

Nuclear Power Plant Outage Planning : an exact optimization approach to test robustness to demand variations and power plant availability

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Electricity in France is mainly generated from nuclear power plants. The multi-annual outage planning of these power plants has to comply with various constraints regarding safety, maintenance, logistics and plant operations, while it must lead to a feasible production program at minimum cost. Given the size of the problem, EDF currently uses local search based tools to optimize the planning. This approach leads to important limitations: a search space limited to local solutions around a given planning; optimization at the aggregated level of weekly time steps; and the use of an estimated average production cost of the remaining production to be fulfilled by conventional thermal power plants, rather the actual scenarios of demand and plant availability. We develop an approach that rely on exact mathematical optimization tools in the aim of gradually lifting those limitations. Our model makes use of column and row generation techniques. It considers a wider search space and allows to satisfy the demand at an infra-daily time step. The use of Benders decomposition (via a row generation algorithm) enables us to test robustness over several demand scenarios. Our model can be extended to account for "smooth" fluctuations in nuclear power plant availability.