8	92.0	11/29/78	07/21/81	12/18/08	**	**
			S	0.9	24.0	06/05/02	12/04/02			
			MU	1.6	41.0	04/25/07	12/26/07			
			E	15.5	405.0	06/15/11	**			
	St. Lucie 1	PWR	S	5.5	140.0	11/14/80	11/23/81	11/30/01	10/02/03	03/01/36
			E	11.9	320.0	11/22/10	07/09/12			
	St. Lucie 2	PWR	S	5.5	140.0	11/23/81	03/01/85	11/30/01	10/02/03	04/06/43
			E	11.9	320.0	02/25/11	09/24/12			
	Turkey Point 3	PWR	S	4.5	100.0	12/18/95	09/26/96	09/11/00	06/06/02	07/19/32
			E	15.0	344.0	10/21/10	06/15/12			
Turkey Point 4	PWR	S	4.5	100.0	12/18/95	09/26/96	09/11/00	06/06/02	04/10/33	
		E	15.0	344.0	10/21/10	06/15/12				
GA	Edwin I. Hatch 1	BWR	S	5.0	122.0	01/13/95	08/31/95	03/01/00	01/15/02	08/06/34
			E	8.0	205.0	08/08/97	10/22/98			
			MU	1.5	41.0	12/19/02	09/23/03			
	Edwin I. Hatch 2	BWR	S	5.0	122.0	01/13/95	08/31/95	03/01/00	01/15/02	06/13/38
			E	8.0	205.0	08/08/97	10/22/98			
	Vogtle 1	PWR	MU	1.5	41.0	12/19/02	09/23/03			
S			4.5	154.0	02/28/92	03/22/93	06/29/07	06/03/09	01/16/47	
			MU	1.7	60.6	08/28/07	02/27/08			

Power Reactor			Power Uprates					Operating License Renewal		
State	Name	Type	Type	%	MWt	Application Date	Approval Date	Application Date	Renewal Date	Expiration Date
GA	Vogtle 2	PWR	S	4.5	154.0	02/28/92	03/22/93	06/29/07	06/03/09	02/09/49
			MU	1.7	60.6	08/28/07	02/27/08			
IL	Braidwood 1	PWR	S	5.0	170.0	07/05/00	05/04/01	05/29/13	Under review	10/17/26
			MU	1.6	58.4	06/23/11	02/04/14			
	Braidwood 2	PWR	S	5.0	170.0	07/05/00	05/04/01	05/29/13	Under review	12/18/27
			MU	1.6	58.4	06/23/11	02/07/14			
	Byron 1	PWR	S	5.0	170.0	07/05/00	05/04/01	05/29/13	Under review	10/31/24
			MU	1.6	58.4	06/23/11	02/07/14			
	Byron 2	PWR	S	5.0	170.0	07/05/00	05/04/01	05/29/13	Under review	11/06/26
			MU	1.6	58.4	06/23/11	02/07/14			
	Clinton	BWR	E	20.0	579.0	06/18/01	04/05/02		<i>N/A</i>	09/29/26
	Dresden 2	BWR	E	17.0	430.0	12/27/00	12/21/01	01/03/03	10/28/04	12/22/29
	Dresden 3	BWR	E	17.0	430.0	12/27/00	12/21/01	01/03/03	10/28/04	01/12/31
	La Salle 1	BWR	S	5.0	166.0	07/14/99	05/09/00	12/09/14	Under review	04/17/22
			MU	1.6	57.0	01/27/10	09/16/10			
	La Salle 2	BWR	S	5.0	166.0	07/14/99	05/09/00	12/09/14	Under review	12/16/23
			MU	1.6	57.0	01/27/10	09/16/10			
	Quad Cities 1	BWR	E	17.8	446.0	12/27/00	12/21/01	03/03/03	10/28/04	12/14/32
	Quad Cities 2	BWR	E	17.8	446.0	12/27/00	12/21/01	03/03/03	10/28/04	12/14/32
IA	Duane Arnold	BWR	S	4.1	65.0	08/17/84	03/27/85	10/01/08	12/16/10	02/21/34
			E	15.3	248.0	11/16/00	11/06/01			
KS	Wolf Creek 1	PWR	S	4.5	154.0	01/05/93	11/10/93	10/04/06	11/20/08	03/11/45
LA	River Bend 1	BWR	S	5.0	145.0	07/30/99	10/06/00		<i>N/A</i>	08/29/25
		BWR	MU	1.7	52.0	05/14/02	01/31/03			
	Waterford 3	PWR	MU	1.5	51.0	09/21/01	03/29/02		<i>N/A</i>	12/18/24
		PWR	E	8.0	275.0	11/13/03	04/15/05			
MD	Calvert Cliffs 1	PWR	S	5.5	140.0	10/01/76	09/09/77	04/10/98	03/23/00	07/31/34
			MU	1.4	37.0	08/29/08	07/22/09			
MD	Calvert Cliffs 2	PWR	S	5.5	140.0	07/13/77	10/19/77	04/10/98	03/23/00	08/13/36
			MU	1.4	37.0	08/29/08	07/22/09			
MA	Pilgrim 1	BWR	MU	1.5	30.0	07/05/02	05/09/03	01/27/06	05/29/12	06/08/32

Power Reactor			Power Uprates					Operating License Renewal		
State	Name	Type	Type	%	MWt	Application Date	Approval Date	Application Date	Renewal Date	Expiration Date
MI	Donald C. Cook 1	PWR	MU	1.7	54.0	06/28/02	12/20/02	10/31/03	08/30/08	10/25/34
	Donald C. Cook 2	PWR	MU	1.7	57.0	11/15/02	05/02/03	10/31/03	08/30/05	12/23/37
	Fermi 2	BWR	S	4.0	137.0	09/24/91	09/09/92	04/30/14	Under review	03/20/25
			MU	1.6	56.0	02/07/13	02/10/14			
	Palisades	PWR	MU	1.4	35.4	06/03/03	06/23/04	03/31/05	01/17/07	03/24/31
MN	Monticello	BWR	E	6.3	105.0	07/26/96	09/16/98		11/08/06	09/08/30
			E	12.9	229.0	11/05/08	12/09/13			
	Prairie Island 1	PWR	MU	1.6	27.0	12/28/09	08/18/10		06/27/11	08/09/33
	Prairie Island 2	PWR	MU	1.6	27.0	12/28/09	08/18/10		06/27/11	10/29/34
MS	Grand Gulf 1	BWR	MU	1.7	65.0	01/31/02	10/10/02	11/01/11	Under review	11/01/24
			E	13.1	510.0	09/08/10	07/18/12			
MO	Callaway	PWR	S	4.5	154.0	03/31/87	03/30/88		N/A	10/18/24
NH	Seabrook 1	PWR	S	5.2	176.0	03/17/04	02/28/05	06/01/10	Under review	03/15/30
			MU	1.7	61.0	09/22/05	05/22/06			
NJ	Hope Creek 1	BWR	MU	1.4	46.0	12/01/00	07/30/01	08/18/09	07/20/11	04/11/46
			E	15.0	501.0	09/18/06	05/14/08			
	Oyster Creek 1	BWR						07/22/05	04/08/09	40/09/29
	Salem 1	PWR	S	2.0	73.0	08/06/85	02/06/86	08/18/09	06/30/11	08/13/36
			MU	1.4	48.0	11/10/00	05/25/01			
	Salem 2	PWR	MU	1.4	48.0	11/10/00	05/25/01	08/18/09	06/30/11	04/18/40
NY	R.E. Ginna	PWR	E	16.8	255.0	07/07/05	07/11/06	08/01/02	05/19/04	09/18/29
	Indian Point 2	PWR	MU	1.4	43.0	12/12/02	05/22/03	04/30/07	Under review	09/28/13
			S	3.3	101.6	01/29/04	10/27/04			
	Indian Point 3	PWR	MU	1.4	42.4	05/30/02	11/26/02	04/30/07	Under review	12/12/15
			S	4.9	148.6	06/03/04	03/24/05			
	James A. Fitzpatrick	BWR	S	4.0	100.0	#	12/06/96	07/01/06	09/08/08	10/17/34
	Nine Mile Point 1	BWR						05/27/04	10/31/06	08/22/29
	Nine Mile Point 2	BWR	S	4.3	144.0	#	04/28/95	05/27/04	10/31/06	10/31/46
			E	15.0	521.0	05/27/09	12/22/11			
NC	Brunswick 1	BWR	S	5.0	122.0	#	11/01/96	10/18/04	06/26/06	09/08/36
			E	15.0	365.0	08/09/01	05/31/02			

Power Reactor			Power Uprates					Operating License Renewal		
State	Name	Type	Type	%	MWt	Application Date	Approval Date	Application Date	Renewal Date	Expiration Date
NC	Brunswick 2	BWR	S	5.0	122.0	#	11/01/96	10/18/04	06/26/06	12/27/34
			E	15.0	365.0	08/09/01	05/31/02			
	McGuire 1	PWR	MU	1.7	58.0	03/05/12	05/16/13	06/14/01	12/05/03	06/12/41
	McGuire 2	PWR	MU	1.7	58.0	03/05/12	05/16/13	06/14/01	12/05/03	03/03/43
	Shearon Harris 1	PWR	S	4.5	138.0	10/04/00	10/12/01	11/16/06	12/17/08	10/24/46
MU			1.6	48.0	04/28/11	05/30/12				
OH	Davis Besse	PWR	MU	1.6	45.0	04/12/07	06/30/08	08/30/10	<i>Under review</i>	04/22/17
	Perry 1	BWR	S	5.0	178.0	09/09/99	06/01/00		N/A	03/18/26
PA	Beaver Valley 1	PWR	MU	1.4	37.0	01/18/01	09/24/01	08/28/07	11/05/09	01/29/36
			E	8.0	211.0	10/04/04	07/19/06			
	Beaver Valley 2	PWR	MU	1.4	37.0	01/18/01	09/24/01	08/28/07	11/05/09	05/27/47
			E	8.0	211.0	10/04/04	07/19/06			
	Limerick 1	BWR	S	5.0	165.0	12/09/93	01/24/96	06/22/11	10/20/14	10/26/44
			MU	1.6	57.0	03/25/10	04/08/11			
	Limerick 2	BWR	S	5.0	165.0	12/09/93	02/16/95	06/22/11	10/20/14	06/22/49
			MU	1.6	57.0	03/25/10	04/08/11			
	Peach Bottom 2	BWR	S	5.0	165.0	06/23/93	10/18/94	07/02/01	05/07/03	08/08/33
			MU	1.6	56.0	05/24/02	11/22/02			
E			12.4	437.0	09/28/12	08/25/14				
Peach Bottom 3	BWR	S	5.0	165.0	06/23/93	07/18/95	07/02/01	05/07/03	07/02/34	
		MU	1.6	56.0	05/24/02	11/22/02				
		E	12.4	437.0	09/28/12	08/25/14				
Susquehanna 1	BWR	S	4.5	148.0	#	02/22/95	09/13/06	11/24/09	07/17/42	
		MU	1.4	48.0	10/30/00	07/06/01				
		E	13.0	463.0	10/11/06	01/30/08				
Susquehanna 2	BWR	S	4.5	148.0	11/24/93	04/11/94	09/13/06	11/24/09	03/23/44	
		MU	1.4	48.0	10/30/00	07/06/01				
		E	13.0	463.0	10/11/06	01/30/08				
SC	Three Mile Island 1	PWR	S	1.3	33.0	04/18/88	07/26/88	01/08/08	11/22/09	04/19/34
	H.B. Robinson 2	PWR	S	4.5	100.0	#	06/29/79	06/17/02	04/19/04	07/31/30
	Oconee 1	PWR	MU	1.6	42.0	09/20/11	On Hold	07/07/98	05/23/00	02/06/33

Power Reactor			Power Uprates					Operating License Renewal		
State	Name	Type	Type	%	MWt	Application Date	Approval Date	Application Date	Renewal Date	Expiration Date
SC	Oconee 2	PWR	MU	1.6	42.0	09/20/11	<i>On Hold</i>	07/07/98	05/23/00	10/06/33
	Oconee 3	PWR	MU	1.6	42.0	09/20/11	<i>On Hold</i>	07/07/98	05/23/00	07/19/34
	V.C. Summer	PWR	S	4.5	125.0	08/18/95	04/12/96	08/06/02	04/23/04	08/06/42
TX	Comanche Peak 1	PWR	MU	1.4	47.0	04/05/01	10/12/01		<i>N/A</i>	02/08/30
			S	4.5	154.0	08/28/07	06/27/08			
	Comanche Peak 2	PWR	MU	1.0	34.0	12/21/98	09/30/99		<i>N/A</i>	02/02/33
			MU	0.4	13.0	04/05/01	10/12/01			
			S	4.5	154.0	08/28/07	06/27/08			
	South Texas Project 1	PWR	MU	1.4	53.0	08/22/01	04/12/02	10/28/10	<i>Under review</i>	08/20/27
South Texas Project 2	PWR	MU	1.4	53.0	08/22/01	04/12/02	10/28/10	<i>Under review</i>	12/15/28	
VT	Vermont Yankee 1	BWR	E	20.0	319.0	09/10/03	03/02/06	01/27/06	03/21/11	***
VA	North Anna 1	PWR	S	4.2	118.0	05/02/85	08/25/86	05/29/01	03/20/03	04/01/38
			MU	1.6	47.0	03/26/09	10/22/09			
	North Anna 2	PWR	S	4.2	118.0	05/02/85	08/25/86	05/29/01	03/20/03	08/21/40
			MU	1.6	47.0	03/26/09	10/22/09			
	Surry 1	PWR	S	4.3	105.0	08/30/94	08/03/95	05/29/01	03/20/03	05/25/32
			MU	1.6	41.0	01/27/10	09/24/10			
Surry 2	PWR	S	4.3	105.0	08/30/94	08/03/95	05/29/01	03/20/03	01/29/33	
		MU	1.6	41.0	01/27/10	09/24/10				
WA	Columbia Generating	BWR	S	4.9	163.0	07/09/93	05/02/95	01/20/10	05/22/12	12/20/43
WI	Kewaunee	PWR	MU	1.4	23.0	01/13/03	07/08/03	08/14/08	02/24/11	****
			S	6.0	99.0	05/22/03	02/27/04			
	Point Beach 1	PWR	MU	1.4	21.5	04/30/02	11/29/02	02/26/04	12/22/05	10/05/30
			E	17.0	260.0	04/07/09	05/03/11			
	Point Beach 2	PWR	MU	1.4	21.5	04/30/02	11/29/02	02/26/04	12/22/05	03/08/33
			E	17.0	260.0	04/07/09	05/03/11			

Note: (1) This table lists power uprates applications submitted to the US NRC before December 31, 2012 by utilities/IPPs for 91 investor-owned commercial power reactors, as well as operating license renewal applications. Power uprates applications submitted before 1990 are in gray shading and not included in regression analysis. (2) Information of operating license renewal (including both approved and pending) is publicly available from the NRC website: "Status of License Renewal Applications and Industry Activities." <http://www.nrc.gov/reactors/operating/licensing/renewal/applications.html>

* San Onofre Unit 2 and 3 were both permanently shut down on June 12, 2013 per commercial decision by Southern California Edison announced on June 7, 2013. See <http://www.songscommunity.com/news2013/news060713.asp>

** Crystal River Unit 3 applications were withdrawn by the Duke Energy on February 6, 2013, and the facility was permanently shut down on February 20, 2013. See <https://www.duke-energy.com/news/releases/2013020501.asp>

Power Reactor			Power Uprates					Operating License Renewal		
State	Name	Type	Type	%	MWt	Application Date	Approval Date	Application Date	Renewal Date	Expiration Date

*** Vermont Yankee Nuclear Power Station was permanently shut down on December 29, 2014 per commercial decision announced by Entergy on April 27, 2013. See http://www.entergy.com/News_Room/newsrelease.aspx?NR_ID=2769

**** Kewaunee Power Station was permanently shut down on May 7, 2013 per commercial decision by Dominion in fall 2012. See <http://dom.mediaroom.com/2013-05-07-Dominion-Shuts-Down-Kewaunee-Power-Station-Permanently>

Online Appendix C: Covariate Balance

Our empirical strategies hinge on the assumption that the two groups of reactors, eventually-deregulated and always-regulated, are *ex ante* similar, in terms of both observable and unobservable characteristics. Table C1 compares these two groups, distinguished by their reactor types (BWRs or PWRs). Both eventually-deregulated BWRs and PWRs are similar to the always-regulated counterparts, in terms of original licensed thermal power (in MWt) and reactor age. The major difference is their location: eventually-deregulated reactors (both BWRs and PWRs) are primarily in the NRC Region I (Northeast) and Region III (Midwest), whereas the majority of regulated reactors are in the NRC Region II (South) and Region IV (West).

Our analyses control for time-invariant reactor characteristics and time invariant factors that apply to all reactors. We also include a variety of time varying control variables such as growth in electricity demand and natural gas price at the state level to address the concern that deregulated and regulated reactors are located in different states. Various robustness tests are also conducted to assess whether selection bias could be influencing our estimates. The results from these robustness tests are similar to our main results, lending us confidence that, despite the location difference, always-regulated reactors provide a reasonably good counterfactual for deregulated reactors.

Table C1: Covariate balance, Eventually-deregulated versus Always-regulated reactors (1991 - 2012)

	Boiling Water Reactors (BWRs)			Pressurized Water Reactors (PWRs)		
Panel A: 76 reactors (excluding 12 reactors that had SPUs before 1991)						
	(1) Deregulated BWRs (n=22)	(2) Always- regulated BWRs (n=7)	(3) <i>p</i> -value (1) vs (2)	(4) Deregulated PWRs (n=22)	(5) Always- regulated PWRs (n=25)	(6) <i>p</i> -value (4) vs (5)
<u>Reactor Characteristics</u>						
Mean Original Licensed Thermal Power (in MWt)	2,848	2,827	.93	2,849	2,893	.82
Mean Reactor Age as of 2012	31.9	30.8	.67	30.7	31.1	.88
NRC Region						
Region I Percentage	59	0		36	0	
Region II Percentage	0	57		9	52	
Region III Percentage	41	0		41	16	
Region IV Percentage	0	43		14	32	
Panel B: 88 reactors (including 12 reactors that had SPUs before 1991)						
	(1) Deregulated BWRs (n=23)	(2) Always- regulated BWRs (n=7)	(3) <i>p</i> -value (1) vs (2)	(4) Deregulated PWRs (n=29)	(5) Always- regulated PWRs (n=29)	(6) <i>p</i> -value (4) vs (5)
<u>Reactor Characteristics</u>						
Mean Original Licensed Thermal Power (in MWt)	2,794	2,827	.89	2,820	2,865	.78
Mean Reactor Age as of 2012	32.1	30.8	.61	31.6	31.3	.82
NRC Region						
Region I Percentage	57	0		41	4	
Region II Percentage	0	57		17	51	
Region III Percentage	43	0		31	14	
Region IV Percentage	0	43		11.	31	

Note: Areas covered by US NRC Regions: Region I: CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, and DC; Region II: AL, FL, GA, KY, MS, NC, PR, SC, TN, VA, VI, and WV; Region III: IL, IN, IA, MI, MN, OH, and WI; Region IV: AK, AZ, AR, CA, CO, HI, ID, KS, LA, MO, MT, NE, NV, NM, ND, OK, OR, SD, TX, UT, U.S. Pacific Territories, WA, and WY.

Online Appendix D: Coefficients of Control Variables

With year indicators controlling for changes over time, both the electricity demand ($Sales_{i,t-1}$) at the state level and natural gas price ($NGPrice_{i,t-1}$) have no significant impacts on the probability of applying power uprates. Capacity markets ($CapacityCreditmarket_{i,t-1}$ or $ForwardCapacityMarket_{i,t-1}$) also have little effect on power uprates investments. Previous EPU status ($EPUstatus_{i,t-1}$) decrease the hazard rate of applying for another power uprate, while a previous MUR or SPU does not significantly change the probability. $Expiration_{i,t-1}$, the number of years left before reactor expiration, has no impacts on the probability of applying power uprate. $LER_{i,t-1}$, the number of licensee event reports submitted to NRC, used as a proxy for the reliability of nuclear plants, also has no impacts on the probability of applying power uprates. Finally, despite the estimated hazard-ratio of $Fleet_{i,t-1}$ is significant, its value is near one, indicating small impact on the probability of applying power uprates that hints decisions on power uprates may be highly individual reactor-dependent. The hazard-ratio estimates of $Extension_{i,t-1}$ are also insignificant.

Table D1: Effect of Deregulation on Overall Power Uprates Applications (Survival Analysis)

	Cox PH Regressions on Power uprates		
	(1)	(2)	(3)
Panel A: All observations, 1991-2012			
PUC_DEREG	2.855*** (.786)	2.877*** (.798)	2.496*** (.724)
Sales	.998 (.001)	.998 (.001)	.998 (.001)
NGPrice	.788 (.115)	.780* (.116)	.750* (.113)
Capacity Credit Market	.720 (.189)	.728 (.190)	.741 (.188)
Forward Capacity Market	.904 (.302)	.954 (.323)	.830 (.269)
MURstatus	1.359 (.953)	1.407 (.969)	2.541 (1.777)
SPUstatus	.582 (.271)	.563 (.267)	.628 (.281)
EPUstatus	.148* (.151)	.139* (.148)	.159* (.165)
Expiration		1.009 (.011)	1.007 (.012)
LER		.981 (.018)	.981 (.018)
Fleet			1.051** (.022)
Extension			.858 (.232)

Note: This table reports hazards ratio estimates of all control variables in Equation (1) with Cox Proportional Hazard regressions. An estimate of hazard ratio greater than one suggests positive impacts. See the note in Table 4. Standard errors in parentheses clustered at the reactor level. *** p<0.01, ** p<0.05, * p<0.1

Table D2: Effect of Capacity Markets and Potential Economies of Scale on Overall Power Uprates Applications

	Cox PH Regressions on Power Uprates	Linear Probability Panel Regressions on Power Uprates	Linear Panel Regressions on Reactor Thermal Power (% of the original licensed power level)
	(1)	(2)	(3)
Capacity Credit Market	.741 (.188)	-.0620** (.0254)	-.614** (.285)
ForwardCapacity Market	.830 (.269)	-.0245 (.0316)	-.341 (.373)
Fleet	1.051** (.022)	.00317 (.00369)	.0968* (.0536)
Electricity Demand (Sales)	X	X	X
Natural Gas Price (NGPrice)	X	X	X
Capacity Market (CapacityMkt)	X	X	X
Prior Uprate Status (PUstatus)	X	X	X
Reactor Characteristics (X)	X	X	X
Commercial Decisions (Z)	X	X	X

Note: In columns (1) to (3), we report hazards ratio estimates of *CapacityCreditMarket*, *ForwardCapacityMarket*, and *Fleet* in Equation (1) by running Cox Proportional Hazard regressions. An estimate of hazard ratio greater than one suggests positive impacts. In columns (4) to (6) and from columns (7) to (9), we report coefficient estimates of these variables in Equation (2), for probability of applying for power uprates and the maximum reactor thermal power, respectively, by running panel data regressions. Standard errors in parentheses clustered at the reactor level. The data covers all observations between 1991 and 2012. *** p<0.01, ** p<0.05, * p<0.1

**Online Appendix E: Nuclear Reactors Deregulated by State Public Utilities Commissions
(in alphabetical order by reactor name)**

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
Beaver Valley 1	PA	In Pennsylvania, the Customer Choice Act went into effect January 1, 1997. As a result of the Pennsylvania Public Utility Commission's final orders regarding restructuring plans submitted by FirstEnergy Corporation and Duquesne Light Company respectively, the nuclear electricity generation portion of these companies' business no longer meets the criteria of Statement of Financial Accounting Standards (SFAS) No. 71 as of June 30, 1998. (See Note 2)	1998
Beaver Valley 2	PA	Same as Beaver Valley 1	1998
Braidwood 1	IL	In December 1997, the Governor of Illinois signed into law the Illinois Electric Service Customer Choice and Rate Relief Law of 1997. Commonwealth Edison Company discontinued the application of regulatory accounting principles SFAS No.71 in December 1997 for the generation portion of its business and performed a SFAS No. 121 impairment analysis to evaluate the recoverability of its generating plant investments.	1998
Braidwood 2	IL	Same as Braidwood 1	1998
Byron 1	IL	Same as Braidwood 1	1998
Byron 2	IL	Same as Braidwood 1	1998
Calvert Cliffs 1	MD	Pursuant to Restructuring Order issued by Maryland Public Utility Commission on November 10, 1999, Baltimore Gas and Electric Company (BGE) discontinued application of SFAS No. 71 for its electric generation business. BGE later transferred Calvert Cliffs Nuclear Power Plant to a non-regulated affiliate, Constellation Energy, effective July 1, 2000.	1999
Calvert Cliffs 2	MD	Same as Calvert Cliffs 1	1999
Clinton	IL	In December 1997, the Governor of Illinois signed into law the Illinois Electric Service Customer Choice and Rate Relief Law of 1997, resulted in discontinued application of SFAS No. 71 for the generation segment of Illinois Power Company's business. Due to uncertainties of deregulated generation pricing in Illinois and due to various operation and management factors,	1998

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
		Illinois Power Company's Boards of Directors voted in December 1998 to sell or close Clinton nuclear plant. In December, 1999, Illinois Power Company sold Clinton nuclear plant, \$20 million for plant and no compensation for fuel inventory, to AmerGen Energy Company (AmerGen), a joint venture of PECO Energy and British Energy.	
Comanche Peak 1	TX	Texas Electric Choice Plan was passed in the 1999 session of the Texas Legislature that will restructure the electric utility in Texas. As a result of the 1999 Restructuring Legislation, the electricity generation portion of Texas Utilities Electric Company's business no longer meets the criteria to apply SFAS No. 71 as of June 30, 1999.	1999
Comanche Peak 2	TX	Same as Comanche Peak 2	1999
Davis Besse	OH	In July 1999, Ohio's new electric utility restructuring legislation was signed into law. FirstEnergy Corporation, on behalf of its Ohio electric utility operating companies, including Ohio Edison Company, Cleveland Electric Illuminating Company and Toledo Edison Company, refiled its transition plan under Ohio's new electric utility restructuring law on December 22, 1999. The application of SFAS No. 71 to Ohio Edison's generation business was discontinued with the issuance of the Public Utilities Commission of Ohio transition plan order. (See Note 3)	2000
Dresden 2	IL	Same as Braidwood 1	1998
Dresden 3	IL	Same as Braidwood 1	1998
Duane Arnold	IA	In January 2006, FPL Energy completed the acquisition of Duane Arnold nuclear plant from Interstate Power and Light Company (\$373 million for plant and no compensation for fuel inventory). FPL Energy operated Duane Arnold nuclear plant as one of its merchant fleets.	2006
Fermi 2	MI	Michigan Public Service Commission orders issued in 1997 and 1998 altered the regulatory process in Michigan and provided a plan for transition to competition for the generation business of Detroit Edison Company. Therefore, effective December 31, 1998, Detroit Edison Company's generation business no longer met the criteria of SFAS No. 71, including Fermi 2.	1999
Hope Creek 1	NJ	Pursuant to the terms of the Final Decision and Order issued August 24, 1999 by the New Jersey Board of Public Utilities under the New Jersey Energy Master Plan and the New Jersey Electric Discount and Energy Competition Act, Public Service Electric and Gas Company (PSE&G) no longer met the requirements of SFAS No. 71 for the electric generation portion of its business.	1999

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
		PSEG Power, LLC and its subsidiaries were formed in 1999 to acquire, own and operate the electric generation-related assets of PSE&G.	
Indian Point 2	NY	In May 1996 the New York Public Service Commission (NYPSC) issued an order in its Competitive Opportunities Proceeding endorsing a fundamental restructuring of the electric utility industry in New York State, based on competition in the generation and energy services sectors of the industry. In September 1997 the NYPSC approved a Settlement Agreement between Consolidated Edison Company of New York Inc. (Con Ed), the NYPSC staff and other parties. Under the Settlement Agreement, Con Ed continued application of SFAS No. 71 to nuclear electric supply portion of its business. However in February 2000, the Con Ed announced an auction process for the Indian Point 2 unit, the retired Indian Point 1 unit and related gas turbines. Entergy later purchased all these assets in September 2001 from Con Ed (\$502 million for plants and \$100 million for fuel inventory), and operated the Indian Point nuclear plant as one of its merchant fleets in wholesale energy markets.	2001
Indian Point 3	NY	In May 1996 the New York Public Service Commission (NYPSC) issued an order in its Competitive Opportunities Proceeding endorsing a fundamental restructuring of the electric utility industry in New York State, based on competition in the generation and energy services sectors of the industry. In 1997, the staff of New York Public Service Commission tentatively concluded that beyond the transition period (the period covered by the individual restructuring agreements), nuclear generation should operate on a competitive basis. In addition, the NYPSC staff concluded that a sale of generation plants to third parties is the preferred means of determining the fair market value of generation plants and offers the greatest potential for the mitigation of stranded costs. The New York Power Authority, which was also pursuing formation of a statewide nuclear operating company, submitted its comments in October 1997 with NYPSC, stated that a forced divestiture of the nuclear plants would add uncertainty to developing a statewide approach to operating the plants and requested that such a forced divestiture proposal be rescinded. However in absent of such statewide solution, Indian Point Unit 3 was sold to Entergy in November 2000 (\$636 million for both Indian Point 3 and FitzPatrick plants, and 171 million for both plants' fuel inventory). Entergy operated the Indian Point nuclear plant as one of its merchant fleets in wholesale energy markets.	2000
James A. Fitzpatrick	NY	Same as Indian Point 3, James A. Fitzpatrick was sold to Entergy in November 2000 (\$636 million for both Indian Point 3 and FitzPatrick plants, and 171 million for both plants' fuel	2000

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
		inventory). Entergy operated the Fitzpatrick nuclear plant as one of its merchant fleets in wholesale energy markets.	
Kewaunee	WI	In July 2005, Dominion Resources Inc. completed the acquisition of the Kewaunee nuclear power station from Wisconsin Public Service Corporation (\$15.4 million for plant and nuclear fuel inventories). Dominion Generation operated Kewaunee as one of its merchant fleets.	2005
La Salle 1	IL	Same as Braidwood 1	1998
La Salle 2	IL	Same as Braidwood 1	1998
Limerick 1	PA	In Pennsylvania, the Customer Choice Act went into effect January 1, 1997. Pursuant to the Customer Choice Act, in April 1997, the Pennsylvania Electric Company (PECO) filed with the Pennsylvania Public Utility Commission a comprehensive restructuring plan. PECO also discontinued the use of regulatory accounting SFAS No. 71 for its electric generation operations by end of 1997.	1998
Limerick 2	PA	Same as Limerick 1	1998
Millstone 2	CT	In April 1998, Connecticut enacted comprehensive electric utility restructuring legislation. The legislation required Connecticut Light and Power to divest its non-nuclear generating assets by January 2000 and its nuclear generating assets by January 2004. In 2000, Dominion Resources Inc. reached an agreement to acquire Millstone nuclear plant from subsidiaries of Northeast Utilities. The acquisition completed in March 2001 (for plants: #2 \$401.5 million and #3 \$790.5 Million; for fuel inventory: #2 \$41.9 million and #3 \$62.8 million). Dominion Generation operated Millstone nuclear plant as one of its merchant fleets.	2001
Millstone 3	CT	Same as Millstone 2	2001
Nine Mile Point 1	NY	In May 1996 the New York Public Service Commission (NYPSC) issued an order in its Competitive Opportunities Proceeding endorsing a fundamental restructuring of the electric utility industry in New York State, based on competition in the generation and energy services sectors of the industry. In 1997, the Niagara Mohawk Power Corporation (NMPC) entered into PowerChoice Agreement with the New York Public Service Commission. The PowerChoice Agreement contemplates that the NMPC's nuclear plants will remain part of the NMPC's regulated business. However the PowerChoice Agreement also stipulates that absent a statewide	2001

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
		New York Nuclear Operating Company, the NMPC would seek other proposals regarding its nuclear assets, including the feasibility of an auction, transfer and/or divestiture of such facilities. In January 1999, the NMPC announced plans to pursue the sale of its Nine Mile Point nuclear plants. In November 2001, Constellation Energy purchased Nine Mile Point Unit 1&2 (\$675 million for both plants, and \$87 million for both plants' fuel inventory), and operated the Nine Mile nuclear plant as one of its merchant fleets in wholesale energy market.	
Nine Mile Point 2	NY	Same as Nine Mile Point 1.	2001
North Anna 1	VA	In 1999, Virginia enacted the Virginia Restructuring Act that established a detailed plan to restructure Virginia's electric utility industry. Under the Virginia Restructuring Act, the generation portion of Virginia Electric and Power Co' Virginia jurisdictional operations is no longer subject to cost-based regulation. The legislation's deregulation of generation was an event that required Virginia Electric and Power Co. to discontinue the application of SFAS No. 71 to the Virginia jurisdictional portion of generation operations in the first quarter of 1999. In April 2007, the Virginia General Assembly passed legislation that returns the Virginia jurisdiction of Virginia Electric and Power Co's generation operations to cost of service rate regulation. As a result, Virginia Electric and Power Co reapplied the provisions of SFAS No. 71 to those generation operations on April 4, 2007.	1999 to 2007
North Anna 2	VA	Same as North Anna 1	1999 to 2007
Oyster Creek 1	NJ	In October 1999, GPU Nuclear Corp agreed to sell Oyster Creek nuclear generating station, \$10 million for plant and no compensation for fuel inventory, to AmerGen Energy Company, LLC (AmerGen), a joint venture of PECO Energy and British Energy. The transaction completed in 2000.	2000
Palisades	MI	In March 1999, Consumers Energy Company received Michigan Public Service Commission electric restructuring orders. Consistent with these orders, Consumers Energy Company discontinued application of SFAS No. 71 for the energy supply portion of its business in the first quarter of 1999.	1999
Peach Bottom 2	PA	Same as Limerick 1	1998
Peach Bottom 3	PA	Same as Limerick 1	1998

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
Perry 1	OH	Same as Davis Besse	1999
Pilgrim 1	MA	On November 25, 1997, Massachusetts enacted comprehensive electric utility industry restructuring legislation. As a result of the Massachusetts electric industry restructuring legislation and the Massachusetts Department of Telecommunications and Energy (DTE) order regarding the related Boston Edison Company settlement agreement, as of December 31, 1997, the provisions of SFAS No. 71 are no longer being applied to the generation business. The Massachusetts electric industry restructuring legislation also provided that an electric company must transfer or separate ownership of generation, transmission and distribution facilities into independent affiliates. In November 1998, Boston Edison Company signed an agreement with Entergy Nuclear Generating Company, an Entergy Corporation subsidiary, to sell its wholly owned nuclear generating unit, Pilgrim Nuclear Power Station (\$14 million for plant and \$67 million for fuel inventory). The transaction completed in July 1999.	1998
Point Beach 1	WI	In September 2007, FPL Energy completed the acquisition of Point Beach nuclear power plant from Wisconsin Electric Power Company (\$719 million for both Unit 1&2, and \$205 million for both fuel inventory). FPL Energy operated Point Beach nuclear plant as one of its merchant fleets.	2007
Point Beach 2	WI	Same as Point Beach 1	2007
Quad Cities 1	IL	Same as Braidwood 1	1998
Quad Cities 2	IL	Same as Braidwood 1	1998
R.E. Ginna	NY	In May 1996 the New York Public Service Commission (NYPSC) issued an order in its Competitive Opportunities Proceeding endorsing a fundamental restructuring of the electric utility industry in New York State, based on competition in the generation and energy services sectors of the industry. In November 1997 the NYPSC approved a Settlement Agreement between Rochester Gas and Electric Corp. (RG&E), the NYPSC staff and other parties. Under the Settlement Agreement, RG&E continued application of SFAS No. 71 to electric supply portion of its business, except certain operational costs associated with non-nuclear generation. Although the Settlement Agreement provided incentives for the sale of generating assets, it required neither divestiture of generating or other assets nor write off of stranded costs. Nevertheless in November 2003, RG&E signed an agreement to sell R.E. Ginna to Constellation	2004

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
		Generation Group LLP (\$408 million for plant and \$21 million for fuel inventory). The transaction completed in June 2004.	
Salem 1	NJ	Same as Hope Creek 1	1999
Salem 2	NJ	Same as Hope Creek 1	1999
Seabrook 1	NH	<p>The state of New Hampshire's attempted to restructure the electric utility industry in that state have resulted in extensive litigation in various federal and state courts. In 1996, New Hampshire enacted legislation requiring a competitive electric industry beginning in 1998. In February 1997, the New Hampshire Public Utilities Commission (NHPUC) issued its restructuring order, which would have forced Public Service Company of New Hampshire (PSNH) and North Atlantic Energy Corporation (NAEC) to write off all of their regulatory assets, and possibly to seek protection under Chapter 11 of the bankruptcy laws.</p> <p>Following the issuance of these orders, Public Service New Hampshire obtained injunctive relief on various grounds from federal district court that prevents implementation of the NHPUC's restructuring orders.</p> <p>In September 2000, the NHPUC approved a Settlement Agreement intended to settle most of these proceedings. The Settlement Agreement also requires PSNH to sell its generation assets and certain power contracts, including PSNH's current purchased-power contract with NAEC for the output from Seabrook. In December 2000, PSNH filed divestiture plans with the NHPUC seeking approval to begin the process of selling its fossil and hydroelectric generation assets and NAEC's ownership share of Seabrook.</p> <p>On December 3, 2001, JP Morgan, on behalf of the Connecticut Department of Public Utility Control (DPUC) and the NHPUC, announced the commencement of an auction that will lead to the sale of the Seabrook nuclear plant. In November 2002, FPL Energy completed the acquisition of Seabrook nuclear power plant (\$749.1 million for plant and decommission trust fund) and operated the Seabrook as one of its merchant fleets.</p>	2002
South Texas Project 1	TX	Texas Electric Choice Plan was passed in the 1999 session of the Texas Legislature that will restructure the electric utility in Texas. Effective June 30, 1999, the Reliant Energy Company discontinued the application of SFAS No. 71 to its electric generation operations.	1999
South Texas Project 2	TX	Same as South Texas Project 2	1999
Surry 1	VA	Same as North Anna	1999 to 2007

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
Surry 2	VA	Same as North Anna	1999 to 2007
Susquehanna 1	PA	In Pennsylvania, the Customer Choice Act went into effect January 1, 1997. Upon the issuance of the Pennsylvania PUC's restructuring order, Pennsylvania Power and Light Company (PP&L) discontinued application of SFAS 71 for the generation portion of its business effective June 30, 1998.	1998
Susquehanna 2	PA	Same as Susquehanna 1	1998
TMI 1	PA	In Pennsylvania, the Customer Choice Act went into effect January 1, 1997. In 1999, GPU Nuclear Corporation sold Three Mile Island Unit 1 nuclear generating station, \$23 million for plant and \$77 million for fuel inventory, to AmerGen Energy Company, LLC (AmerGen), a joint venture of PECO Energy and British Energy. This sale was completed on December 20, 1999.	2000
Vermont Yankee 1	VT	In March 2001, the board of Vermont Yankee Nuclear Power Corporation (VYNPC) voted to proceed to auction the plant. In August 2001, Entergy's domestic non-utility nuclear business agreed to purchase Vermont Yankee Nuclear Power Plant VYNPC (\$145 million for plant and \$35 million for fuel inventory), to be paid in cash upon closing. The transaction completed in July 2002.	2002

Notes:

- (1) State deregulation and relevant activities come from SEC filings of the reactors involved. Activities include removing generation assets from rate base, or nuclear plants divestitures. These information were cross - checked against U.S. Department of Energy, Energy Information Administration, "Status of Electricity Restructuring by State" retrieved from http://www.eia.gov/electricity/policies/restructuring/restructure_elect.html, and dockets from relevant state public utilities commissions.
- (2) Under traditional ratemaking practice, regulated electric utilities are granted exclusive geographic franchises to sell electricity. In return, the utilities are obligated to make investments and incur obligations to serve customers. Prudently incurred costs are recovered from customers along with a return on investment. Regulators may require utilities to defer collecting from customers some operating costs until a future date. These deferred costs are recorded as regulatory assets in the financial statements, in accordance with the criteria of Statement of Financial Accounting Standards (SFAS) No. 71, "Accounting for the Effects of Certain Types of Regulation."

As the generation portion of the utility industry moves toward competition, in July 1997, the Financial Accounting Standards Board (FASB) Emerging Issues Task Force (EITF) reached a consensus on Issue No. 97-4, "Deregulation of the Pricing of Electricity - Issues Related to the Application of FASB Statements No. 71, Accounting for the Effects of Certain Types of Regulation, and No. 101, Regulated Enterprises Accounting for the Discontinuation of Application of FASB Statement No. 71" (EITF No. 97-4). EITF No. 97-4 concluded that a company should no longer apply SFAS No. 71 to a segment, e.g. the electric generation portion of the business, which is subject to a deregulation plan at the time the deregulation legislation or enabling rate order contains sufficient detail for the utility to reasonably determine how the plan will affect the segment to be deregulated.
- (3) In October 1997, Cleveland Electric Illuminating Company and Toledo Edison Company discontinued application of SFAS 71 for their nuclear operations.

Reactor Name	State	Deregulation Activities	Year of Removal from Rate-Base
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(4) Data of plant sales is from Nuclear Energy Institute at <http://www.nei.org/Knowledge-Center/Nuclear-Statistics/US-Nuclear-Power-Plants/US-Nuclear-Plant-Sales>
