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TITLE: Risk assessment of Rooppur Nuclear Power Plant & Future of the ‘Padma River.

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ABSTRACT:
The Rooppur Nuclear Power Plant (RNPP) is a crucial step towards energy security in Bangladesh. However, it also raises concerns about environmental and community impacts. This poster presents a comprehensive risk assessment of the RNPP, including safety features, emergency preparedness, and regulatory compliance. The study analyzes existing data and best practices to understand potential accidents and stresses the need for strict safety protocols. It also explores the socio-economic and environmental impacts on nearby communities, such as radiation exposure and the Padma River(water source)contamination. Also, it shows Water consumption & Withdrawal from the Padma River for RNPP’s Pressurized Water Reactor (PWR)

INTRODUCTION/BACKGROUND:
The world faces complex challenges concerning the interplay between economics, energy, and the environment. The Government of Bangladesh aims to elevate the nation's status to a middle-income country by 2021 and a developed nation by 2041. To materialize these visions, the availability of secure, affordable, and diverse energy sources, particularly in the form of electricity, is critical. In 2007, the Bangladesh delegation attending the General Conference of the International Atomic Energy Agency (IAEA) made a formal request to the IAEA's Director-General.One of Bangladesh's mega-projects is the Rooppur Nuclear Power Plant, for which discussions with the Russian government commenced in 2009. But, regardless of its importance and usability, it contains long-term risks which can affect people from the nearby locality, and it can make hazards to the Padma River ecosystem as it uses water-water energetic reactor (WWER) also known as VVER (Voda Voda Energo Reactor) which main fuel for cooling the power plant is Water. Three cooling circuits (primary, secondary, and tertiary) of the Pressurized Water Reactor (PWR) will be used on RNPP. Water collection from the Padma River will highly affect the GK(Ganga-Kabotakh) project.

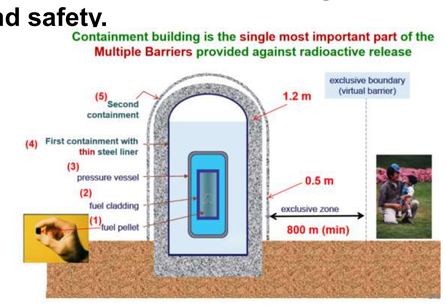
METHODOLOGY:
As primary data related to security aspects are not available, the study relies on existing information and data obtained from scientific literature, reports, official documents, and relevant publications.

RNPP at a Glance[1]

Units	2 × 1,200 MWe (gross)
Reactor Type	VVER
Model	V-523
Design	AES-2006, VVER-1200, Generation III+
Design life	60 years
Owner	Bangladesh Atomic Energy Commission
General Contractor	JSC Atomstroyexport (Subsidiary of Russia’s State Atomic Energy Corporation ROSATOM)
Main Water Source	Padma River

Risk Identification:
1.Thermal Efficiency: The low thermal efficiency of nuclear power plants with VVER reactors (about 33%) [2] poses a risk as a significant amount of energy (about 66%) is released into the environment, resulting in energy loss.
2. Water Consumption: The water consumption of a nuclear power plant, particularly with once-through cooling systems, can be substantial (up to 666 million cubic meters per year for a 2x1,200 MWe plant) [3]. This poses a risk in regions with limited water resources or during droughts.
3. Water Withdrawal: The high-water withdrawal rates of nuclear power plants with once-through cooling systems (up to 6.7 billion cubic meters per year for a 2x1,200 MWe plant) [3] can have adverse effects on the local water ecosystem and availability.
4. Padma River Changes: The Padma River's constantly changing path, combined with its potential for flooding and erosion, can pose a risk to the stability and long-term operation of a nuclear power plant relying on it as a primary water source.

Risk Assessment:
1.Technical Risks: This involves the assessment of technical risks related to the design, construction, and operation of the nuclear power plant, including the reliability of safety systems, equipment failure, and operational risks.
2.Natural Hazards: Evaluating the susceptibility of the nuclear power plant to natural hazards such as earthquakes, floods, tsunamis, and severe weather events is crucial for ensuring its resilience and safety.



Source: https://rnpp.gov.bd

3.Radiation Safety: Conducting a thorough assessment of potential radiation exposure and its impact on workers, nearby communities, and the environment is essential to prevent adverse health effects.



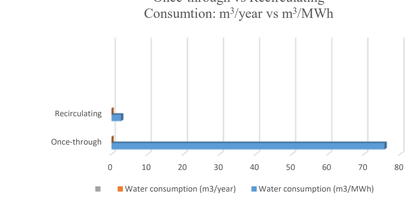
Source: Google Earth(2023)

4.Location: It is located near the mainstream of the Padma River. If any disaster happens, then the whole water flow will be contaminated, and aquatic life will be at risk. It can also spread contamination to the downstream side of Bangladesh River network.

Systematic Risks:
The official website conducted site resources investigation studies in collaboration with various institutions between 2009 and 2011 to meet international requirements. The Rooppur Nuclear Power Plant (RNPP) is expected to begin production in 2024 and has a design life of 60 years.[1] It has been 16 years since the final survey of the site. Additionally, the Padma River's path is dynamic and constantly changing.

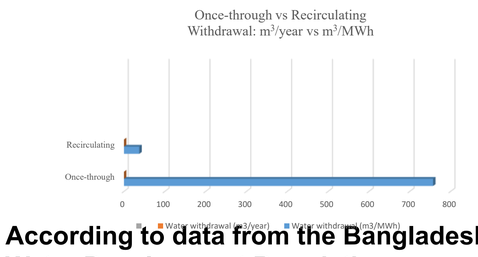
Water consumption:
Water consumption in a nuclear power plant depends on the type of cooling system used, the climate conditions, and the plant's efficiency. According to the International Atomic Energy Agency (IAEA), the average water consumption of a nuclear power plant with a once-through cooling system is about 75.7 cubic meters per megawatt-hour (MWh) of electricity produced, while the average water consumption of a nuclear power plant with a recirculating cooling system is about 2.7 cubic meters per MWh. [4]
A VVER-1200 nuclear power plant has a gross electrical output of about 1200 MWe and a net electrical output of about 1114 MWe. [5] Assuming a plant capacity factor of 90%, a VVER-1200 nuclear power plant would produce about 8.8 million MWh of electricity per year.
Therefore, the annual water consumption of a VVER-1200 nuclear power plant would be:

Cooling system	Water consumption (m^3/MWh)	Water consumption (m^3/year)
Once-through	75.7	666 million
Recirculating	2.7	24 million



Water withdrawal:
Water withdrawal is the amount of water that is taken from a source for any purpose. Water withdrawal may or may not result in water consumption, depending on how much water is returned to the source after use.
Water withdrawal from a nuclear power plant depends on the type of cooling system used, the climate conditions, and the plant's efficiency.
According to the IAEA, the average water withdrawal of a nuclear power plant with a once-through cooling system is about 757 cubic meters per MWh of electricity produced, while the average water withdrawal of a nuclear power plant with a recirculating cooling system is about 37.6 cubic meters per MWh. [4]
Therefore, the annual water withdrawal of a VVER-1200 nuclear power plant would be:

Cooling system	Water withdrawal (m^3/MWh)	Water withdrawal (m^3/year)
Once-through	757	6.7 billion
Recirculating	37.6	331 million



According to data from the Bangladesh Water Development Board, the average minimum flow over the last twelve years is 632 cumsec (22,300 cusec).[6] This flow level would allow for around 345 cusec of makeup water, which is necessary for the plant's operation. However, if there is a sudden drop in flow to only 3,100 cusecs, as observed in May 2011, it will pose a safety threat to the plant. There is a concern that such abnormal reductions in flow could occur in the future, and if they do, the Rooppur Nuclear Power Plant (RNPP) would be forced to shut down due to water scarcity.

Results & Discussion:
The water consumption and withdrawal of the RNPP project depend on the type of cooling system used. A once-through cooling system would consume about 666 million cubic meters of water per year and withdraw about 6.7 billion cubic meters of water per year for a 2x1,200 MWe plant. A recirculating cooling system would consume about 24 million cubic meters of water per year and withdraw about 331 million cubic meters of water per year for a 2x1,200 MWe plant. [3]

Now, we can start to think about the risk factors of RNPP. RNPP is the very first nuclear power plant in Bangladesh. So, there is a minimum chance of failure as all water will be coming from Padma River. If Farakka Barrage is turned off for political reasons and dry season remain for longer than usual for climate change then RNPP can be in danger for shortage of cooling water. The GK Project also can be affected for excessive water withdrawal.

CONCLUSIONS:
- The Rooppur Nuclear Power Plant (RNPP) project is a strategic and ambitious initiative of the Government of Bangladesh to meet the growing demand for electricity and to diversify the energy mix of the country.
- The RNPP project has the potential to contribute to the economic and social development of Bangladesh, as well as to the global efforts to combat climate change by reducing greenhouse gas emissions from the power sector.
- However, the RNPP project also entails significant environmental and social risks that need to be carefully assessed, managed, and monitored throughout the project lifecycle. These risks include water consumption and withdrawal, radiation safety, natural hazards, and socio-cultural impacts.
- The RNPP project should adhere to the national and international standards and best practices for nuclear power plant design, construction, operation, and decommissioning. The RNPP project should also engage with the relevant stakeholders, especially the local communities, to ensure transparency, accountability, and public acceptance of the project.

REFERENCES:
[1] https://rooppurnpp.portal.gov.bd//sites/default/files/files/rooppurnpp.portal.gov.bd/page/323ceed5_dcaf_40b7_9518_bf407d9b928f/A%20Dream%20Comes%20True%20September%20%202017.pdf
[2] (Kostarev et al., 2019) https://doi.org/10.1088/1757-899X/552/1/012022
[3] https://www2.kuet.ac.bd/icmiee2018/files/ICMIEE18-241.pdf
[4] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1911_web.pdf
[5] http://aris.iaea.org/PDF/VVER-1200%28V-491%29.pdf
[6] https://www.thedailystar.net/cooling-water-requirement-for-rooppur-nuclear-power-plant-42883

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