

Advanced Nuclear Energy Control Systems for Enhanced Operational Safety in Bangladesh's Civilian Nuclear Programs

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Introduction: In the transition of the nuclear power energy sector of Bangladesh, the control system needs to be robust, intelligent, and reliable. The increasing investment of the government in the nuclear sector of the country, especially the Rooppur Nuclear Power Plant development project, needs proper understanding of the long-term behavior of the control system. The purpose of this paper will be to outline the possibility of improving the performance of the nuclear energy sector of Bangladesh through the implementation of advanced data-driven infrastructures in the control system of the nuclear energy sector of the country.

Methodology: This research evaluates 30 years' operational indicators from 1995-2024. The dataset was analyzed based on these 4 variables: Control System Reliability (%), Safety Incidents Count, Energy Output (MWh) and Regulatory Compliance Index. Data was examined using descriptive statistics, multi-year trend analysis, and cross-variable comparisons to identify performance patterns.

Result: Analysis shows that the early levels of control system reliability were widely fluctuating but stabilized and improved noticeably around the turn of the decade in the years around 2010. Various years featured vastly high levels of reliability metric points, implying performance scaling through simulation tools or advanced control system enhancement. In addition to that point, levels of energy production showed greater constancy during years of high levels of reliability. This information suggests that advances in control system technology are often associated with fewer safety accidents and more reliable outputs of energy.

Conclusion: The results point out that the modernization of control systems is essential in improving operational safety at the Bangladesh nuclear energy facilities. It shows how increased reliability, improved regulatory compliance, and decreased incident frequencies all together improve by integrating advanced, automated, and predictive safety technologies. However, for further improvement in safety performance and assurance of sustainability in energy generation, AI-aided control architecture, real-time fault detection, and algorithmic safety monitoring will be recommended as Bangladesh progresses in developing nuclear capabilities.

Keywords: Nuclear Safety; Control System Reliability; Regulatory Compliance; Energy Output; Bangladesh Nuclear Program.