

Predicting the Cost of Unplanned Shutdowns of Power Stations: An Accelerator-Driven Subcritical Reactor Case Study

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The use of intermittent power generators, such as wind and solar power, is increasing in electricity grids around the world. Electricity grid operators are expected to provide a 100% reliable supply to their customers; they must therefore be able to cope with the growing use of power generators that may suddenly and unexpectedly increase or decrease the quantity of power that they are providing. One aspect of this larger supply and demand balancing problem is the immediate cost faced by a power station owner when they fail to meet their contracted electricity sales.

This paper presents a model for analysing the immediate financial cost to an electricity supplier when its power generators unexpectedly shut down, in the context of the UK National Grid. The model probabilistically selects historical electricity prices to be used during simulated power station shutdowns. Included in the analysis is an examination of historical data regarding the impact on the national electricity price of a sudden and unexpected failure of a power station. The conclusion of this analysis is that the electricity price is insensitive to the sudden loss of 600 MWe from the grid.

The predicted cost of failure is examined for one particular case study, the Accelerator-Driven Subcritical Reactor (ADSR). The ADSR is a potential future form of nuclear power generator, which promises increased proliferation resistance, fuel efficiency and decreased production of radioactive waste products. The ADSR faces reliability engineering challenges,



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many of which are centred about its required particle accelerator system.

The examination of financial costs associated with ADSR reliability has identified lifetime costs of power station failures of the order of hundreds of millions of pounds. The costs have been projected for a range of degrees of reliability: the difference in cost between these scenarios identify the value of engineering improved reliability. The findings have been presented in such a way that the reader is able to select ADSR performance specifications of their own choosing and extract the associated cost of unplanned shutdowns over the lifetime of the facility.

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