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MATHEMATICAL RELIABILITY MODEL FOR FAILURE CAUSE ANALYSIS OF ELECTRICAL SYSTEM WITH COMPLEX WHOLE STANDBY REDUNDANCY

Abstract

In this paper the mathematical reliability model of repairable electrical system with complex whole standby redundancy for minimal cut set probability characteristics calculation is proposed. Minimal cut set probability characteristics are used for failure cause analysis as well as for creating recommendations on how we can improve system reliability. The analyzed system is composed of four components: two generators G1, G2 and two converters VD1, VD2. The generator G1 and the converter VD2 make up the main subsystem, and G2, VD2 make up reserve subsystem. The reliability of such system is formalized by dynamic fault tree. System down state occurs if both main and reserve subsystems are in down state. Subsystem down state occurs if even one of its components is in down state. Time to failure for all components is distributed according to Weibull and repairing time is distributed exponentially. In the model such load-sharing phenomena are formalized. Firstly, load-sharing of reserve subsystem components are depending on the main subsystem state. Secondly, load-sharing of the main subsystem components are depending on the state of it's another component. Thirdly, load-sharing of the reserve subsystem components are depending on the state it's another component. The state and event model of the system is constructed using dynamic fault tree. Such system can be in seven states, three of which are operational. Eight events can occur in the system, four of which are failures. Using states and events model, the split homogeneous Markov model of the system is constructed. Such model has 112 differential equations. By the split homogeneous Markov model minimal cut set probability characteristics are defined. "TV1–G2" cut is recognized as the most weak with 33.75% percent ratio. The main advantage of the proposed mathematical reliability model for electrical system with complex whole standby redundancy consists in treating load-sharing impact on cut probability characteristics.