Nuclear Power Plant Construction: Paying the Bill

Over the next few years U.S. electric utilities will be asking for revenue increases to pay the cost of building some 50 nuclear power plants which are currently under construction (Table 1). Eighty-five billion dollars has been spent on these projects so far and, according to data provided by the utilities, an additional $45 billion will be needed to complete them. These revenue requests will, if granted, result in electricity rate hikes of unprecedented magnitude: a total increase in utilities' revenues of roughly $25 billion, or about 20 percent of 1982 levels would eventually be required. If requested rate increases are severely limited by the regulators, the financial condition of many of the utilities with nuclear construction projects would be further impaired

Because of the way most states regulate electric utility rates, the cost of constructing these plants has not yet been reflected in the electricity bills of customers. Instead, funds have been borrowed and raised through stock offerings. Only after the plants begin producing commercial power do customers begin to reimburse the utilities in cash for the costs incurred in building the plants, along with a competitive return on stockholders' investment. In addition, typical regulatory practice heavily loads the cost to consumers of new generating facilities in the first few years that the plant is in operation. In many affected areas all of this could mean jumps in customers' electricity bills upwards of 50 percent as soon as the plants begin commercial operation.

The sudden rate hikes that accompany the opening of nuclear plants (a phenomenon often called "rate shock") are likely to be especially unpopular, not only because of the unusually large size of the hikes, but also because in most cases neither more electrical power nor additional generating capacity is needed right now. In fact, in all but a few specific regions, such as New England, the United States has an excess of electrical-generating capacity.

Although at present it may look as if many new nuclear plants were poor investments, it is not certain that the construction of those plants that are eventually completed will appear to have been a bad idea in retrospect ten or twenty years from now. Demand for electrical power has recently started to escalate as economic growth rates have risen, and the replacement of imported petroleum and acid rain-generating coal as power plant fuels could produce substantial political, environmental, and economic benefits.

For the present, though, several utilities face serious difficulties There has already been a huge default in the case of the Washington Public Power Supply System (WPPSS). And currently, a number of investor-owned utilities—the Long Island Lighting Company (Lilco), Public Service of New Hampshire, Consumers Power of Michigan, and Public Service of Indiana, among others—have serious financial problems

The purpose of this article is to describe and measure the nationwide scope of a problem that has generally been discussed on a case by case basis, without sufficient regard to the interrelation of the issues involved.

The origins: demand growth declines while project costs escalate

Industry standards typically call for electrical utilities to maintain maximum generating capacity between 15 and 22 percent above projected peak load demand. If we take 18

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percent as the average requirement, in the early 1970s, when most of the nuclear plants currently under construction were planned, there was no slack capacity in the aggregate by this standard (Chart 1) At the same time, fossil fuel prices were also increasing at unprecedented rates, real crude oil prices quadrupled between 1970 and 1980 and anthracite coal prices roughly doubled [1] Under the circumstances nuclear power looked like a good bet to all but a few observers Government agencies actively encouraged utilities to invest in nuclear plants, and opposition was not widespread

In the mid 1970s, the growth in demand for electricity slowed markedly (Chart 1) In fact, some industry projections 10 years ago overstated the need for capacity in 1983 by nearly 50 percent [2] As a result, the new capacity brought on line during the 1970s has allayed immediate concerns with most utilities' ability to meet peak load demand Moreover, fossil fuel prices have stabilized, real anthracite coal prices actually decreased by about six percent between 1980 and 1982.[3]

In addition, the 1979 incident at Three Mile Island raised concerns with the safety of nuclear plant operations The regulations issued by the Nuclear Regulatory Commission to address the safety issue have contributed substantially to increasing both the cost of plant construction and the time needed to complete the projects

Finally, over the past several years, the cost of capital to utilities has risen markedly This not only increased the direct construction cost of the plants, but also exacerbated the cost consequences of delay.

As a result of all of these changes, building nuclear generating plants has apparently not turned out to be as good an investment as originally expected In fact, current estimates of the completion costs of plants now under construction are as much as ten times as high as the levels originally forecasted when the projects were initiated Faced with cost escalations of this magnitude, U S utilities have cancelled 33 of the 39 new nuclear plants ordered since 1974. No new nuclear plants have been ordered since 1978 [4]

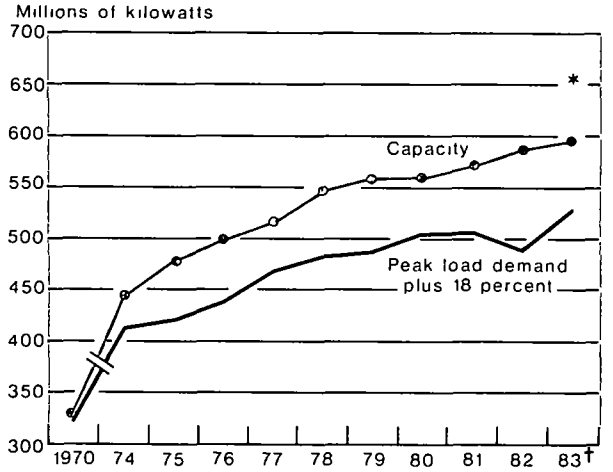
Market structure and rate regulation

The organization of the electrical utility industry is unique in several respects, and its particular market structure will exert a major influence on the ultimate impact of current nuclear construction projects. While utilities in most parts of the country are privately owned, the industry is subject to far-reaching government influence, particularly on the state level State governments have granted particular utilities the exclusive right to serve specific geographical areas In return for this distribution monopoly, however, state governments retain the right to approve or disapprove utilities' proposed electricity rates Another important characteristic of the organization of the electrical utility industry is its extensive vertical integration A few utilities do not sell power directly to final consumers but only to other utilities, and a few firms act only as retailers of power produced by others But for the most part utilities produce at their own plants most or all of the power they sell directly to final consumers The issues raised by nuclear plant construction and the range of possible resolutions are, in large part, determined by this combination of distribution monopoly, rate regulation, and vertical integration

In most states electrical rates are set by governmental bodies called public service commissions or public utilities boards These regulatory agencies typically allow rates high enough to meet the costs utilities incur in purchasing fuel and in operating and maintaining their generating plants and transmission facilities In addition, utilities are allowed to

Chart 1

United States Electrical Generating Capacity and Summer Peak Load Demand plus 18 Percent



*Capacity if all nuclear plants under construction were on line

†Preliminary

Source Edison Electric Institute

[1] U S Department of Energy, Energy Information Administration, *Annual Energy Review*

[2] For example, the National Electric Reliability Council estimate of electricity demand in 1983 made in 1974 was about 750 million kilowatts, compared with the actual 450 million

[3] *Annual Energy Review, op cit*

[4] The Atomic Industrial Forum, "Historical Profile of U S Nuclear Power Development" (January 1984)

Accounting for Construction Work in Progress

In most states utilities may not begin to pass the cost of plant construction onto customers before commercial operation begins. In the terminology used by utilities and their regulators, the value of construction work in progress (CWIP) is not typically included in the "rate base"—the aggregate value of the plants whose cost utilities are allowed to recover from their customers. Some states do allow utilities to begin recovering a part of the value of CWIP before plants open, but most do not.

The exclusion of CWIP from the rate base creates a financing problem for utilities, especially given how long it takes to build large generating facilities Most investors would be unwilling to advance funds to a utility for building a plant in the expectation of not receiving any return for a period of up to ten years. Therefore, to aid power companies in raising construction funds, most regulatory commissions allow utilities to include on their income statements a special item called "Allowance for Funds Used During Construction" (AFUDC) Regulators and accountants allow utilities to report a noncash income item equal to the interest paid that year on debt incurred to build the plant and a competitive return on stockholders' equity in the plant.

The utility does not actually receive cash income in that amount, but with AFUDC included in its financial statement the firm is considered creditworthy enough to continue raising money in capital markets In other words, by allowing utilities to report AFUDC income, regulators are in effect providing some assurance to potential investors that the utility will eventually be able to recover the funds spent on the construction project with a return retroactive to when the funds were raised.

Under ordinary circumstances, once the plant is completed the utility is allowed to begin recovering from its ratepayers the entire cost of building the plant, including both direct expenditures and all accumulated funds used during construction

Another common regulatory practice is to base rate decisions on the book value of the firm's assets. Over time, therefore, as the book value of a plant is depreciated, the revenue return allowed on each asset declines. Therefore, as any plant ages, the amount consumers must pay as a return on capital investment declines. This means that a large proportion of the total investment in any new plant is charged to the consumers in the first few years of operation. Inflation magnifies the effect of this "front loading" in real terms. First, inflation raises interest rates in general and therefore the rate of return utilities are permitted to earn. Second, with inflation, the real value of the payment stream (which is fixed in nominal terms) is depressed by greater amounts each year

For all of these reasons, a large part of the impact of an expensive new plant's completion is felt by consumers all at once when the plant goes into service Given how long it has taken to build those nuclear plants currently under construction and how high capital costs have been over the last ten years, the practices of deferring rate hikes until commercial operation commences and of "front loading" the capital costs has resulted in the potential for huge additions to utilities' rate bases and consequent "rate shock."

collect enough from their customers to service any bonded debt incurred to build plant or purchase equipment and to pay stockholders a competitive rate of return on their equity in the company.

A crucial feature of public utility regulation is that utilities are typically not allowed to recover from their customers the cost of building new plants until those plants begin generating electricity for sale (box). This regulatory practice leads to sudden, large rate hikes for utilities bringing expensive projects into commercial operation.

It is very difficult to predict accurately the utility revenue increase or electricity rate hike which will accompany the opening of specific nuclear plants. The cost of capital is different to different utilities, and different regulators allow different returns on stockholders' equity. Some of the plants may never be completed In the states that allow utilities to begin recovering the cost of new plants before commercial operation, part of the required revenue increase may already have been implemented Many relevant figures may change by the time the plants finally go into service.[5] Finally, regulators, legislatures or the courts may not allow the utilities to recover the full costs of construction on any one of a number of grounds

These qualifications notwithstanding, the rough estimates in Table 2 provide a consistent basis for aggregation and comparison across utilities and regions. The required revenue increases in the *first year* of operation (Table 2, column 4) represent the sum of the following costs:[6]

[5]For example, the Department of Energy forecasts 5 4 percent growth of electricity sales in 1984 See Energy Information Administration, *Short Term Energy Outlook* (June 1984) Demand growth raises the revenue increases required (as more operation and fuel costs are incurred) but lowers the required rate hikes per kilowatt hour (as fixed costs are spread over more kilowatt hours)

[6]Table 2 reports revenue increases only for the 60 investor-owned utilities with shares of one or more nuclear plants under construction These utilities collectively own about two-thirds of the aggregate nuclear capacity under construction The rest is owned by private cooperatives and governmental agencies

- operations, maintenance, and fuel costs of two cents per kilowatt hour produced, assuming the plant operates 65 percent of the hours in a year,

- capital costs of an amount sufficient to service a mortgage with initial principal equal to the cost of the plant at completion over 30 years at 14 percent interest, and

- annual charges of 6 percent of the cost of the plant at completion to account for depreciation and taxes [7]

This estimate of additional revenue requirements is expressed as a percentage of the utility's revenues for 1983 electric utility operations It is important to emphasize that these estimates are for the first year of operation only A large share of the utility revenues associated with a specific plant is computed as a proportion of the capital value of the facility As the plant is depreciated, this portion of revenues will decline

There are a few utilities with nuclear construction work in progress which will not require very large rate increases to meet their share of the obligations incurred in building a plant However, the (weighted) average percentage revenue increase of some 35 percent for these utilities is more than twice as large as the average 15 percent increase in nominal revenues experienced by all U S electrical utilities between 1970 and 1980 [8] And in some cases, the required increase is extremely large, exceeding 50 percent for 14 utilities

The revenue increases associated with completion of nuclear plants will probably be mitigated by the relatively low operations, maintenance, and fuel costs at nuclear plants Much of the new nuclear capacity that comes on line will initially be used to replace older oil and coal fired plants Operations and maintenance costs for the older plants, especially the oil fired ones, are much higher than for nuclear plants Therefore, as nuclear capacity replaces oil and coal fired capacity, the average variable cost of producing electricity will probably decrease

The fifth column of Table 2 reports the net increases of revenue required, assuming all of the electricity produced by each nuclear plant replaces power produced currently at the utility's average 1983 costs for operations, maintenance, and fuel In the cases of the utilities with the highest variable cost of production—generally in the oil-burning northeast—the eventual savings could be substantial In fact, the savings could be even greater than those shown in Table 2, because these estimates are based on average production costs for all plants, but utilities can be expected to replace their highest variable cost facilities first

It should also be noted that the expected percentage *revenue* increases listed in Table 2 will not translate directly into electricity *rate* increases How much rates per kilowatt hour do increase will depend on how many kilowatt hours are sold The demand for electricity could very well increase substantially over the next few years, along with the growth of GNP A few years' real growth of 3 percent would wipe out most of the present excess capacity if no additional plants are completed [9] To the extent that each utility increases the sale of electrical energy, part of the revenue increase would be covered by these sales

In another way, however, a given initial rate increase might understate the long term economic and financial impact of nuclear plant completion The experience of the 1970s suggests that consumers will respond to the likely initial electricity rate increases by conserving electricity and by increasing their own production of electricity (Under current federal law, in fact, utilities are required to purchase excess electricity produced by their customers) Reductions in nuclear utilities' sales would lead to further rate hikes, to provide enough revenues to meet fixed costs.

Aggregate and regional economic effects

For the national economy, the impact of the rate increases expected upon completion of nuclear construction work in progress would generally be moderate A $25 billion shift from utilities' customers to investors in nuclear utilities would probably not have substantial macroeconomic consequences, but such a transfer might have significant distributional effects The average price of electricity per kilowatt hour nationwide would increase substantially Thus, electricity-intensive industries with large investments in fixed plants, such as ferro-alloy and aluminum smelting and petrochemicals, would suffer the most

In specific regions of the country the effects on economic development may be greater While 23 states are not seriously affected directly, in 13 others revenue increases could exceed one percent of state personal income (Chart 2) By this standard, the most severe problems appear to be concentrated in northern New England and in the Ohio and Mississippi Valleys Some regions which could be affected by large rate increases are not shaded in Chart 2 because the local nuclear plants are being constructed by government-owned utilities or public authorities (notably the Pacific Northwest)

There are, of course, differences in the impact of nuclear plants within states (Table 2, columns 6 and 7) In New York

[7] The results are mildly sensitive to these assumptions Allowing the total rate of return to vary from 18 percent to 22 percent and allowing the operating factor to vary from 55 percent to 70 percent yielded estimates of total revenue increases ranging from $20 billion to $25 billion The results reported in the table lie in the middle of that range

[8] U S Federal Power Commission (1970), U S Energy Information Administration, Statistics of Privately Owned Electric Utilities (1980)

[9] In Chart 1, for example, the excess reserves according to the 18 percent standard was about 13 percent in 1983

State, for example, Long Island has a severe problem while New York City is unlikely to be directly affected

The regulatory response

Under normal circumstances action on rate increases by public utilities boards is fairly routine Utilities document the need for a rate increase, consumer advocates present their arguments, and the board members vote to award the utility an increase they see justified by the economic and financial circumstances

However, any request for an unusually large rate increase would ordinarily be subject to special scrutiny by regulators and extensive judicial review And in the cases of nuclear plants, because of the controversies surrounding nuclear power and because the capacity is not immediately needed, the attention paid to the regulatory proceedings will be especially intense The rules under which these regulatory agencies operate provide some grounds for extraordinary actions by public service commissions

First, many states do not allow utilities to recover the cost of constructing plants that are abandoned before completion For example, Washington State utilities entered into contracts with the Washington Public Power Supply System to pay for the construction of WPPSS power plants whether they operate or not But the courts voided these contracts, ruling that the utilities had no right to commit themselves to pay for power never received. Firms with expensive construction work in progress in states that do not allow recovery of investment in incomplete projects have substantial incentive to finish their projects, even if the electricity is not presently needed or when the completed plant would not be an economical generating facility

Table 1

U.S. Nuclear Plant Construction Projects as of January 1, 1984
(All estimates are as of March 31. 1984 unless otherwise noted)

Plant	Capacity (megawatts)	Estimated Final Cost (thousands)	Percent Complete	Status/Estimated Date of Commercial Operation	Principal Owner
Beaver Valley 2	852	3,076,208	78	1986	Ohio Edison
Bellefonte 1	1,235	5,575,000	77	1989	TVA
Bellefonte 2	1,235		57	1991	TVA
Braidwood 1	1,120	2,077,600	70	1986	Commonwealth Edison
Braidwood 2	1,120	1,465.500	54	1987	Commonwealth Edison
Byron 1	1,120	2,200,000	93	1985	Commonwealth Edison
Byron 2	1,120	1,535,700	67	1986	Commonwealth Edison
Callaway 1	1 188	2.850.000	99	Low power license	Union Electric Co
Carroll County 1	1 120	·	0	On order	Commonwealth Edison
Carroll County 2	1.120	·	0	On order	Commonwealth Edison
Catawba 1	1,145	1.800,000	99	1985	North Carolina Elec Membership Corp
Catawba 2	1.145	2.100,000	72	1987	North Carolina Municipal Power Agency
Clinton 1	950	2.867 982	83	1986	Illinois Power Co
Comanche Peak 1†	1,150	1.945,000	97	1985	Texas Utilities
Comanche Peak 2†	1.150	1,945,000	65	1986	Texas Utilities
Diablo Canyon 2	1.106	2 219,500	96	1985	Pacific G&E
Fermi 2	1,093	3,071,258	98	1984	Detroit Edison
Grand Gulf†	1.250	3 000 000	100	1984	Middle South
Hartsville A-1‡	1,205	6,735,000	44	Indefinitely suspended	TVA
Hartsville A-2‡	1 205			Indefinitely suspended	TVA
Hope Creek	1,067	3 780,000	85	1986	Public Service E&G
Limerick 1	1,065	2,657,000	94	1985	Philadelphia Elect
Limerick 2	1 065	3,766,000	31	1990	Philadelphia Elect
Marble Hill 1	1,130	3,009,156	56	Indefinitely suspended	PS Indiana
Marble Hill 2	1,130	2,061 482	35	Indefinitely suspended	PS Indiana
Midland 1†	492	4.430,000		Cancelled	Consumers Power
Midland 2†	818		84	Indefinitely suspended	Consumers Power
Millstone 3	1.159	3,538,500	84	1986	Conn Light & Power
Nine Mile Point 2	1,080	5 100,000	75	1986	Niagara Mohawk
Palo Verde 1	1,304	1,905,694	99	1985	Arizona Public Service

Even when plants are completed, rate increases sufficient to pay back all costs of construction may not be automatic Some states, such as New York and Ohio, allow utilities to recover only those costs of construction which were "prudently" incurred Under this regulatory provision the state public service commission has the right to conduct detailed investigations into the history of each construction project and to judge whether any "mistakes" that might have been made could reasonably have been foreseen and avoided by the utility's management For example,[10] under this principle the staff of the New York State Public Service Commission has concluded that up to $1 6 billion of the $4.1 billion cost of constructing the Shoreham nuclear facility had been imprudently incurred The Commission itself has not ruled on the staff's recommendation, but if it accepts this finding Lilco could have to absorb a business loss of that magnitude

In fact, regulatory law offers a number of mechanisms for opponents to challenge almost any utility's case for almost any rate increase In some states, for example, the public service commission may deny rate increases to utilities to pay for plants whose capacity is not needed to meet demand And some public service commissions, those of New York and Connecticut, for example, have placed limits on the total construction costs for specific plants which will be reimbursed through rate increases

Consumers cannot be certain of being able to find legal grounds for avoiding any rate increase, utilities have recourse to the courts for protection from arbitrary actions

[10]State of New York, Department of Public Service, *Investigation of the Shoreham Nuclear Power Station Executive Summary Testimony* (February 1984)

Table 1

U.S. Nuclear Plant Construction Projects as of January 1, 1984 *(continued)*
(All estimates are as of March 31, 1984 unless otherwise noted)

Plant	Capacity (megawatts)	Estimated Final Cost (thousands)	Percent Complete	Status/Estimated Date of Commercial Operation	Principal Owner
Palo Verde 2	1 304	1,330,563	99	1986	Arizona Public Service
Palo Verde 3	1,304	1,463,743	88	1987	Arizona Public Service
Perry 1	1,205	2,651 300	94	Indefinitely suspended	Cleveland Elec Illum
Perry 2	1,205	2,461,700	44	1988	Cleveland Elec Illum
River Bend 1	934	2,473,643	86	1985	Gulf States Utilities
River Bend 2	934			Cancelled	Gulf States Utilities
Seabrook 1†	1,198	2,539,900	89	Indefinitely suspended	PS New Hampshire
Seabrook 2†	1,198	2,709,100	29	1987	PS New Hampshire
Shearon Harris 1	915	2,830,298	85	1986	Carolina P&L
Shoreham	854	4,100,000	99		Long Isl Lighting
South Texas Proj 1†	1,250	{7,411,006	50	1987	Houston L&P
South Texas Proj 2†	1,250		18		Houston L&P
Susquehanna 2	1.011	2.159 000	99	Low power license	Pennsylvania P&L
Vogtle 1	1,100	3,722,379	65	1987	Georgia Power
Vogtle 2	1,100	1 475,671	22	1988	Georgia Power
Waterford 3	1,151	2,649,200	100	1984	Middle South
Watts Bar 1	1.165	{3,505,000	97	1985	TVA
Watts Bar 2	1,165		63	1986	TVA
Wolf Creek†	1,150	2,900,000	91	1985	Kansas G&E
WPPSS 1‡	1,266	3 460,209	60	Indefinitely suspended	WPPSS
WPPSS 3‡	1,242	3.809,203	50	Indefinitely suspended	WPPSS
Yellow Creek 1‡	1 285	{3 875,000	33	Indefinitely suspended	TVA
Yellow Creek 2‡	1,285		33	Indefinitely suspended	TVA
Zimmer 1	810	3 100,000	85	Converted to coal	Cincinnati G&E
Total for all plants	59,286	135 338,495			

*Not available
†1983 Estimates
‡1982 Estimates
Source Federal Energy Regulatory Commission, individual utilities, and the Atomic Industrial Forum

by state regulators However, rate increases to pay for very expensive and apparently unneeded capacity cannot be considered automatic Most of the large rate increases associated with the completion of nuclear plants currently under construction will probably come under very contentious challenge before regulatory commissions, in state legislatures and executive chambers and before state and federal courts

Financial consequences and capital market responses Any possibility that previously expected rate increases may be slow in coming or may not come at all threatens the financial health of some of the utilities with nuclear construction work in progress It is difficult to say exactly how much of a loss any given utility could bear because the tax treatment of such write-offs complicates matters considerably However, if a utility has less than 100 percent of its owners' equity invested in a nuclear project, then the senior creditors of the firm, if not necessarily the stockholders, would probably be protected, even if the full book value of the nuclear project had to be written off as a loss When the book value of nuclear construction work in progress

Table 2

Investor Owned Utilities with Nuclear Construction Work in Progress*

Utility	Plant Completion Cost (millions)	Expenditures Remaining (percent)	Nuclear Exposure (percent)†	First Year Required Revenue Increase (percent)	Revenue Increase Net Operating Savings (percent)	Current Revenues per Kwh (cents)	First Year Net Revenue Increase per Capita (dollars)‡	First Year Net Revenue Increase % Personal Income (percent)‡
Arizona Public Service Co	1 368	4	84	46	25	6 8	200	1 9
Atlantic City Electric Co	189	15	26	9	5	8 8	24	0 2
Bangor Hydro-Electric Co	115	42	96	35	22	6 4	149	1 8
Canal Electric Co (MA RI)	184	42	196	27	19	5 0	10	0 1
Carolina Power & Light Co (NC, SC)	2 372	15	68	34	28	5 3	144	1 8
Central Hudson Gas & Electric Corp (NY)	459	25	70	25	19	7 8	91	0 9
Central Maine Power Co	403	36	62	22	16	5 9	103	1 2
Central Power & Light Co (TX)	1 868	66	90	47	33	6 7	432	4 3
Central Vermont Public Service Corp	144	31	71	25	17	5 9	63	0 7
Cincinnati Gas & Electric Co	1 442	15	59	39	33	5 6	172	1 6
Cleveland Electric Illuminating Co	2 344	28	55	49	32	7 2	268	2 3
Columbus & Southern Ohio Electric Co	787	15	71	27	23	5 3	124	1 3
Commonwealth Edison Co (IL)	7 279	27	95	47	15	7 6	271	2 2
Connecticut Light & Power Co	2 071	19	75	37	22	8 2	160	1 2
Consumers Power Co (MI)	4 430	16	97	69	57	5 8	222	2 0
The Dayton Power and Light Co	871	15	58	30	24	6 5	178	1 8
Detroit Edison Co	2 457	2	70	26	19	6 6	116	1 0
Duke Power Co (NC SC)	975	16	49	11	9	4 5	101	1 0
Duquesne Light Co (PA)	1 127	28	56	35	23	7 3	159	1 4
El Paso Electric Co	743	4	164	73	23	8 1	457	6 0
Fitchburg Gas and Electric Light Co (MA)	47	42	88	41	17	8 4	6	0 1
Georgia Power Co	2 376	48	59	22	17	5 1	129	1 4
Gulf States Utilities Co (TX LA)	1 732	14	102	31	26	4 8	299	2 8
Houston Lighting & Power Co	2 283	66	37	15	11	6 4	174	1 3
Illinois Power Co	2 294	17	119	69	57	5 3	304	3 1
Interstate Power Co (IA IL)	§	100	0	13	−2	5 3	87	0 9
Iowa-Illinois Gas and Electric Co	§	100	18	16	−2	5 7	62	0 6
Kansas City Power & Light Co (KS MO)	1 363	9	105	56	39	6 3	232	2 0
Kansas Gas and Electric Co	1 363	9	116	79	60	5 4	540	4 7
Long Island Lighting Co	5 018	5	143	78	49	10 9	251	1 9
Maine Public Service Co	79	42	129	60	43	5 7	218	2 8
Middle South Utilities Inc. (MS LA AR)	5 349	0	146	49	40	4 6	266	2 9
Montaup Electric Co (MA RI)	294	30	137	32	23	5 5	37	0 4
New England Power Co (MA)	951	30	92	24	18	5 5	66	0 7

exceeds 100 percent of equity, both stockholders and bondholders would be exposed to losses Based on data for 1983 there are 14 utilities whose total investment in nuclear construction projects exceeds their stockholders' equity (Table 2, column 3).

No one knows exactly what would happen in the event that a privately-owned utility sought court protection from its creditors. Surely the legal proceedings would be lengthy, complex, and costly It is highly unlikely, however, that delivery of electrical power to consumers in the bankrupt utility's service area would be disrupted, at least in the short run.

The uncertainty lies in the short- and long-term financial impacts of a utility's recourse to the courts for protection, and especially its eventual effect on electricity rates. If the utility loses access to short-term capital markets, and if cash flows are insufficient to meet current expenses, the company could make operating decisions that would lead to a deterioration in the quality of service. In the longer run, investors might eventually be willing to lend money to the utility or its reorganized successor, but only at a very high rate of return. It is unclear how large the capital markets' penalty would be, but any higher cost of capital to the utility would

Table 2

Investor Owned Utilities with Nuclear Construction Work in Progress* *(continued)*

Utility	Plant Completion Cost (millions)	Expenditures Remaining (percent)	Nuclear Exposure (percent)†	First Year Required Revenue Increase (percent)	Revenue Increase Net Operating Savings (percent)	Current Revenues per Kwh (cents)	First Year Net Revenue Increase per Capita (dollars)‡	First Year Net Revenue Increase % Personal Income (percent)‡
New York State Electric & Gas Corp	918	25	34	26	22	6 4	40	0 4
Niagara Mohawk Power Corp (NY)	2 091	25	43	23	20	5 9	101	1 0
Ohio Edison Co	2 823	27	85	52	37	6 4	227	2 3
Pacific Gas and Electric Co (CA)	2 220	4	55	15	9	6 5	33	0 3
Pacific Power & Light Co (OR CA ID WY MT WA)	388	100	0	11	10	3 5	33	0 3
Pennsylvania Power & Light Co	1 943	1	62	40	31	5 4	125	1 1
Pennsylvania Power Co	266	31	67	35	27	5 6	36	0 3
Philadelphia Electric Co	6 423	43	96	73	48	7 6	416	3 6
Portland General Electric Co (OR)	388	100	23	16	15	4 1	66	0 6
Public Service Co of New Hampshire	1 968	41	119	107	61	7 3	539	5 5
Public Service Electric & Gas Co (NJ)	3 591	15	69	33	21	8 4	134	1 1
Public Service Co of Indiana Inc	4 209	53	0	121	98	4 9	615	6 8
Public Service Co of New Mexico	479	4	53	36	23	6 4	225	2 5
Puget Sound Power & Light Co (WA)	194	100	30	9	8	3 5	20	0 2
Rochester Gas & Electric Corp	714	25	56	35	28	6 9	159	1 4
Southern California Edison Co	743	4	51	5	2	7 5	18	0 1
Texas Utilities Co	3 417	19	80	26	18	5 6	97	0 8
The Toledo Edison Co	1 630	28	103	81	56	6 9	557	5 4
Union Electric Co (MO)	2 850	2	114	60	50	4 6	361	3 2
United Illuminating Co (CT)	1 049	39	119	59	20	9 7	168	1 2
Washington Water Power Co	194	100	24	21	22	2 4	75	0 8
Western Massachusetts Electric Co	439	17	96	41	26	7 7	132	1 4
Totals or Averages	93 709	24	74	35	29	6 0	143	1 3

*Information as of December 31 1983

†Exposure is measured as value of construction work in progress on nuclear projects as a percentage of the proprietors capital in each utility

‡Population and income figures are the totals for the counties served in part or in whole by each utility These figures understate the actual per-capita cost and cost as a percentage of personal income because in many cases utilities serve only part of a single county The understatement is probably greatest for the utilities in the New England states

§The Carroll County Facility is on order but construction has not yet begun

Source Federal Energy Regulatory Commission Census Bureau Atomic Industrial Forum and individual utilities

be translated into higher electricity rates

The consequences of several electrical utilities experiencing difficulties at the same time would be felt in the financial system as a whole; the aggregate investment at risk is substantial. If we take those utilities with more than 100 percent of their proprietors' capital invested in a nuclear project to be most severely at risk, then the nuclear investment most threatened is about $21.5 billion

Capital markets have already taken note of this situation. Over the past six months the common stocks of utilities with nuclear projects underway did significantly worse than the average for the industry. In fact, regression analysis of utility stock price changes between November 1, 1983 and June 1, 1984 for a sample of utilities with and without nuclear construction projects shows an additional decrease in the aggregate market value of a company's common stock of between 10 and 15 cents for every dollar the firm has spent on nuclear construction work in progress.[11] In other words, the stock market may have essentially "written off" this proportion of the value of nuclear construction work in progress between November 1983 and June 1984, either in anticipation of rate hike denials or in response to the added uncertainty of the return to their investment. It remains to be seen whether capital markets are correct in their current assessment that, on average, state public service commissions will disallow 10 to 15 percent of the rate increases necessary to recover from ratepayers the utilities' investment with a competitive return.

Conclusions

At present, it looks as if the construction of many nuclear power plants in the United States could turn out to be a poor investment. The capacity and power produced by these plants is, for the most part, not needed immediately. Moreover, current fossil fuel prices and the huge capital costs incurred in building these plants make most of them very expensive sources of electricity But given the market structure and regulatory environment unique to the electric utility industry some or all of the costs of these plants can be passed onto electricity users

A competitive return on utilities' entire investment in nuclear plants could only be guaranteed in some parts of the country by requiring consumers to pay more for electricity than the cost of production at available alternative sources. There are places served by utilities with nuclear construction work in progress which could, in the short run, acquire both electrical energy and firm peak load capacity at much less than the capital plus operating costs of a newly completed nuclear plant. In other places moderate additions to transmission capacity would facilitate sufficient imports from neighboring regions of the United States or from Canada.

This does not mean, however, that construction of any given nuclear plant should be abandoned. Once built, nuclear plants have relatively low marginal operating costs, so abandonment of most projects that are close to completion is probably not cost beneficial. Furthermore, completion of nuclear plants now provides some insurance against increases in fossil fuel prices and against possible "brownouts" caused by unexpectedly rapid increases in the demand for electricity.

Ordinarily, an acceptable reconciliation of the interests of investors and ratepayers could probably be reached through routine regulatory processes or through litigation. However, the regulatory system for electrical utilities we have in place was not designed to contain or manage controversies with stakes running into billions of dollars. Consequently, the controversy inevitably takes on a political dimension. The relative losers in the regulatory process, whoever they are, will almost certainly make an arguable claim that the outcome is unfair or inefficient. There will be calls for special legislation or regulatory reform aimed at reducing or reallocating the burden imposed by new nuclear plants.

There have already been some proposals for passing part of the burden onto state or federal taxpayers. For example, it has been suggested that state authorities purchase some plants. However, substantial new borrowing by state power authorities could increase the cost of capital for other state operations

Under some proposals the federal government might purchase the plants and retain them as a "strategic energy reserve" against the possibility of an interruption in oil supplies. The federal government would face lower capital costs than the investor-owned utilities, because it pays a much lower risk premium than a private firm. But the debt service payments associated with the purchase of the plants would make it harder to reduce the federal budget deficit.

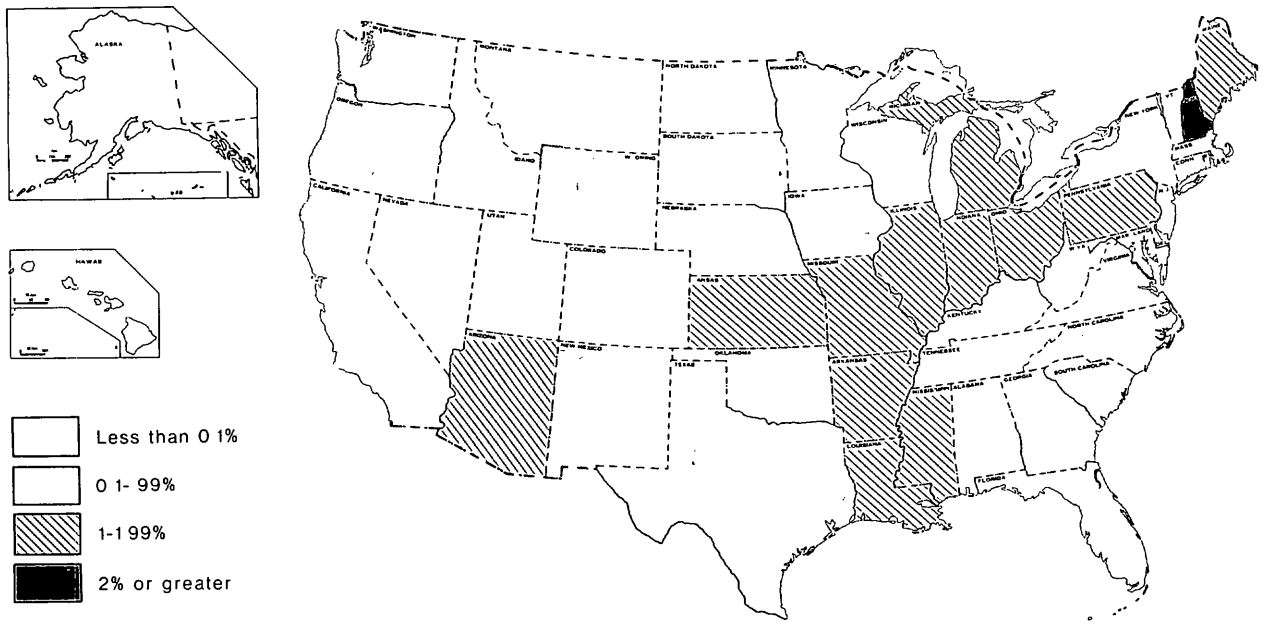
Regulatory reform of various types might reduce the cost marginally or make it easier to bear. Under current regulatory practice the immediate effect of plant completion is to increase electricity rates markedly. Over time, however, the cost of individual plants to consumers in terms of rates per kilowatt hour will probably decline for two reasons. First, as consumption of energy increases with general economic growth, the fixed cost of the plant is spread over more kilowatt hours generated. Second, as the book value of the plant depreciates, the amounts customers must pay to stockholders as a return on the owners' equity in the facility declines.

Therefore, a part of the rate shock associated with plant completion is an artifact of the effective "front loading" of the cost of plants in the first few years of operation. But

[11]The finding that each dollar invested in nuclear projects reduces the total market value of a company's common shares by between 10 and 15 cents is sustained even when the four utilities with the most widely publicized difficulties, Lilco, Public Service of New Hampshire, Public Service of Indiana, and Consumers Power, are omitted from the sample

Chart 2

Expected Required Net Revenue Increase: Percent of State Personal Income



Sources Federal Energy Regulatory Commission, Individual Utilities, and Federal Reserve Bank of New York calculations

"front loading" is not the only way of compensating utilities' investors for the funds they have provided It might make more sense to spread out the costs and savings over the life of the plant. Alternative regulatory schemes might "phase in" the lifetime cost of the plant over a long period, possibly commencing before commercial operation, while maintaining the same net present value as the current system.

There are other regulatory reforms, which while not directly related to nuclear facilities financing, have an impact on this problem. A number of proposals have been offered in recent years aimed at enhancing the competitiveness of the electrical utility industry. For example, one proposal aims to promote competition among wholesale producers of electricity by separating production and distribution Other proposals would make utilities' rate structures more complex by encouraging wider use of differentials by time of day and for different service qualities It is expected that rate structures more closely based on costs would create an incentive for more efficient use of energy and capacity and reduce the overall cost of electricity.

Unfortunately, in the current environment of uncertainty regarding the return on investments in nuclear plants it would be very difficult to implement any reform. Capital markets are likely to interpret any changes in the rules of the game as an attempt to pass the cost of nuclear plants back to stock and bondholders. Further disenchantment with electric utilities on the part of capital markets would make electricity even more expensive, and defeat the intent of reform over the long run Therefore, the challenge is to minimize the burden to be borne, to find and implement a just allocation of the burden, and to do both in a way that maintains investor confidence

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