Current Issues in Nuclear Power Projects Decision Making

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Overview

- Global setting 2011
- Economy, Energy, Climate – what else?
- The Challenges:
  - Is it Safety?
    - How safe is safe enough?
  - Or Financing?
    - What financing?
    - What are the options?
    - Who is interested?
    - What are the realities?

Messages

IAEA
Oil prices and forecasts

- Nominal – Reference Scenario
- Nominal – 450 Scenario
- Real ($2008) – 450 Scenario
Foreign exchange

Risk mitigation: Hedging with derivative instruments
Commodity prices

Source: IMF (2010)
Climate change realities

Global mean temperature

Global average sea level

Northern hemisphere Snow cover
The polluters

- F-gases
- N$_2$O
- CH$_4$
- CO$_2$ LULUCF
- CO$_2$ industrial processes
- CO$_2$ energy

Gt CO$_2$eq

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050
The Cost of Cleaner Energy
The maximum costs of diverse measures to prevent one ton of CO₂ emissions, in euros

- Photovoltaics: 611 euros
- Biofuels: 585 euros
- Geothermal: 540 euros
- More fuel-efficient cars: 415 euros
- Diesel cars: 254 euros
- Wind power: 91 euros
- Solar thermal energy: 75 euros
- Combined cycle power plants: 34 euros

By comparison:
- Emissions certificates: 19.40 euros
- Nuclear energy (European Pressurized Reactor): 7 euros

Sources: Ulrich Fahl, University of Stuttgart; European Energy Exchange, 12/2/2009
Why Nuclear Power?

The drivers have not changed!

- Growing energy need
- Climate change
- Energy security
- Fossil price rise
- Water needs

Nuclear Power

- Improved operations, good economics and safety record

In spite of

- Economic crisis

IAEA
What are the Challenges?

- Is it Safety?
  - Or “How Safe is Safe Enough”?
- Or Politics?
  - 4 years are a short period.
- Economics and Financing is an Issue.
  - Who, what and why.
- Knowledge and Specialists?
  - Can we?
Challenges to Financing NPP

- Uncertainty in the Regulatory process
- Construction Supply Chain risks
- Deregulated electricity market rules and regulation
- Operational performance risk
- Negative Public Perception of nuclear
- Nuclear liability and insurance on how to cap and allocate the “extraordinary nuclear occurrences”
- Management of spent fuel and waste, and decommissioning
How Safe is Safe Enough?

- Banqiao, Shimantan & others, Henan, China 1975 - 30,000 immediate, 230,000 total, hydro-electric dam failures (18 GWe lost)
- Machhu II, India 1979, 2500 dead, hydro-electric dam failure
- Mexico City 1984, 498 dead, LPG explosion
- Deepwater Horizon, Gulf of Mexico, USA 2010 11 dead, Oil well blowout, over 4 million barrels of oil caused massive pollution in Gulf of Mexico
The Economics of Nuclear

Key Advantages of the Nuclear Power

- Relatively low fuel cost: economic competitiveness
- Suitable for base load capacity
- Long life time
- Low external costs
- Guarantee for energy supply
- Capacity development: contribution to national high technologies sector.

Key Challenges to the Nuclear Power

- Highly capital intensive: high upfront capital costs, which are difficult to finance
- Sensitive to interest rates
- Long lead times (planning, construction, etc)
- Long payback periods
- Regulatory/policy risks
- New financing structures required to attract private investors

“The most scalable carbon free source of electricity”
Prof. Jeffrey Sachs
Life cycle cash flow for a nuclear power plant

- Revenues from electricity sales (actual revenues will vary with market conditions and customer makeup)

- Years 0-10: Design and construction
- Years 10: Production costs (O&M plus fuel)
- Years 30: Major refurbishment (e.g. steam generator replacement)
- Years 80-100: Decommissioning

IAEA
Challenge: NPPs overnight capital cost uncertainty

IAEA: Data collected from various publications and studies to keep track of nuclear power plants investment costs, since 2008 (updated Aug 2010), all data in 2008 USD
Traditional Financing Model

- Government financing: take all risks and costs
- Utilities (Generators) borrowed on balance sheet

Who finally pays for all the costs?

Essentially 100% risk on the customer:

All costs: construction and operations passed on to the customer!
## Challenge: Highly capital intensive

Approximate market capitalization of the leading EU and US utility companies (Aug 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Utility</th>
<th>Market capitalisation (USD billions)</th>
</tr>
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<tbody>
<tr>
<td>EU</td>
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<tr>
<td>US</td>
<td>Public Service Enterprise Group</td>
<td>17</td>
</tr>
</tbody>
</table>
Challenge: Highly capital intensive

Overnight capital cost quoted for a typical 1000MW nuclear plant range from $2 - $6 billion, therefore it is a significant investment commitment.

Gross Domestic Product (GDP) in $2009 billions

More than 60 (35%) countries have GDP below $10b

Source: IMF World Economic Outlook, October 2010
Challenge: Investment cost uncertainty

- Possible explanations?
- Different definitions: what are the true costs? EPC costs, owners cost and contingency costs
- Regional input cost differences
- Localisation rate
- First-of-a-kind (FOAK)
- Existing site or greenfield site
- Technology and reactor type
- Accounting, regulatory, …
**Challenge: Credit rating pressure**

- **Why?**
  - Bad history, where utilities suffered rating downgrades
  - Currently, most utilities seeking to built nuclear generation do not appear to adjust their financial policies, a credit negative

- **What they seek?**
  - Partnerships - balance sheet strengthening
  - Increasing liquidity to help utilities maintain their credit rating

Some rating agencies like Moody’s take a negative view to issuers seeking to build new NNPs
Challenge: Government Support

Credit without government support or export credit agency is very difficult......

3 August 2010 World Nuclear News
NRG has slashed its monthly spend on its planned new reactors at the South Texas Project (STP) by 95% pending the long-awaited decision on federal loan guarantees

25 February 2010 REUTERS
The Municipal Electric Authority of Georgia (MEAG) launched bond financing for the proposed US Vogtle 3-4 units, only after it got an approval for the US Government loan guarantee

2 July 2009 Nucleonics Week
OECD support for export credits by extending the repayment period for nuclear from 15 to 18 years and “more flexible definitions of repayment schedules”
Other challenges of investing in NP projects

- Political tenures are too short
- Size of capital outlay is not unique, however the size of comparative markets (oil and gas) is larger and more flexible
- Market liberalization is not a show stopper when offset by a corresponding larger size of Utilities/Operators size (M&A)
- But requires a longer-term perspective than just short-term share holder value maximization
New Financing Models

- Government Financing
  - Risk transferability from public to private
  - Ownership transferability from public to private
- Corporate Finance
- Co-operative Models
- Project Finance

Combined models proposed and already in use
Combined models emerging and likely to be widely used
Combined models widely used

Trend continues but initial government support of some form is imminent ...
Shareholders are important for Finland

Together they use 30% of electricity in Finland, want own generation

54 local energy utilities (55%)
15 industrial and trade companies (45%)

Voimaosakeyhtiö SF (66%)
E.ON Nordic (34%)

Fennovoima

Owners get electricity at production cost in proportion to their share. This “Mankala-model“ is widely used in the Finnish power sector.
Human Resources
Knowledge and Competence

Number of Operating Reactors by Age

- Baby boomers retirement
- New entrants
- STAGNATION
- Fukushima
- Chernobyl
- TMI
- HR build up in the 70ies

Note: Age of a reactor is determined by its first grid
Industry must address immediate issues
- Stress tests
- Design, delivery, and operations
- Safety Culture
- Economics
- Competence

Governments must address longer term issues
- Policy-making
- Strong focus on R&D
- Education & infrastructure
- Transparency and Outreach

Higher Risk
Shorter Time

Lower Risk
Shorter Time

Higher Risk
Longer Time

Lower Risk
Longer Time
Concluding Comments

- Firm government commitment and support - imminent
- New financing approaches/models are emerging, repackaging existing methods and combination of project finance/co-operative model
- Global financial crisis will make financing for investors very challenging, especially for large scale infrastructure projects like NNP –financial regulators to impose tougher rules (Basel III, UK bank levy, US Financial Regulatory Bill, etc)
- *Pure project finance is still challenging for nuclear projects - the availability of finance for new NPPs will depend on the initial government support.*
“Disclaimer”

- This presentation presents a “free market” view on investment in nuclear power projects.

- If the public sector (governments) wishes to invest in nuclear power as part of its socio-economic development priorities, finance is not a real obstacle.

- It becomes an issue in the presence of other equally important development needs and private sector participation is sought.