Causes & mitigation strategies of NPP construction schedule delay: Gap analysis between domestic and international project

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Introduction

- Recently, nuclear power capacity worldwide is increasing steadily with 52 reactors under construction due to economic efficiency, reliability and closeness to nature, without carbon dioxide emissions over full life cycle as a base load source of electricity.
- Seventeen countries are currently building nuclear power plants, and 52 reactors were under construction as of 1 July 2020. However, all reactors under construction in at least 10 of the 17 countries have experienced mostly year-long delays. Over the two years 2018 and 2019, there is only one unit out of 15 units that started up on-time that is Tianwan-4 in China as shown in figure 1.
- The schedule delay led to many undesirable effects on the project and its stakeholders such as lawsuits between parties, increased costs, loss of revenue, construction termination, and reputational damage.
- The scope of this research is to identify and compare the delay factors and the effective mitigation strategies between a domestic and an international project.

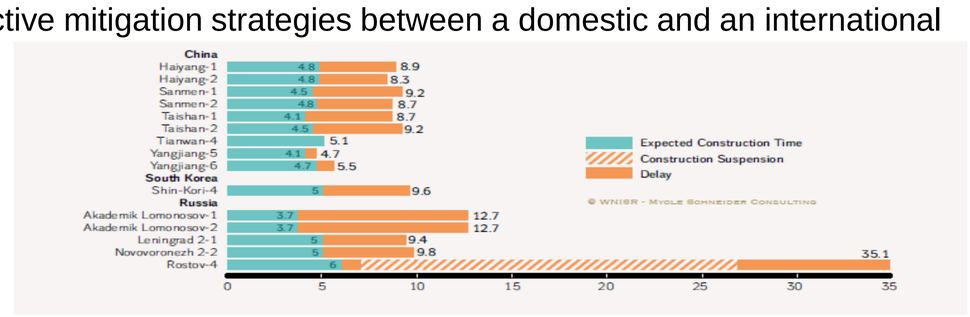

Figure 1. Delays for Units Starts UP 2018 - 2019

Source : WNISR with IAEA-PRIS, 2020

Methodology

Research activities	Research output
Literature review	• Cause of NPP Construction schedule delay • Mitigation Strategies for schedule delay
Questionnaire Design	• 12 major delay factors • Mitigation Strategies for each delay factor
Survey	• Email survey to 23 experts
Delay factor analysis	• Gaps between domestic project and international project
Mitigation Strategy Analysis	• Gaps between domestic project and international project

Survey Result

Table 1. Important delay factors in NPP project.

Main Causes	Domestic		International		Gaps	
	Mean	Rank	Mean	Rank	Differ.	Rank
Inadequate completion of design and frequent design change	4.13	1	4.17	1	0.04	10
Changes in policy & enhanced requirements and a delay in approval from regulatory body	3.94	2	3.94	2	0.00	11
Slow procurement, manufacturing of equipment and delivery to the site for installation	3.31	4	3.67	3	0.36	3
Difficulty in managing subcontractor chain	2.69	9	3.06	7	0.37	2
Quality issues related to manufacturing and construction	2.81	7	2.94	9	0.13	8
Shortage of manpower and insufficient number of staff	3.13	6	3.33	4	0.20	6
Corruption and collusion in nuclear supply chain	1.94	11	1.94	12	0.00	11
Poor contract management and project management	2.44	10	2.67	11	0.23	5
Delay in approval of design documents	3.44	3	3.28	6	0.16	7
Lack of communication and interface control among parties	2.75	8	3.00	8	0.25	4
Lack of skilled and experienced labors : Low productivity under poor environment	3.25	5	3.33	4	0.08	9
Different weather and language barrier and culture gap	1.69	12	2.94	9	1.25	1

Table 2. Mitigation strategies of inadequate completion of design and frequent design change.

Mitigation Strategy	Domestic		International		Gaps	
	Mean	Rank	Mean	Rank	Differ.	Rank
Thoroughly review the design by experienced designer	3.56	4	3.67	2	0.11	4
Control design interface among parties	3.50	5	3.44	5	0.06	5
Reflect lessons learned from previous project	4.00	2	4.06	1	0.06	5
Improve communication and coordination among relevant departments	3.44	6	3.56	4	0.12	3
Define clear scope and responsibility management of design change	4.13	1	3.61	3	0.52	1
Ensure participation of manufacturer and construction expert in initial stage of design	3.63	3	3.33	6	0.30	2

Table 3. Mitigation strategies of changes in policy & enhanced requirements and a delay in approval from regulatory body.

Mitigation Strategy	Domestic		International		Gaps	
	Mean	Rank	Mean	Rank	Differ.	Rank
Regularly check changes in government regulation/laws and act	3.44	5	3.50	5	0.06	4
Prior consultation with regulatory body to reach a consensus	3.25	6	3.78	2	0.53	1
Make a good relationship with regulatory body	3.63	2	3.39	6	0.24	2
Submit documents as soon as possible for approval	3.50	4	3.67	3	0.17	3
Rapidly respond to regulatory body's comment	3.88	1	3.89	1	0.01	5
Prepare for collapse of nuclear supply chain	3.56	3	3.55	4	0.01	5

Conclusion

This study found that both projects have similarities and differences in terms of delay factors and mitigation strategies. The following delay factors were identified as the important with both projects: inadequate completion of design and frequent design change, changes in policy & enhanced requirements, delay in approval from regulatory body and slow procurement & manufacturing of equipment and delivery to the site for installation. To mitigate the identified delay factors, the following mitigation strategies were evaluated as the most effective in both projects: contract with qualified and experienced subcontractor, reflect lessons learned from previous project, clearly define scope and responsibilities, use of skilled and experienced labors on similar project and accurate and prompt decision. These findings will help project managers to understand different risks between the domestic and the internal project. The risk factors identified in this study need to be closely monitored and controlled with appropriate mitigation ways to avoid or reduce the schedule delay.