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Role of Government in Nuclear Power

> "Strong and consistent government support is an essential prerequisite for initiating or expanding any nuclear programme, as a part of a long-term national energy strategy."[1]

Nuclear power development is, and has been, driven by the actions of governments.

Government utilities, public power utilities, or investor-owned utilities (IOUs) with regulated rate treatment built nuclear power plants in operation and are building the nuclear power plants under construction.

A high degree of government involvement was typical during the period when the existing nuclear power plant fleet was built. This high degree of government involvement reflected the structure and organization of the electricity industry during this period.

The most important factor for a nuclear power plant is capital cost. The cost of capital for government utilities, public power utilities, or investor-owned regulated utilities is lower than the cost of capital for private power plant developers and investors.

More importantly, government utilities, public power utilities, or investor-owned regulated utilities can take a long-term view when investing in large infrastructure projects that provide public benefits, such as nuclear power plants.

[1] The Financing of Nuclear Power Plants," OECD/NEA No. 6360, 2009

Electricity markets not compatible with nuclear power

Electricity industry restructuring, privatization, and reform in the electricity industry over the past decade and longer have reduced the role of government in the electricity industry. New nuclear power plants are being considered in countries or regions that have reformed the electricity industry and put electricity markets into place.

There are examples of market-based merchant[2] power plant development of conventional power plants, but no merchant nuclear power plants have been built. Several attempts to develop merchant nuclear projects suggest that this is difficult and may not be possible. There are serious questions as to whether nuclear power plants can be or will be developed as market-based investments.

Generation investments driven only by short-term electricity markets will not deliver desired levels of reliability, electricity cost stability, and environmental impacts. The long-term system planning and generation investment approach that led to the first round of nuclear power plant development decades ago is missing from these electricity markets.

Government nuclear power options

Governments can and should make long-term infrastructure investments, including nuclear power projects, if markets do not deliver these investments. The role of government in new nuclear power plant development is critical.

This paper provides some options for governments to take action to encourage a new round of nuclear power development.

Potential approaches for government to facilitate nuclear power plant investment range from a comprehensive government nuclear power program to more discrete and targeted support.

Comprehensive government nuclear program

Some countries, including France, Russia, South Korea, and China, have adopted a national nuclear power program that builds a national nuclear fleet, develops nuclear power industrial capability, and develops a national nuclear vendor. This approach usually leads to sales of nuclear power plants to other countries.

The role of government in nuclear power is and has been widespread. However, there are few countries where the nuclear power programme can be considered as a comprehensive government enterprise.

[2] The term merchant, as used in this paper, refers to a power plant project that is developed based on the revenue from market sales of power. This is different from a power plant project with a long-term power purchase agreement (PPA), which provides revenue security and credit support to the project by the PPA counterparty.

The governments pursuing this state capitalism[3] approach have a government electric utility that can place orders for multiple nuclear power units that are supplied by government-owned nuclear vendors and constructors.

These programs involve a combination of large national nuclear power plant fleets and national nuclear power plant suppliers.

Large national nuclear power fleets

National nuclear power programs involve a fleet of nuclear power plants in the host country. The nuclear fleet development may allow the government (as a buyer of nuclear projects and technology) to obtain price concessions from outside vendors. These purchases from outside vendors may be the first step in creating a national nuclear power industrial capability.

A large national nuclear fleet, especially if there are multiple identical units, allows experience and learning. This learning may lead to lower capital cost and faster construction time as the fleet build proceeds. The large nuclear fleet will also allow an approach to management, operations, and maintenance that provides benefits in higher operational performance and lower O&M cost. A large national fleet also means a large requirement for nuclear fuel that may provide the basis for vertical integration into nuclear fuel cycle industries.

National nuclear power plant vendors

Investing in a large national fleet of nuclear power plants also brings opportunities to establish state-owned companies that build and sell those nuclear power plants, along with related goods and services. The nuclear power plant investment strategy is used to drive a larger industrial development strategy.

In this national nuclear industrial development approach, the entire value chain is integrated into one national economic entity. This approach is linked to the number of nuclear units – a plan to build many new nuclear units presents opportunities for national nuclear industrial development that would not be possible with a smaller build program.

Government-owned nuclear vendors, with large orders from affiliated government electric utilities, can develop an integrated nuclear supply chain, invest in human resources, and invest in manufacturing capacity based on long production runs. Learning curve effects and mass production benefits (at all levels of the supply chain) are captured by the government as multiple identical units are built with declining unit costs.

This approach will result in national nuclear champions that may be competitive in the global nuclear power market based on experience and proven results in the home country.

This approach, done well, may result in a national nuclear power plant enterprise that can offer buyers one-stop shopping that includes a proven reactor design built by an experienced

[3] Ian Bremmer's book about state capitalism – ***The End of the Free Market, Who Wins the War Between States and Corporations*** – explains the forces underlying the nuclear power industrial strategy in China.

vendor, support from a full-service integrated supply chain, operation and maintenance contracts, operators, cradle-to-grave nuclear fuel services, and even project financing.

To provide a comparable integrated offering, non-national reactor and power plant vendors must use subcontracts and other agreements to bring a team of unrelated commercial entities together. If financing and operation is a part of the package, financial entities and utilities with nuclear operations expertise must be included in the team. Just getting a winning team in place is a major challenge. This portfolio of project agreements adds cost (to meet risk premiums and profit margins of subcontractors), risk (as responsibility is shared between multiple commercial entities), complexity (project management is more difficult due to multiple entities with multiple interests and contractual rights), and the need for effective project management.

Some national nuclear programs, such as those in Russia, use national financing and loans as a competitive edge in the export market. The Russian offer to finance, build, own, and operate nuclear power plants in Turkey (i.e., the nuclear BOO approach) and the government-to-government loans linked to nuclear power sales in Belarus, Bangladesh, Vietnam, Hungary and other countries is based on Russian government financial resources.

China's large domestic nuclear power plant build programme is also developing potentially formidable competitors that will soon enter the nuclear power export market.

As South Korea demonstrated in the UAE win, national nuclear companies can get it right and prevail over both commercial reactor vendors and other national nuclear companies.

Government ownership of nuclear plants

Even if a country does not intend to establish a national nuclear power company, governments can drive investment by a government utility. A government utility has the ability to recover the costs of a power plant investment through a combination of electricity rates and other government revenues.[4] A government can make long-term electricity resource planning and investment decisions that reflect the long-term public benefits of nuclear power.

Government investments in nuclear power plants may be used to achieve national goals such as energy independence, improved fuel security, lower carbon emissions, local economic growth, and the creation of highly skilled nuclear jobs.

Government-owned companies

In some countries, the electricity industry is not a part of government, but consists of one of more state-owned enterprises (SOEs).

In some cases, this may be little different from direct government ownership. The SOE may be controlled by the government and used to implement government policies and plans. The

[4] To the extent that the investment is not recovered through electricity rates, the government may implicitly or explicitly fund the investment through general tax revenues.

SOE may have electricity prices that are controlled by the government.[5] In this situation, the government can provide relatively strong support for a nuclear power plant investment.

Some SOE electricity companies are financially independent and function more like a regulated electric utilities. Depending on the situation, an independent SOE may be unable to build a nuclear power plant without significant government financial support. The relationship between an electric utility SOE and the regulator and the government owner may allow such support to be provided in multiple and indirect ways.

Cooperative efforts between government and industry

Japan's approach to the nuclear power industry involves "cooperation" between commercial utilities, commercial reactor vendors, and the government. While the level of cooperation in the Japanese nuclear programme might seem more focused than the more purely commercial approach in some other countries, it is quite different from the national (state capitalism) approach to nuclear power taken in countries such as Russia and China.

Japanese nuclear companies view the emergence of national nuclear power enterprises as a powerful competitive threat. The 2010 creation of International Nuclear Energy Development of Japan (JINED) was intended to help Japan compete with the national nuclear vendors by enhancing the cooperation level and coordination between Japanese reactor vendors that are competing in the export market.

Public Power Utilities

A slightly different approach to government (or public) ownership and control of electricity utilities is seen in the U.S. approach to public power. Public power entities have tax-exempt status and legal authority to set rates and raise revenue, allowing the entities to raise capital on favorable terms for power plant investments.

In the U.S. electricity industry, a variety of public power utilities exists. There are municipal utilities, electric cooperatives, and federal government utilities that operate alongside regulated IOUs and deregulated companies.

- Municipal entities (cities, counties, utility districts, and other local government entities) are often also electric utilities; municipal utilities are co-owners in many of the nuclear power plants in the U.S.;

- Federal power entities, including the nuclear utility TVA;

- Electric cooperatives and G&T Cooperatives; often part owners of nuclear power plants.

The tax status, ability to raise revenue, and access to capital markets may mean that public power utilities can invest in nuclear power plants more easily than merchant generators. In

[5] For example, a government-owned utility may charge electricity rates that are below cost in order to achieve some government social policy, with the shortfalls coming out of general government revenue. The opposite example is when a low-cost government electricity provider charges rates that are much higher than costs in order to bolster government revenues with dividends.

some public power utilities, political oversight may make a large and long-term investment in a nuclear power plant difficult.

The Finnish Mankala companies such as TVO and Fennovoima are similar to US Generation and Transmission Cooperatives, but Finnish law allows private companies to join these entities.

Regulated IOUs

The U.S. electricity industry is dominated by investor-owned utilities (IOUs) that are regulated by state utility commissions in regions that did not undertaken electricity restructuring.

A regulated IOU may be able to undertake a nuclear power plant project and to recover the investment in rates, with the level of regulatory certainty determined by the approach to resource planning in the state, the regulatory approval process, and other factors.

In the 1970s and 1980s, a number of U.S. IOUs invested in nuclear power plants that experienced significant delays and cost overruns. This led to the establishment of detailed rules and regulatory oversight of utility resource planning.

In states with a clear set of laws and rules regarding power plant investments, a utility may have a high level of regulatory certainty that it will be able to recover investments in approved resource plan projects, including nuclear power plants.

Power contracts

Even in regions where the electricity sector has been restructured, there may be a regulated, government, or public power electricity provider that has an obligation to serve customers. These load-serving entities (LSEs) could enter into power purchase agreements (PPAs) that would provide revenue support to a new nuclear power plant.

Some countries with electricity markets have put provisions in place to ensure reliability and capacity investments using capacity mechanisms and payments outside the energy market. These provisions could be used to provide some revenue support for new nuclear power plants.

Italy was, prior to the Fukushima Dai-ichi event, considering a return to nuclear power. Italy has a regulated government-owned retail entity that is a single buyer for about a third of the total electricity supply in the country. There were proposals for this entity to enter into PPAs or other contracts that would provide the credit support needed for new nuclear power plants.

A long-term PPA may provide as much or more revenue security to a nuclear power plant developer than regulated rate base treatment provides to an IOU investing in a new nuclear power plant.

PPA terms can also place incentives (and risk) on the nuclear plant developer. A PPA could place the risk of delays on the developer by requiring replacement power during delays; could include stipulated power prices that place cost overrun risk on the developer, and could

include delivered power quantities that place operational performance risk on the operator of the completed nuclear power plant.

A PPA may allow a nuclear power plant developer to raise capital using the PPA as credit support under a project finance model.

In countries with electricity markets, governments might structure a nuclear electricity contract (e.g., a CfD) to provide revenue assurance to a nuclear project developer. Such contracts might be an effective way to achieve national electricity planning goals related to the level and type of nuclear power plant build through providing additional revenue certainty, while preserving the key features of the electricity market.

An example of this approach is the UK negotiated Hinkley Point C deal.

An auction process may also be used instead of a negotiated contract to bring some market competition into the process.

In an auction approach, the government could offer a package of targeted nuclear project incentives (e.g., a site, certain capacity payments, tax reductions, etc.) bundled with a nuclear electricity contract that has a structure but not a price. Bidders in this auction would compete on the price they would require for the nuclear electricity contract. The winners in this auction would be those qualified bidders that asked for the lowest prices in the nuclear electricity contract.

Focused Government Support

More focused and limited government support may also be able to facilitate nuclear power plant investment.

Revenue support

The U.S EPAct of 2005 included a measure to enhance revenue for some new nuclear power plants through a Production Tax Credit (PTC) of $18 per MWh, with limits.

The UK government's Hinkley Point C deal includes multiple revenue support mechanisms (e.g., capacity payments, carbon payments, a CfD contract, etc.) to help the economics of new UK nuclear power plants.

Cost support

Governments can also provide support for nuclear power plants by lowering costs. A key tool for governments in this respect is the ability to commit low-cost capital.

The U.S. EPAct of 2005 provides for loan guarantees for a limited number of new advanced nuclear power plant projects. These loan guarantees are intended to increase access to funding and lower the costs of funding for new nuclear power projects.

The UK Hinkley Point deal also includes a loan guarantee.

Risk reduction

Another way that governments can offer targeted support to the nuclear industry is to lower risk.

To some extent, revisions to US NRC licensing process to move to the new Part 52 approach (i.e. a single construction and operating license) from the earlier Part 50 approach (i.e. a construction license process followed by a separate operating license process after the nuclear plant was completed) was such an effort.

In a similar move, the UK government has changed the planning approvals process for new nuclear power plants and is conducting reactor design reviews in a process that is analogous to the US NRC Design Certification process.

The new UK Planning process that was specifically put in place to avoid the historically long and difficult Sizewell B decision process was again changed when the UK government changed. It remains to be seen if the even newer version of the planning process will be a help or hindrance to the proposed nuclear plants in the UK.

Siting, licensing, and the potential for delays due to intervention are large risks for a new nuclear power plant, so efforts to improve the planning and licensing processes should lower risk to a new nuclear power plant.

In an even more focused risk reduction mechanism, the U.S. EPAct of 2005 includes provisions to compensate a new nuclear power plant project for certain regulatory and legal delays during construction by providing limited standby insurance support.

Other support

There are other focused support mechanisms that a government might offer, including assistance in obtaining a site, providing a site, acting as a first customer for a new nuclear plant design with FOAK risks (perhaps through a PPA, as discussed above), funding nuclear power research and development, and assistance to new nuclear power plants in obtaining necessary permits and licenses (e.g. the NP2010 DOE program).

In the US, the government helped fund nuclear industry efforts to obtain the first NRC licenses under the new Part 52 process. The US Government also funds research and development for nuclear power plants.

Conclusions

New nuclear power projects are moving ahead only where governments have a significant role.

As the nuclear industry gains experience, there is a possibility that the role of government in the nuclear power industry may become less critical.

If nuclear project economics were improved and risks were reduced, merchant nuclear projects might be feasible. This would require lower nuclear power plant capital costs, lower risks of construction schedule delays and cost overruns, higher electricity market prices, real costs for carbon emissions, and other changes.

However, until nuclear industry and market conditions change, new nuclear power projects will be developed only with a significant role of government.

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