

Innovation in nuclear energy development: analyzing the build-own-operate model in the Türkiye-Russia nuclear power plant project



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Introduction

The Türkiye-Russia nuclear power plant (NPP) project takes a unique approach by using the Build-Own-Operate (BOO) model, which is first in the nuclear energy sector. Unlike traditional methods, this model gives full ownership and operational control to the contractor—a Russian consortium. This study compares the BOO model with other common NPP contract types, such as Turnkey (TK), Split, and Multi-contract arrangements.

Description of the research problem

The BOO model is an alternative financing and ownership structure in energy infrastructure projects, differing significantly from conventional contracting types. However, this model has never been implemented in a nuclear power plant project before. Its first application is the Akkuyu Nuclear Power Plant project between Türkiye and Russia. This study examines the advantages and disadvantages of the BOO model by comparing it with traditional contracting types, assessing its economic, technology-knowledge transfer and strategic implications. The findings contribute to the broader discourse on sustainable energy investments and policy-making, particularly in nuclear energy development.

Methodology

This study employs a comparative analysis approach to evaluate the BOO model in the Akkuyu Nuclear Power Plant project against conventional nuclear power contracting models, such as TK, Split, and Multi-contract arrangements. The research includes a review of contractual frameworks, financial structures, and technology-knowledge transfer mechanisms. Data is sourced from regulatory documents,

industry reports, and academic literature to assess key performance indicators such as cost efficiency, project timelines, and domestic technology absorption. Additionally, case studies of previous nuclear projects under traditional contracts provide a reference for understanding the unique challenges and opportunities presented by the BOO model. The findings aim to inform policy discussions on the feasibility and long-term impact of BOO in nuclear energy development.

Results

Comparisons of some vital parameters for different contracting types are demonstrated in the table. The level of technology and knowledge transfer in a BOO contract depends heavily on the specific terms of the agreement. In the case of the Akkuyu NPP, Türkiye has emphasized localization and technology and knowledge transfer as key elements of the agreement. On the other hand, some concerns arise from the Akkuyu agreement; these include long-term dependency on the foreign operator for plant operation. Additionally, there are uncertainties regarding the management of spent nuclear fuel and the lack of well-defined penalties for project delays, which raises concerns about accountability and schedule adherence.

Conclusions

BOO contracts offer several advantages for newcomer countries with no prior experience in the decommissioning of NPPs. To facilitate knowledge and technology transfer, specific terms must be explicitly included in such agreements. Concerns arising from the Akkuyu Project underscore the importance of carefully structured BOO agreements to balance immediate benefits with long-term strategic national interests. Lessons learned from the Akkuyu Project continues provide valuable insights for future nuclear projects.

Contracting Type	Cost	Responsibility Share	Knowledge & Tech Transfer	Project Time
Turnkey	High, due to a single contractor managing the entire project.	Contractor holds full responsibility; minimal client involvement.	Limited; technology remains with the contractor.	Generally fast, as a single entity manages all phases.
Split Contract	Moderate; allows for competitive pricing but requires careful cost management.	Shared between multiple contractors, increasing coordination challenges.	Moderate; some technology transfer occurs, but integration can be complex.	Longer than TK due to coordination efforts.
Multi-Contract	Variable; potentially cost-efficient but complex to manage.	Client takes on significant responsibility in coordinating contractors	High; greater opportunities for knowledge transfer and localization.	Can be the longest due to multiple contracts requiring extensive coordination.
BOO	Lower upfront cost for the client but long-term financial reliance on the contractor.	Fully contractor-owned and operated, limiting host country responsibility.	Depends on agreement (High in Akkuyu case)	Fast due to contractor’s full control and financial motivation.

