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Financial Crisis: Impact on New Nuclear Reactors

presented to

Carnegie Endowment for International Peace

by

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November 13, 2008

Outline of Presentation

- U of C Study – 2004

- What has changed?

- Being Proactive
 - Enabler – Clean energy jobs
 - Alternative financial schemes
 - Science-based solutions

- If we don't change the paradigm – where are we?

Perpetual: Enhanced Role of Nuclear Energy – In the Long-Run

- Climate change policies (international, federal, state, and local) will impact fossil-fired sources of electricity.
- Energy security policies will also input choices of electricity.
- We are moving to “cleaner” sources (ex. nuclear energy is moving to more efficient nuclear fuel enrichment operations).
- Nonproliferation issues will have heightened focus – expanded fuel assurance regimes.

Future Nuclear Station: Projected Unit Costs (c/kWh)

The Economic Future of Nuclear Power, August 2004

<u>Overnight capital cost \$/kW</u>		<u>1200</u>	<u>1500</u>	<u>1800</u>
1 st unit	7 yr build, 40 yr life	5.3	6.2	7.1
	5 yr build, 60 yr life	4.3	5.0	5.8
4 th unit	7 yr build, 40 yr life	4.5	4.5	5.3
	5 yr build, 60 yr life	3.7	3.7	4.3
8 th unit	7 yr build, 40 yr life	4.2	4.2	4.9
	5 yr build, 60 yr life	3.4	3.4	4.0

Key Findings in Recent Nuclear Power Assessments

- The risk premium paid to bond and equity holders for financing is an important influential factor judging the economic competitiveness of nuclear energy.
- Two factors imbedded in the risk premium are:
 - Nonquantitative: time in the regulatory process when significant capital is at risk (i.e., start of construction to operation)
 - Quantitative: risk of default or delayed payments to bond holders
- Success of early movers will be important indicators to the financial markets.

Generic Changes to the Nuclear Energy Landscape

- Expanding nuclear energy will require a larger pool of highly-trained scientists and engineers and skilled crafts people, all of which are in short supply.
- Significant number of new nuclear plant constructions may produce significant bottlenecks:
 - Ultra heavy/ultra large forgings
 - Large manufactured components
 - Logistics
- Additional plants will require increasing demand on materials that will likely be subject to currency fluctuations and commodity price spikes.
- As new plants go through a detailed design effort, overnight costs generally rise.

Duke Nuclear Power Plants Double in Price

- Duke Energy raised the expected construction costs of its proposed Lee Nuclear Station (2 units of 1117 MWe each) to \$11 billion, excluding financing costs* – that is roughly twice the company's original estimates – approximately \$5000/kw.
- Some of this increase is due to current commodity prices; however:
 - Steel prices have declined greatly since the July 2008 commodity price peak.
 - In China, the world's largest steel producer, prices of benchmark hot-rolled coil dropped to a one-year low of \$595 a ton, down 42 percent from a record high of \$1,030 hit in July.
- But, nuclear power plant planning and construction takes so long** that steel prices could be much higher by the time construction starts on Duke's plants.
- Nuclear power plant construction costs are therefore hard to forecast.

* Based on filing on 11/3/08 with the S.C. Public Service Commission.

** COL in 2012; construction period 2012-2018.

Moody's Report – Financial Risks

According to Moody's (Moody's Corporate Finance, New Nuclear Generation, Special Report, October 2007):

- The prospects are strong for steadily rising electricity rates, regardless of whether new nuclear generation is built or not.
- Current expectations regarding new nuclear generation are ambitious.
- Cost associated with new nuclear build are early best estimates.
- Given the numerous regulatory overhang and construction execution risks identified, Moody's will be less inclined to hold a given rating over the course of a long-term construction cycle, if the company has been active with aggressive return strategies (translation: need to minimize tendency to expand its leverage).

Loan Guarantees – Credit Subsidy Costs

- Title XVII loan guarantee authority is currently **\$18.5 Billion**.
- DOE received 19 Part I applications from 17 companies to support 21 reactors at 14 sites, representing **\$122 Billion of loan guarantees** (response to the 6/30/2008 solicitation).
- Credit subsidy costs are “the big enchilada.”
 - Rating agency preliminary credit assessment based on the underlying economics of the project without the loan guarantee
 - The full term of exposure as long as 30 years
 - Use of project-specific ratings to gauge the probabilities of default and recovery
 - Use of assumed structure of project and estimated project economics
 - Credit subsidy cost, based on cumulative default calculation; pre-completion risk being the most significant component of the calculation.
 - Final scoring cleared by OMB

Being Proactive – Steps that can be Taken to Mitigate these Risks

Step-by-Step

- Step 1 – Federal Support for Early Movers
- Step 2 – Recommendations of Oversight Panels
- Step 3 – Alternative Financing Mechanisms
- Step 4 - Implementation of Science-based Engineering Tools

Step 1 – Federal Support for Early Movers

EPACT 2005 and events since:

- Standby risk insurance
- Federal loan guarantees
- Production tax credit
- Price-Anderson coverage
- Standard Contract for New Licensees

Step 2 – Federal Support for the GEN III+ Plants and More Assurance on the Backend

- The NAS Report (Review of DOE's Nuclear Energy Research and Development Program, Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences, National Research Council, October 2007) recommended that:
 - Successful completion of the NP 2010 program (i.e., the design, construction, and operation of GEN III+ plants) be the highest priority for and, consequently, have the most significant support at DOE
 - DOE/industry/NRC should work toward high-quality applications and minimizing delays throughout the process
 - Common licensing issues among the family of designs are fully standardized

- Going forward – need a more robust structure to finance and manage the back-end of the nuclear fuel cycle

Step 3 – Consideration of Alternative Financing Mechanisms

- Joint financing with end users, including the PHEV Industry – clean energy jobs
- Consideration of more direct financial linkages in a future carbon policy (cap/trade)
- Consideration of enhanced PPP arrangements (1933; TVA)

Joint Financing with End Users

- Expanded financing for grid upgrades, PHEVs, and other end-uses that are tied to:
 - Expanded clean energy jobs
 - Reduced dependency on petroleum products
 - Sustainable resources such as expanded fresh water

- Prospects of financial entities willing to lend improves (for example, the WB has done extensive financing for expanded fresh water sources).

- Prospects for long-term power purchase agreements (PPAs) improve (for example, bulk purchase of electricity to fuel PHEVs).

Fossil Fuel Generation Unit Costs with and without Greenhouse Policies, (c/kWh 2003 prices), The Economic Future of Nuclear Power, August 2004

	Under Current Environmental Policies	Under Greenhouse Policy
Coal-fired	3.3 to 4.1	8.3 to 9.1
Gas-fired	3.5 to 4.5	5.8 to 6.8

Illustration: Splitting the price signal impact – 50 percent to Government for R&D and 50% for generator's avoided cost – could underwrite 25-50% of the investment in nuclear energy

Illustrative Benefit of a PPP Arrangement

- Fully Loaded Capital Cost – \$8000/kw
- Capital Cost Share – 40 percent of the fully loaded
- Loan Guarantee – reduction of 20 percent of the capital share or about \$640/kw
- PPP – reduction of 50 percent of the capital share or about \$1600/kw

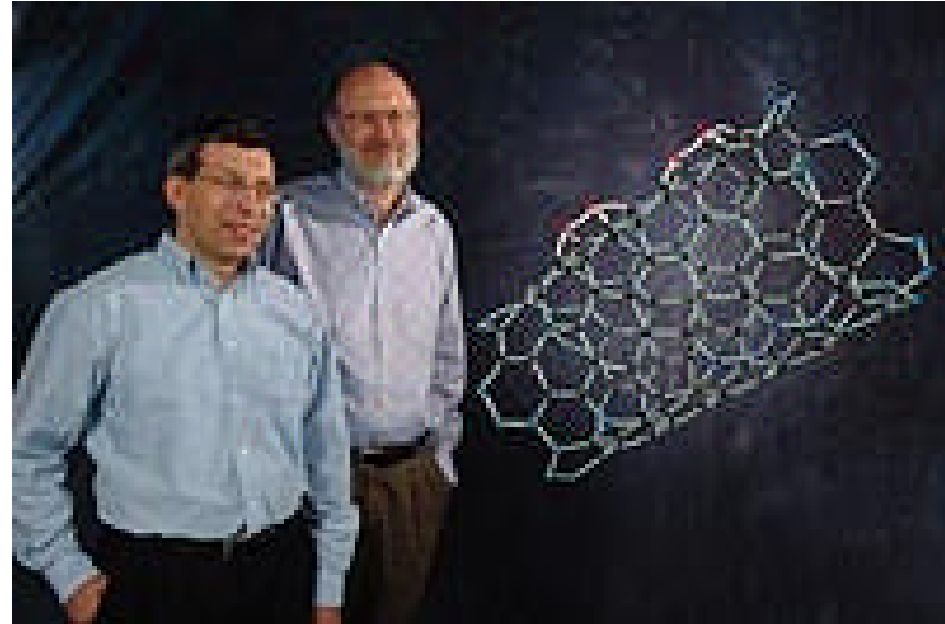
Step 4 – Implementation of Science-Based Engineering Tools

- Enhanced simulation that can better identify and target the physical processes which underlie their design
 - Provide increased confidence to regulators – in turn, could reduce capital costs as well as risk premium
 - Requires the collaboration of significant scientific research organizations, the regulatory community, and commercial entities



Step 4 – Implementation of Science-Based Engineering Tools – contd.

- Enhanced materials
 - Structural analysis of materials behavior ongoing
 - Enhanced life-cycle analysis (including all supply chain issues) is needed, particularly with plants likely to have 60-year operating lives



Researchers at Argonne National Laboratory are experimenting with carbon nanotube structures to learn about improving materials for thermoelectric power generation.

Conclusions

- Evolving climate change and energy security policies require nuclear energy to have an enhanced role.
- To mitigate the perceived financial risks for new nuclear plants, four steps might be considered: support for early movers; collaborative support for GEN III + licensing; alternative financing arrangements, and science-based engineering solutions.
- To enable this economically viable future: this energy sector must attract the best and brightest; must offer an attractive, forward-looking environment; cutting edge science must be at its forefront.

Final Thought

