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The Risks of Building New Nuclear Power Plants

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Deja Vue – All Over Again?

- Atomic Energy originally promoted as “too cheap to meter”
- But existing generation of nuclear units became so expensive:
  - Owners experienced severe financial problems
  - Many plants cancelled
  - Many cost disallowances and settlements in lieu of disallowances
  - Plants sold/divested at far below book value – ratepayers bore hundreds of millions of stranded costs

US Nuclear Industry Construction Cost Experience

- The nuclear plants operating in U.S. today were built in the 1960s-1980s.
- Data compiled by U.S. Department of Energy reveals that originally estimated cost of 75 of today's nuclear units was $45 billion in 1990 dollars.
- Actual cost of the 75 units was $145 billion, also in 1990 dollars.
- $100 billion cost overrun was more than 200 percent above the initial cost estimates.
- $100 billion overrun does not include escalation and interest.

U.S. Nuclear Industry Construction Cost Experience

Year Construction Started	Estimated Overnight Cost (1990$)	Actual Overnight Cost (1990$)	Percentage Over
1966-67	$560/kW	$1,170/kW	209%
1968-69	$679/kW	$2,000/kW	294%
1970-71	$760/kW	$2,650/kW	348%
1972-73	$1,117/kW	$3,555/kW	318%
1974-75	$1,156/kW	$4,410/kW	381%
1976-77	$1,493/kW	$4,008/kW	269%

U.S. Nuclear Industry Construction Cost Experience

- DOE study understates cost overruns because (1) it does not include all of the overruns at all of the 75 units and (2) it does not include some of the most expensive plants – e.g. Comanche Peak, South Texas, Seabrook, Vogtle.
- For example, cost of the two unit Vogtle plant in Georgia increased from $660 million to $8.7 billion in nominal dollars – a 1200 percent overrun.

Many Owners Experienced Significant Financial Problems

- Public Service Company of New Hampshire went bankrupt due to financing difficulties associated with the Seabrook Nuclear Plant.
- Long Island Lighting Company nearly went bankrupt – sold $5 billion Shoreham nuclear plant to State of New York for $1. Share price dropped from high of $19.75 in 1978 to less than $7 in 1984.
- Consumers Power nearly went bankrupt – Midland nuclear plant originally estimated to open in 1975 and cost about $500 million. Ten years and $3.5 billion later, Company cancelled the unfinished plant. Shares dropped from $55 pre-Midland to $5 + Company suspended common stock dividend.

State Regulatory Commissions Disallowed Recovery of Substantial Amounts of Imprudently Incurred Costs

- From 1984 to 1993, electric utilities with nuclear construction projects wrote off in excess of $17 billion, net of tax effects, for abandoned plants and regulatory disallowances.
- In 1980s alone, state commissions disallowed from utility rate base more than $7 billion of nuclear costs due to construction imprudence.
- Another $2 billion in nuclear costs were disallowed due to imprudence of building new capacity that was physically excess when completed.

Examples of Individual Plant Disallowances

- Texas Utilities forced to write off $1.2 billion disallowance of Comanche Peak nuclear plants.
- Georgia Public Service Commission disallowed $1.1 billion due to mismanagement of construction of Vogtle nuclear units.
- Owners of the Nine Mile Point Unit 2 nuclear plant agreed to $4.45 billion cap for ratepayer recovery of costs for the unit. This meant that the owners would absorb at least $1.56 billion in project costs.
- $1.4 billion disallowance of the construction costs of Gulf States Utilities' River Bend Station.
- Many other nuclear plant owners also forced to absorb significant construction cost disallowances

Investments in New Nuclear Plants Remain Very Risky

- Industry now optimistically estimates that new generation of nuclear plants can be built at lower cost -- for $1,200 - $2,000 per KW. This means $2-$3 billion construction cost for a new nuclear plant.
- These optimistic cost estimates based on new plant designs that have not actually been built in the US and on changes in the US regulatory process.
- These estimates are from 2004 and earlier years. Do not reflect changed much more competitive environment for design, labor and commodity resources needed to build power plants.
- At same time, due to earlier overruns, the nuclear industry has a serious credibility issue concerning the reliability of nuclear construction cost estimates.

Costs of New Fossil Power Plant Projects Have Increased Dramatically in Recent Years

- Duke Energy Carolinas estimates that new coal-fired power plant capital costs have increased by approximately 90% to 100% since 2002 - costs have increased by about 40% since early 2006.
- Cost increases are due, in large part, to significant increase in worldwide demand for power plants. Demand for plants is straining the supply.
- Significant cost increases for critical power plant commodities, e.g., steel, copper, fabricated alloy piping, concrete.
- Demand and costs have escalated significantly for both on-site plant construction labor and skilled manufacturing labor.

Costs of New Fossil Power Plant Projects Have Increased Dramatically in Recent Years

- Fewer bidders for work, higher prices, earlier payment schedules and longer delivery times.
- All of these factors can be expected to impact costs of other power generating technologies, not just coal-fired units.
- Reasonable to expect that these changed market conditions also will increase new nuclear power plant capital costs.

Table 1

Commodity/ Construction Material	Avg. Annual Escalation from ~1986 – 2003 (Recent Historic Average)	Avg. Annual Escalation Since Dec. 2003 – April 2007 (Last 40 Months)	Last 40 Mo. Of Escalation As Ratio of Recent Historic Avg.
Nickel	3.80%	60.30%	15.9X
Copper	3.30%	69.20%	21X
Cement	2.70%	11.60%	4.3X
Iron & Steel	1.20%	19.60%	16.3X
Heavy Construction	2.20%	10.50%	4.8X

Sources: Nickel, Copper: London Metal Exchange
Cement, Iron, Steel & Heavy Construction: U.S. Bureau of Labor Statistics

What U.S. is doing to encourage investment in new nuclear units

- Streamlining licensing process
  - Early Site Permitting
  - Combined construction and operating licenses
  - Significantly limited role for public in hearing process
  - NRC pre-approval of standardized plant designs
  - Allow utilities to use more commercial grade components and equipment

What U.S. is doing to encourage investment in new nuclear units

- Financial incentives in EPACT 2005
  - Extension of Price-Anderson Act to 2025
  - 1.8 cents per kWh production tax credit for first 6,000 MW of new nuclear generation for first 8 years of operation. Limited to a total of $125 million per 1,000 MW of new generation
  - Insures utilities for construction delays due to hearings or litigation.
  - Federal guarantees for up to 80 percent of estimated project costs for innovative technologies – including new advanced nuclear reactor designs – that will diversify and increase energy supply while protecting the environment.
- Moral Support from federal government

New Power Plant Designs Under Consideration in the US

- 4 main designs are under consideration for the new nuclear plants in the U.S.

  Advanced Boiling Water Reactor (ABWR)
  Westinghouse AP1000
  GE Extra Simplified BWR (ESBWR)
  European Pressurized Water Reactor (EPR)

The ABWR and AP1000 designs already have been pre-approved by NRC.

New Power Plant Designs Under Consideration in the US

- Although it contains many design changes, the ABWR basically is an updated version of the BWRs that were built in the US in the 1960s-1990s.
- Four ABWRs have been built in Japan. Two more are under-construction in Taiwan.
- The AP1000, ESBWR and EPR represent very different designs with new passive design features.
- Will use natural circulation, larger design margins and fewer plant systems.

Actual Construction or Operating Experience with New Plant Designs

- No operating experience with any plant with AP1000, ESBWR or EPR design.
- Only one plant with an EPR design – Olkiluoto-3 – is even under construction.
- Project has experienced significant problems, delays and cost increases.
- Turnkey project -- builder, the French company Areva, took a $922 million write off in 2006 due to cost increases at Olkiluoto-3.
- Project now 18 months to 2 years behind schedule, with currently projected completion in 2009 and 2010.

Japan and Taiwan ABWR Cost Experience

- First 2 ABWRs completed in Japan in 1995 and 1996 cost about $2000/kW
- 3rd ABWR, Shira 2, has been described as "expensive" compared to these first two units, costing between $2375-$2590/kW.
- 4th ABWR in Japan cost about $2220-2224/kW.
- Two 1350 MW ABWRs under construction in Taiwan were originally projected to cost about $3.7 billion and to be completed in 2003 and 2004.
- Latest estimates - commercial operations will not start until 2009 and 2010 and project may cost between $7.4 and $9.1 billion.

Estimated US ABWR Construction Cost and Schedule

- Detailed cost and schedule have been prepared for building of 2 ABWRs at TVA's Bellefonte site.
- All of the companies that participated in the TVA cost and schedule study would benefit financially from decision to build new nuclear power plants.
- Estimated $1611/kW cost is very optimistic.
- Does not include owner's costs – typically add about 10-20% to the overnight cost of building a plant.
- Low cost estimate reflects using many facilities that had been built to support TVA's cancelled nuclear plants at the same site.

US Nuclear Industry Plans

- The NRC has said that it has received letters of intent for 19 construction-operating license applications (COL) including 27 reactors.
- These include:
  - Constellation Power – 2 EPR plants at Calvert Cliffs and Nine Mile Point (NY)
  - Dominion – 2 ESBWR at North Anna (VA)
  - Duke – 2 AP1000 at Cherokee in South Carolina
  - Exelon – 1 plant at the Clinton site (IL)
  - NRG – 2 ABWRs at South Texas
  - NuStart Consortium/Entergy – 1 ESBWR in Mississippi
  - NuStart/TVA = 1 AP1000 at the Bellefonte site (AL)
  - Progress -2 AP1000, 1 in FL, 1 in NC
  - SCANA – 2 AP1000 in SC
  - Southern Company – 2 AP1000 in GA
  - TXU – 6 new units with undetermined design

Mega-Project Construction Cost Experience

- New billion dollar mega-projects traditionally cost much more than original estimates.
- Especially true for first-of-a-kind projects
- 1988 RAND Corporation studied the performance of 52 mega-projects.
- Study concluded that: "the data on cost growth, schedule slippage and performance shortfalls of megaprojects are certainly sobering, but the most chilling statistic is that only about one in three of these projects is meeting its profit goals… Megaprojects take so long to develop from concept to reality that the need or opportunity for profits that originally spawned them may have passed by the time they are ready to begin producing"

Remaining Nuclear Risks for Plant Owners and Investors

- **Risk of higher construction costs**
  - Higher costs due to changed market conditions and increased worldwide demand for new power plants.
  - Availability of skilled craftsmen
  - Some significant increases in construction costs should be expected even if actions by federal government and nuclear industry mean no repeat of the 200 percent or higher overruns experienced by the existing generation of plants.
- **Risk of regulatory delays due to first-of-a-kind designs, inadequate documentation, or insufficient NRC staff (i.e., too many applications, too few staff to review).**
- **Risk that future state commissions in regulated states will not pass imprudently incurred construction or operation costs through to ratepayers.**

Remaining Nuclear Risks for Plant Owners and Investors (con't)

- **Risks resulting from deregulation of electric industry in areas of the U.S.**
  - **No captive customers**
  - **Plant owners must fund entire decommissioning liability.**

- **Risk of loss of substantial plant investment as a result of a significant accident or incident – TMI-2 went from a billion dollar asset to a loss in less than an hour.**

Remaining Nuclear Risks for Plant Owners and Investors (con't)

- **EPACT2005 provides for federal government guarantees of up to 80% of a plant's estimated cost but requires that before a loan guarantee is granted, the estimated subsidy cost must be covered by a specific appropriation or by an up-front payment from the borrower.**
  - **DOE has indicated that because appropriations for the program are not expected, each borrower will have to pay the estimated subsidy cost (including estimated default losses) which will have to be approved by the U.S. Office of Management and Budget.**
  - **OMB will want to ensure that the up-front payments are high enough to cover all anticipated default and other subsidy costs incurred by the loan guarantee program. Size of the payments required by OMB could strongly affect the value of the loan guarantees to borrowers.**
  - **Nuclear Energy Institute has said that the procedures outlined in the DOE guidelines for the loan guarantee program are so restrictive and so conditional that they would not support the financing of a nuclear power plant.**

Remaining Nuclear Risks for Plant Owners and Investors (con't)

- **Risk that not enough new nuclear power plants of any one design will be built and, therefore, that critical economies of scale and learning curve will not be achieved – as result, nuclear units will not become cost competitive without substantial continuing governmental incentives and guarantees.**
- **Risk that Congress will revise, limit or eliminate nuclear incentives and guarantees in EPACT2005.**
- **Public Acceptance of new nuclear units could be lost if a significant accident/event occurs at any nuclear plant**
- **Risks associated with temporary storage and the permanent disposal of high level nuclear wastes.**
- **Risk of nuclear terrorism.**

