Project Structuring and Risk Allocation for NPP Construction

Greg Kaser

Senior Project Manager

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Outline of the Presentation

1. **NPP construction experience – evidence from the WNA reactor database**
2. **Project risks:**
    - Market uncertainty
    - Contractor performance
    - Stakeholder involvement
3. **Contracting & financing strategies**
4. **Developing and disseminating good practice**

1. NPP Construction Experience

Average Construction Times of Nuclear Power Plants

Region	NPPs (number)	Net Capacity (MWe)	Construction completed within period (months)			
			Before 1980	1980-1999	From 2000*	All
Generation I reactors						
North America	14	1 789	51	:	:	51
EEA	43	7 515	60	:	:	60
CMEA	4	346	89	:	:	89
East Asia	1	137	56	:	:	56
World	**62**	**9 787**	**61**	**:**	**:**	**61**
Generation II reactors						
North America	138	126 203	69	130	516‡	101
Latin America	8	6 056	74	150	250	178
EEA	142	130 932	65	92	295	94
CMEA/FSU	88	61 537	63	87	223	97
East Asia	117	100 850	51	54	58	55
South Asia	29	10 272	65	139	81	95
West Asia	1	915	:	:	436◊	436
Africa	2	1 830	:	101	:	101
World	**525**	**436 595**	**64**	**95**	**120**	**90**
Generation III reactors						
North America	4	4 434	:	:	60	60
EEA	2	3 300	:	:	108	108
FSU	5	5 408	:	:	71	71
East Asia	18	23 033	:	40	76	72
West Asia	4	5 360	:	:	60	60
South Asia	2	1 834	:	:	127	127
World	**35**	**43 441**	**:**	**40**	**73**	**74**

CMEA: Council for Mutual Economic Assistance
EEA: European Economic Area
FSU: Former Soviet Union

* Includes NPPs under construction
‡ Watts Barr-2 only
◊ Bushehr only

Source: WNA Reactor Database

Construction times - Lessons

- Standardization of plant design to simplify configuration, improve functionality and control systems and optimize production processes.
- Undertake detail design and work planning prior to construction.
- Modular construction techniques to allow manufacturing and construction to proceed in parallel and better quality control.
- Lean construction/ manufacturing philosophy to rationalize tiers of contracting, integrate processes and eliminate disruption and non-conformities.
- Contracting to ensure partnership:
  - risks are shared to improve communication and work planning between the client, main contractor (e.g. EPC contractor) and sub-contractors and suppliers;
  - shared objectives of on-time/ to-budget delivery.
- **Goal of an average construction time of <60 months!**

2. NPP Risks & Characteristics

- **Three types of project risk need to be managed:**
  - Technical;
  - Business; and
  - Social and political.
- **Nuclear power plants have the characteristics of 'infrastructure':**
  - Enablers of economic and social activity;
  - Strategic assets – secure energy in terms of price and reliability;
  - Part of a network;
  - Enduring – over 40 years of operating life;
  - Around-the-clock operation (base-load generation with 90% capacity factor);
  - Fixed assets;
  - Attached legacies – decommissioning at end of service.

Historically NPPs have been seen as contributing to a nation's development and to be publicly owned. It is therefore a major challenge to obtain commercial financing (rather than development financing). The developer of a nuclear power plant must have a longer term outlook and strong credit rating.

Project Risk Matrix

Type of risk	Pre-completion Phase		Post-completion Phase		General
	Development	Construction	Operation	Dismantlement	
Technical	Siting approval Environmental impact assessment Design modifications	Construction workforce Supplier workforce Vendor & contractor performance: • Cost overruns • Delays • Quality & re-work • Supply chain fragmentation Working practices & industrial safety	O&M workforce Plant performance Fuel supply Used fuel storage/ reprocessing Nuclear event at the plant Nuclear event elsewhere	Decommissioning workforce Dismantlement & demolition workforce Used fuel disposal arrangements Radioactive waste and other materials disposal approval & arrangements	Safety assessment and licensing Maturity of the technology Project management
Business	Project finance arrangements Project procurement arrangements	Impacts of cost overruns and delay	Power purchase arrangements Sales revenues Supplier agreements	Decommissioning fund arrangement Radioactive waste disposal fund & facility	Electricity market Interest rate Exchange rate Price & cost inflation Insurance arrangements Export credit & country risks Carbon market
Societal & Political		Localized disruption	Local communities' attitude towards emergency preparedness drills	Localized disruption	Energy policy Environmental policy Regulatory change Legislative change Enforcement of contracts General public approval Local community support

Mitigating major risks

- **Technical:** Construction delay often arise from interface problems with:
  - Regulatory bodies
    - How to handle modifications to what was promised or expected?
    - How to prevent hold points from becoming road blocks?
  - Suppliers and sub-contractors
    - How to handle modifications to contract or specification?
    - How can cost escalation be contained and/or reimbursed if work is delayed?
    - How flexible is the work schedule if variations must be accommodated?
- **Business:** Market uncertainty arise from a number of sources:
  - Long-term uncertainty over revenue flow (equity stakes?);
  - Short-term volatility in commodity prices (inflation, deflation and hedging?);
  - Impact on financing from construction delays (government guarantees, flexible loan terms?);
- **Social & Political:** Stakeholder involvement can be strengthened by:
  - 'Recruiting' local champions (N.B. not paid) such as local councillors, educators, editors, chambers of commerce, etc. through briefings while respecting their independence;
  - 'Town hall' meetings and information to households and customers.

Structuring a project

- **Project delivery system should**:
  - Allocate the risks among the key stakeholders (i.e. project participants) equitably; and,
  - Provide incentives to fulfill their responsibilities:
    - Developers and their financier (and/or investors?) and their contractors;
    - Builders and sub-contractors and their financiers and their client (the developer);
    - Operators and their financiers and/or investors and their customers.
  - Distribute the risks and rewards as balanced 'packages':
    - Development phase – technology vendor-architect/engineer-developer/owner;
    - Construction phase – developer/owner-EPC contractor-suppliers/sub-contractors;
    - Operating phase – owner/operator-technology vendor?;
    - Dismantlement phase – owner/operator-technology vendor?.
  - Use entry points to engage other stakeholders (e.g. the community):
    - National policy debates (e.g. on energy security, GHG mitigation, etc.)
    - Consumer concerns (e.g. on the price of electricity and its volatility)
    - Local economic development policy discussions (e.g. on well-paying long-term jobs, on recruiting local labour for the project, on contribution to vocational education, etc.)

3. Contracting & Financing Strategies

Contracting method	Scope of responsibility	Advantages	Risks
Multi-package	Prime contractors deliver discrete packages of engineering, works and component supply.	Plant owner enjoys direct control over the project. Packages can be tendered to a wider range of suppliers.	Owner's project management is spread over a multiplicity of contractors.
Split-package	Responsibility for the works is divided between two to five EPC contractors (e.g. for nuclear island, conventional island, civil engineering, etc.).	Plant owner retains detailed oversight of the project but must coordinate contractors.	Accountability for risks may be blurred unless there is strong project management organization set up by the plant owner.
Single EPC package	EPC contractor assumes responsibility for completing all phases of the project.	Reduced need for owner's project management organization.	Clear accountability for performance is required to ensure risks are managed. A close and durable relationship must be fostered between the plant owner and the EPC contractor.

Contracting implications

- **NPP Project complexities:**
  - Developer/owner cannot stand aside from the construction. Owner is usually also the operator of the plant and carries the liability for the plant's safe operation.
  - Meeting the regulatory body's requirements is the owner's responsibility.
- **Design complexities:**
  - Technology vendors offer a proprietary design so comparing bids is not straight forward.
- **Engineering, procurement & construction (EPC) contractor:**
  - Has the experience in **managing a project** and is responsible for delivering the project on time: but,
  - **Managing the regulatory interface** remains the responsibility of the developer/owner; along with the technology vendor of the nuclear steam supply system and the design authority.
  - Milestone payment arrangements are common.
- **Sharing risks without accumulating contingencies in the price:**
  - Sub-contractors expect a voice in project management if they are to accept liability in the event of delay in completing manufacture and construction activities.
  - Incentive payments can encourage the right behaviour but the client must resource this.

Financing options

- **Utility raises finance through issue of corporate bonds and/or equity:**
  - Corporate finance has been the main means for financing the construction of NPPs to date.
  - However, it can restrict the utility's other investment possibilities (e.g. expansion through an acquisition at home or abroad).
- **Merchant plant using project finance:**
  - Project finance for merchant plants is available for non-nuclear energy technologies. The Braka project in UAE was intended to be project financed but the owner is providing funding.
  - The lengthy pay-back period of the investment is a problem but long-term investors (e.g. pension funds) want reliable income streams.
- **Development finance:**
  - World Bank and European Investment Bank used to finance NPPs but no longer do so. European Bank for Reconstruction & Development has financed decommissioning.
  - Projects must meet the Equator principles for sustainable economic, social and environmental development.
- **Export credit finance:**
  - Some NPP projects are benefitting from export credit guarantees.

Role of government

- **Stable regulatory environment:** Energy policy and safety-environmental policies need to be predictable; but,
- **Several governments have changed direction since Fukushima:** e.g. Decisions by Germany, Japan, Switzerland have had a major financial impact on utilities.
- **Deregulated vs. regulated electricity markets:**
  - Do consumers really have a choice or a voice (in practice)?
  - Unpredictable energy prices are a significant business risk for NPP construction.
  - Market distorting subsidies for renewables will displace nuclear from base-load generation.
- **Governments must take the initiative on long-term issues:**
  - Used fuel and waste disposal programmes.
  - Security of energy supplies.
  - Universal supply obligation.

4. Developing & Disseminating Good Practice

- **Fostering partnership within the supply chain**:
  - WNA initiative to define a common vendor approach to supplier certification and oversight is under discussion.
  - WNA review of contracting arrangements underway for new build.
  - WNA Construction Risk Management Working Group newly established.
- **Questions**:
  - Should governments prescribe the project delivery system for strategic energy assets?
  - Will governments that have agreed to opt out of nuclear energy allow international development banks to co-finance NPPs?
  - Will the 'level playing field' provisions of the Energy Charter Treaty deter governments from extending preferential treatment to renewable energy technologies? The World Trade Organization could rule on feed-in tariffs with cross-border implications (e.g. Ontario, Austria).

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Thank you:

Greg KASER
WNA London
kaser@world-nuclear.org

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