Joint ICTP-IAEA School of Nuclear Energy Management

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Financing Structures for a Nuclear Power Plant Project

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Overview

- The Economics of Nuclear
- Nuclear Power Plants (NPPs) Financing: Major Challenges
- Define Financing
- Sources and Types of Financing
- Existing and Emerging Financing Models and Trends
- Contractual and Ownership Arrangements
- Financial Risk Management
- Concluding Comments
### The Economics of Nuclear

<table>
<thead>
<tr>
<th>Key Advantages of the Nuclear Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatively low fuel cost:</td>
</tr>
<tr>
<td>Price stability</td>
</tr>
<tr>
<td>Performance of nuclear reactors</td>
</tr>
<tr>
<td>Long life time</td>
</tr>
<tr>
<td>Guarantee for energy supply</td>
</tr>
<tr>
<td>Security of Supply</td>
</tr>
<tr>
<td>Clean source of energy</td>
</tr>
<tr>
<td>Economic development: job creation, industrial development, etc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Challenges to the Nuclear Power</th>
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</thead>
<tbody>
<tr>
<td>Complex and highly capital intensive: high upfront capital costs, which are difficult to finance</td>
</tr>
<tr>
<td>Sensitive to interest rates</td>
</tr>
<tr>
<td>Long lead times (planning, construction, etc)</td>
</tr>
<tr>
<td>Long payback periods</td>
</tr>
<tr>
<td>Construction cost uncertainty</td>
</tr>
<tr>
<td>Regulatory/policy risks (revised safety measures)</td>
</tr>
<tr>
<td>New financing structures required to attract private investors</td>
</tr>
</tbody>
</table>
Challenge: NPPs overnight capital cost uncertainty -
Overnight capital cost range by region

- IAEA: Data collected from various publications and studies to keep track of nuclear power plants investment costs, since 2008 (updated August 2012)

All data in 2008 USD
Challenge: NPPs overnight capital cost

* Overnight capital cost quoted for a typical 1000MW NPP ranges from:*

- **Macro or economy level:** GDP
- **Micro or Corporate level:** Market capitalisation

$2 - $6 billion!
Challenge: Highly capital intensive

Gross Domestic Product (GDP) in $2011 billions

More than 60 or 30% countries have GDP below $10b

More than 50% countries have GDP below $50b

Source: IMF World Economic Outlook, October 2012
### Challenge: Highly capital intensive

Approximate market capitalisation of the leading EU, US and Asian utility companies

<table>
<thead>
<tr>
<th>Country</th>
<th>Utility</th>
<th>Market capitalisation (USD billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>GDF SUEZ</td>
<td>53</td>
</tr>
<tr>
<td>EU</td>
<td>EDF</td>
<td>40</td>
</tr>
<tr>
<td>EU</td>
<td>Enel</td>
<td>35</td>
</tr>
<tr>
<td>EU</td>
<td>RWE</td>
<td>28</td>
</tr>
<tr>
<td>US</td>
<td>Duke Energy*</td>
<td>50</td>
</tr>
<tr>
<td>US</td>
<td>Southern Company</td>
<td>41</td>
</tr>
<tr>
<td>US</td>
<td>Exelon Corporation</td>
<td>30</td>
</tr>
<tr>
<td>US</td>
<td>Dominion Resources</td>
<td>30</td>
</tr>
<tr>
<td>Asia</td>
<td>Korea Electric Power Corporation</td>
<td>16</td>
</tr>
<tr>
<td>Asia</td>
<td>Saudi Electricity Company</td>
<td>16</td>
</tr>
<tr>
<td>LA</td>
<td>Centrais Eletricas Brasileiras</td>
<td>8</td>
</tr>
</tbody>
</table>

*Duke Energy merged with Progress Energy in July 2012 to form the largest US utility (Updated October 2012)*
Challenge: Investment cost and Interest During Construction (IDC)

($/kW) in 2008 dollars

North America  Europe  Asia

5% 6Yr  10% 6Yr

challenge: investment cost and interest during construction (idc)
Challenge: Longer NPP Payback Period

Commercial banks usually look towards a payback period of 5 – 7 years!

So which projects would Banks prefer?

Power Plant Project Schedule

Revenue

Debt repayment

Years

Years

1 2 3 4 5 6 7 8 9 10 15 20 30 40 60

Nuclear

gas

coal
Challenge: Long lead times

Finland

- Olkiluoto-3 project in Finland, an EPR 1600MW
- Original cost Dec 2003
- Fixed Price Turnkey Contract (Areva-Siemens)
- €3.2 billion
- Six year delay
- Operational: 2015?
- Considerable cost overruns? $2 billion or more

Asia

- Some projects in Asia are constructed in 5 or less years
- Example: the success story Qinshan III CANDU Unit 1 reactor built in China in 51.5 months, 117 days ahead of schedule, total project cost of $2.5b
- Taishan EPR units, in China to built in approximately 52 months
- “Areva sees future EPR being built in 3-5 years”

FUTURE? Financiers want to see more success stories
**Challenge: Credit rating pressure**

<table>
<thead>
<tr>
<th>Investment Grade</th>
<th>Fitch</th>
<th>Standard &amp; Poors</th>
<th>Moody's</th>
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<tbody>
<tr>
<td>AAA</td>
<td>AAA</td>
<td>Aaa</td>
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<tr>
<td>AA+</td>
<td>AA+</td>
<td>Aa1</td>
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<tr>
<td>AA</td>
<td>AA</td>
<td>Aa2</td>
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<tr>
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<td>A-</td>
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<td>BBB+</td>
<td>Baa1</td>
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<tr>
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<td>BBB</td>
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<td>BBB-</td>
<td>BBB-</td>
<td>Baa3</td>
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<table>
<thead>
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<th>Speculative Grade</th>
<th>Fitch</th>
<th>Standard &amp; Poors</th>
<th>Moody's</th>
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<tr>
<td>BB</td>
<td>BB</td>
<td>Ba2</td>
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<td>B2</td>
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<tr>
<td>B-</td>
<td>B-</td>
<td>B3</td>
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<tr>
<td>CCC+</td>
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</table>
Challenge: Credit rating pressure

Historical Corporate Bond Spreads (Merril Lynch)
Challenge: Credit rating pressure

- “Moody's Says Substantial Nuclear Plant Cost Overruns Increase TVA's Rate Pressure and Debt Ceiling Risks…” (9 April 2012, Moody’s Investors Service)

- “…..ratings agencies could downgrade French energy giant EDF and British Gas owner Centrica if they decide to build four reactors..” (7 April 2012 This is Money)

- “S&P set to downgrade Italy's Enel rating” (Reuters 12 March 2012)
Challenge: Credit rating pressure

- If countries cannot manage their debt it has an impact on their sovereign credit rating.

- S&P May Cut AAA Rating Of European Union, Many EU Banks …credit watch negative (Business insider 7 December 2011)

- Germany AAA credit rating negative outlook (Moody’s July 2012)

- USA loses prized AAA credit rating from S&P (Reuters 6 Aug 2011)

- Moody’s warning to USA.. (The Guardian 11 Sep 2012)
Challenge: Foreign exchange risk

Risk mitigation: Hedging with derivative instruments
Challenge: Commodity prices risk – impact on input cost

Source: IMF Primary Commodity Prices (October 2012)
Challenges: Yield Seeking Investors

- Nuclear vs non nuclear market index

Source: Yahoo Finance.com, November 2012
Major Challenges to Financing NPP

Other Challenges

- Operational performance risk
- Uncertainty in the Regulatory process
- Construction Supply Chain risks
- Deregulated electricity market rules and regulation
- Multinational Institutions policy on credit availability
- 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
So what is Financing? Providing necessary capital through issuance of debt and/or equity

Debt Financing
Local banks
International financial institutions
Export credit agencies
Suppliers
International development organizations
Capital markets: like bonds
Cost of debt: Interest paid

Equity Financing
Local and foreign investors
Shareholder
Capital markets: like IPO
Cost of capital: return on capital
Financing: Cost of finance

In simple case weighted average cost of capital (WACC) is:*

\[
\text{WACC} = \frac{\text{Debt}}{\text{Debt} + \text{Equity}} \times R_d + \frac{\text{Equity}}{\text{Debt} + \text{Equity}} \times R_e
\]

Where:
- \( R_d \) is the cost of debt
- \( R_e \) is the cost of equity

* Without any tax adjustment
Financing: Cost of finance

Generally, for nuclear the cost of finance is higher – with risk premium of x% above other power generation assets added to the interest rate

\[ \text{WACC}_{\text{Other}} + \text{Risk premium for nuclear} = \text{WACC}_{\text{Nuclear}} \]
How to attain finance?

- What are the different financing models employed in the nuclear industry?
  - Government
  - Industry
Types of Financing

- **Government**
  - State Budget (like, tax revenue)
  - Equity ownership
  - Government incentives (like, loan guarantee, construction delay insurance, guaranteed long term power purchases agreements)
- Export credit
- Long-term Infrastructure bonds issuance
Government Financing: An example

China

JV between CGNPC* (70%) and EDF (30%) to co-own and operate two nuclear reactors at Taishan

Nuclear power program cost about $10 billion to construct 2 EPR

IAEA

*CGNPC = China Guangdong Nuclear Power Company
Export Credit Agency (trade finance): Provides financing services such as guarantees, loans and insurance to domestic companies for their activities in order to promote exports in the domestic country:

- Exporter
- Foreign Buyer
- Lending Bank
- Commercial Banks
- ECA
- Customer

How does it work?

- Payment on Delivery
- Letter of Undertaking
- Cover
- Repayment
- Loan agreement
- Delivery
- Repayment of the loan
- Credit
- Credit Insurance
Types of Financing

Governments seek private sector participation

- **Industry financing**
  - Corporate finance or balance sheet finance
  - Project Finance
  - Co-operative finance or hybrid financing
  - New financing trends
Corporate finance or balance sheet finance: borrowing or raising equity against the assets of the company as a whole. A bank or bond holder which provides funds to the company has a claim against the company’s whole cashflows, unless the loan is secured against a particular asset, as is common for mortgages. Risk of that investment is borne by all providers of capital to that company – Example EDF

| France |
| Flamanville 3 project in France, by EDF (Areva PWR 1650MW) |
| Construction cost €6b (Jul 2010) |
| Operational: 2016? |
| 4 yrs behind schedule |
| More than €2 billion over budget (2005 estimate €3.3 billion) |

Others: Enel, RWE, E.On GDF SUEZ..
Industry Financing

- **Project Finance** (non or limited recourse)
  Long term finance based on the projected cash flow of the project - In nuclear pure project finance is still not applied but some combination of corporate finance and project finance…hybrid finance

- **Co-operative finance or hybrid financing**

  Example Olkiluoto 3 or Finnish Model - expanding equity partners to diversity risk
  
  - Characteristics of hybrid financing (corporate/project finance):
    - The project financed on the balance sheet of TVO
    - Part of equity and loan is provided by the large customers
    - A long-term PPA with large customers ensuring future stable revenue stream from the project
    - Leverage characteristics similar to project finance – 75% debt and 25% Equity
Industry Financing: New trends emerging

Expanding equity partners to diversity risk..others like Romania (state-controlled nuclear power generator Nuclearelectrica) seeks partners for 2 units at Cernavoda nuclear power plant (NPP).

Equity Investment by vendors (The strategic partner/s) - the new market trend? The extend of investment will depend on the structure of project.

Regional Alliance: Small countries are forming regional alliance with regional partners to attract strategic investors with competence and financial capability to build the new nuclear power project.
Industry Financing: New trends emerging

- Owners and investors looking towards the capital markets

**Infrastructure Bonds**

- State-owned China Guangdong Nuclear Power Holding (CGNPH) completed the sale of its first offshore yuan bond, raising CNY1.5bn ($240m) via a three-year bond at 3.75%..rated A+/A3 - Fitch & Moody’s (Nuclear Business, Nov 2012)

- Korea Hydro and Nuclear power, which has issued $750 million in bonds (Reuters, 11 Sep, 2012)

**Initial Public Offering**

- IPO is issued by the China National Nuclear, formed late last year -state-owned parent is China National Nuclear Corporation (CNNC), which is a large state owned enterprise, backed by government with a strong credible AA- Stable (Moody’s) credit rating (The Wall Street Journal, 20 Aug, 2012)
Financing Models Trend

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

Ownership transferability from public to private

Government Financing

Corporate Finance

Co-operative Models

Project Finance

Government Support

Risk transferability from public to private
Existing Contractual Arrangements

- Basically there are the following main types of contractual approach that have been **applied** for NPP projects:

- **Turnkey contract**: a single contractor or a consortium of contractors takes the technical responsibility for the whole NPP project.

- **Split-package**: the overall responsibility is divided between a relatively small number of contractors, each building a large section of the work.

- **Multi-contract**: the owner or its architect-engineer assumes overall responsibility for engineering and managing the NPP project, issuing a large number of contracts.
New Contractual Arrangements

- Built Own Operate scheme: A contractual arrangement whereby a project company is authorized to finance, construct, own, operate and maintain an infrastructure.
- The project company is allowed to recover its total investment, operating and maintenance costs plus a reasonable return thereon by collecting tolls, fees, rentals or other charges from facility users.

Example:
- Akkuyu NPP Project in Turkey
- Russian design: VVER 1200MW – 4 units
- Main stakeholders: Russian Federation and the Republic of Turkey
- Project Company: Russian government companies affiliated with Rosatom to BOO the NPP
- Construction likely to start in 2014
To attain finance requires development of “Financial Risk Management Strategy Framework”

- Identify, Assess and Estimate financial risks
- Allocate risks— who takes on the responsibility? based on the financing model & contractual/ownership structure
- Develop Risk Mitigation Strategy

Includes construction and operational cost risks
### Financial risk mitigation strategy framework

#### An Example

**Construction Phase**

<table>
<thead>
<tr>
<th>Name of risk</th>
<th>Risk assessment</th>
<th>Allocation</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction delay</td>
<td>Medium</td>
<td>Owner/Contractor</td>
<td>Qualified third party contractors/PMC</td>
</tr>
<tr>
<td>Credit risk</td>
<td>High</td>
<td>Owner/Lender</td>
<td>Well defined loan agreement</td>
</tr>
<tr>
<td>Foreign Exchange/Currency</td>
<td>Medium</td>
<td>Owner/Lender</td>
<td>FX hedging strategy</td>
</tr>
<tr>
<td>Interest</td>
<td>Medium</td>
<td>Owner</td>
<td>Fixed rate/ECA</td>
</tr>
</tbody>
</table>
Concluding Comments

- Governments have a critical role with explicit long-term commitment
- Wide range of overnight capital cost challenging for newcomers
- Financing and construction duration key influencing factors to impact total investment cost
- The Fukushima accident foreseeable risk might lead to additional safety measures, which might increase the cost of NPPs
- Government financing still dominate the industry
- ECA support is vital and ensures bankability of the project
- Private financing - JV among utilities with robust balance sheets and hybrid financing
- Risk diversification and meticulous Financial Risk Management Strategy imminent
- Strict financial industry regulation, like Basel III to impact liquidity and more vigilance of large scale risky projects
- Financing NPP is challenging but viable with new financing trends emerging to support nuclear new built
Thank very much you for your attention!

IAEA...atoms for peace.