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Strengthening Bangladesh's Energy Infrastructure: Grid Stability with Rooppur Power Plant

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Abstract

This study examines how the commissioning of Rooppur Power Plant Unit 1 may improve the stability of Bangladesh's electrical system, with a focus on how the grid manages frequency and voltage under normal and demanding conditions. The study focuses on how Rooppur power plant connects to other important areas in the country via 230 kV and 400 kV transmission lines, including Gopalganj, Bogra, Kaliakoir, and Dhaka. Bangladesh's power grid has struggled with reliability issues in recent years. In 2016, a nationwide blackout affected millions of people after a transmission failure. A partial power outage occurred in 2022, caused by technical problems and power shortages. These blackouts highlighted the need for a more reliable grid to support the growing demand for electricity.

By comparing the grid's performance in 2015 and 2035, the study shows significant improvements on the horizon. With the integration of Rooppur power plant, the grid will benefit from stronger transmission lines, better frequency control, and more stable voltage regulation. The simulation on full scale simulator at Rooppur power station training center predict that by 2035, the grid will be able to withstand higher faults and recover more swiftly from interruptions. The usage of technologies such as Automatic Frequency Control (AFC) and Flexible AC Transmission Systems (FACTS) will help to a steady and reliable power supply. To conclude, Rooppur power plant will play a vital role in modernizing Bangladesh's power infrastructure, limiting the potential of future blackouts, and addressing the country's rising energy needs.

Keywords

Grid stability, frequency control, voltage regulation, fault tolerance, power outages.

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Biographies

S. M. Shafiul Nahid S. M. Shafiul Nahid is an Assistant Engineer at Rooppur Nuclear Power Plant (RNPP) in Bangladesh, specializing in instrumentation and control systems. His work includes expertise in sensors, actuators, and motor-operated valves (MOV) for turbine and reactor protection systems. Shafiul also has significant experience with inverters and power plant operation and maintenance. He graduated with a Bachelor's degree in Electrical and Electronic Engineering (EEE) from Chittagong University of Engineering and Technology (CUET) in 2017, ranking in the top 5% of his class. His undergraduate thesis focused on the innovative use of organic acids as electrolytes in lead-acid batteries, proposing sustainable solutions for industrial liquid waste management. In addition to his academic background, Shafiul has completed specialized training in control systems, sensors, and automation in the Russian Federation, as well as industrial training at the Training Institute for Chemical Industries (TICI). These experiences have enhanced his technical expertise in automation and energy systems. Shafiul's research interests include renewable energy, power electronics, electric drives, and sustainable energy solutions. He is passionate about advancing energy technology to address global energy challenges. He aims to pursue graduate studies to deepen his knowledge and contribute to innovative solutions in renewable energy and automation, fostering sustainable advancements in the energy sector.

Mohammed Shale Jounaed Monir is a nuclear engineering professional with a strong academic foundation and hands-on experience in power plant operations and management. He earned his B.Sc. in Electrical and Electronic Engineering from Chittagong University of Engineering & Technology (CUET) in 2015 and completed his M.Sc. in Nuclear Engineering at the University of Dhaka in 2018. Beginning his career in the operation department of SUMMIT Barisal Power Plant, he gained valuable experience in managing power generation systems from 2018 to 2019.

In 2019, Mohammed joined Rooppur Nuclear Power Plant, where he currently serves as Unit Shift Supervisor (USS). In this role, he is responsible for coordinating and overseeing the operations of the reactor, turbine, electrical systems, instrumentation and control (I&C), and ventilation systems across all unit-related buildings. His duties include

ensuring smooth operation, troubleshooting critical systems, and optimizing plant performance while strictly adhering to regulatory standards and safety protocols. He ensures compliance with plant-specific regulatory documents, including operating instructions, technical procedures, and emergency protocols, as well as guidelines from both national (BAERA) and international (IAEA) regulatory bodies.
With specialized training from Rosatom Academy in Russia, Mohammed has developed advanced skills in reactor and turbine operation, safety management, and leadership. His ability to align technical operations with regulatory and safety standards makes him a key contributor to the reliable and efficient functioning of the nuclear power plant. He is passionate about leveraging his expertise in engineering and management to enhance plant performance, ensure safety, and support sustainable growth in the energy sector.

Tanverul Isam is a skilled and multidisciplinary professional with a background in mechanical engineering, turbine technology, and nuclear power plant operations. He earned a Bachelor's Degree]in Mechanical Engineering from Chittagong University of Engineering &Technology, where he developed a strong foundation in thermodynamics, fluid mechanics, mechanical systems design, and problem-solving. Tanverul Islam further advanced his knowledge by completing a Master of Science (MSc) degree in Business Studies from Rajshahi University, acquiring essential business management skills, strategic thinking, and leadership capabilities. A key milestone in Tanverul Islam's career was completing specialized training at Roastom Academy, a leading institution known for its advanced turbine programs. During this training, he gained in-depth expertise in turbine technology, including design, operation, and optimization, with a strong emphasis on energy efficiency and maintenance. This training equipped with hands-on experience in working with complex turbine systems, particularly in the context of industrial and energy sectors. In addition to his technical expertise in mechanical engineering and turbine technology, has gained significant experience in nuclear power plant operations. He has worked at Rooppur Nuclear Power Plant, where he contributed to the operation, maintenance, and safety protocols of the plant's mechanical and turbine systems. He played an integral role in optimizing plant performance, ensuring compliance with regulatory standards, and troubleshooting complex mechanical and electrical issues in critical systems. This experience has given him a deep understanding of nuclear power generation, plant reliability, and operational efficiency. Combining engineering expertise with business acumen, brings a unique skill set to any project, particularly in energy generation, renewable energy solutions, and power plant management. He is passionate about integrating technical and business strategies to optimize energy production, improve plant performance, and drive sustainable growth in the power sector.

Prodip Kumar Sadhu graduated with a Bachelor of Science in Mechanical Engineering from Chittagong University of Engineering & Technology in 2015. With a strong academic foundation, he quickly transitioned into the professional world, specializing in Non-Destructive Testing (NDT) within the nuclear power plant construction industry. He gained hands-on experience in various NDT techniques, including ultrasonic testing, radiographic testing, and eddy current testing, working on high-profile projects in the nuclear sector. In addition to his professional experience, Prodip Kumar Sadhu enhanced his expertise through specialized training in Russia, where he received advanced instruction in NDT methods in Tsniitmas, safety protocols, and quality control processes for nuclear power plants. This training further strengthened his technical knowledge and ability to apply international best practices to complex projects. In recognition of his outstanding work ethic, technical proficiency, and leadership skills, he was honored as the "Employee of the Year" in 2021 at Nuclear Power Plant Company Bangladesh Limited. This award was a testament to his dedication to excellence and his significant contributions to the success of nuclear plant construction projects, ensuring the highest standards of safety and reliability. With combination of practical experience, international training, and professional recognition, he continues to be a valued contributor to the field of engineering, specializing in the critical domain of NDT in nuclear power plant construction. Combining engineering expertise with business acumen, brings a unique skill set to any project, particularly in energy generation, renewable energy solutions, and power plant management.