UNIVERSITI TEKNOLOGI MARA

HYBRID DP-ABC FOR MULTI-OBJECTIVE LONG-TERM GENERATION MIX: MALAYSIA ELECTRICITY SUPPLY INDUSTRY CASE

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ABSTRACT

The recent issues of depletion in oil, severe gas shortage, increasing in fuel cost and the environmental impact has become major challenges for the Malaysian power sector. These have led Malaysia to find alternative resources to generate electricity. The problem of what the optimum future fuel mix strategy for Malaysia is critical for ensuring sustainability of supply. Here, the development of long-term optimal generation mix model considering various objective functions could be used by the government and power utility to determine optimum long-term generation mix that could ensure an efficient, secure and environmentally sustainable supply of energy. Moreover, the effects of economic and political constraints on Malaysia's generation mix in this study could help the Malaysian government to optimally plan energy-related policies that could drive the optimum generation mix strategy. This study could also help investors in new generation capacity to make decisions regarding new investment plans. This approach includes a single objective model, a multi-objective model, an improved multi-objective model and a stochastic applied in improved multi-objective model. The research has been carried out by first developing the long-term single objective generation mix planning model using DP. Three different objectives of generation mix were optimized individually namely cost, emission and the power system's reliability subjected to the constraints that gives view to utilities on the impact of technologies in generation mix through a different objective. A sensitivity analysis was carried out to explore the effects of the parameter constraints on the future generation mix. Secondly, the development of a long-term multi-objective generation mix planning model using DP. The optimum future generation mix need to consider environmental impact and the reliability of power system for ensuring sustainable of supply. Meanwhile, the combined cost, emission and reliability model in this thesis allow a better sight for utilities with options in planning preferences. Third is the development of an improved multi-objective by hybrid DP approaches which is the utilities can have a more accurate generation mix planning while reduce the discrimination when setting the priority for every objective. In these approaches, four optimization techniques were tested that provided the best performance of results. Then, since investing in a new power plant is risky and involves many uncertainties, the study has been extended to model stochastic in a hybrid DP multi-objective programming that models the uncertainty in some underlying parameters in the generation mix model. These models have been analysed using the Malaysia test system with 32 units and 132 units. Based on the comparative studies, the proposed HDP multi-objectives yielded a better solution in terms of providing the lowest MOI as compared to the non-optimal WSM DP model. Meanwhile, between the four HDP models, the simulation results showed that the HDPABC method provided the best result in obtaining the lowest MOI. From the HDPABC, the Malaysia's optimum generation mix in year eighteen is 45.11% from gas, 35.34% from coal, 9.82% from RE and 9.73% from hydro.

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