Reliability model for failure cause analysis of electrical system with component load-sharing redundancy

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Abstract **In the paper mathematical reliability model for electrical repairable system with component load-sharing redundancy is proposed. Such model adequately takes into account impact of load-sharing on minimal cut set probability indexes. For reliability modelling dynamic fault tree and Markov analysis is used.**

Keywords **minimal cut set, load-sharing redundancy, reliability model, dynamical fault tree, Markov model.**

I. INTRODUCTION

Recommendations for system reliability improving are developed on the basis of "weak" point analysis. By "weak" point, that is called cut, it's understood set of component which simultaneously down state leads to system failure. The analysis of system with component load-sharing redundancy is needed taking into account load changes impact on cut probabilistic indexes. Using well-known logic and probabilistic approach it's cannot adequately take into account this phenomenon. For such problem solving is used approach that based on the latest achievements of Markov analysis [1]–[3].

II. RELIABILITY MODEL

The system is composed of three components (fig. 1*a*): generator G and two converters VD1 and VD2. System function is to provide electricity for consumers that connected to its out.

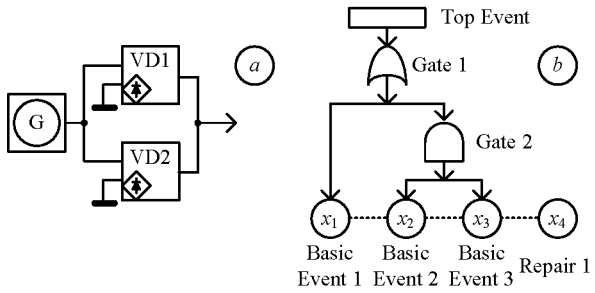

Fig.1. Functional diagram (*a*) and dynamic fault tree (*b*) for system

Reliability of system is formalized by dynamic fault tree (fig. 1*b*). System down state («Top Event») is occured if generator G in down state («Basic Event 1») or both converters VD1 («Basic Event 2») and VD2 («Basic Event 3») in down state. Time (life) to failure for all components is distributed by Weibull.

The basic evens are complemented by scaling functions that describe system behavior by load. Such functions are mathematically describes three related phenomena:

- Turning off/on generator G, if both converters VD1 and VD2 in down/up state;
- Turning off/on converters VD1 and VD2, if generator G in down/up state;
- Load changing one converter if other in down state.

System repair ("Repair 1") renews all down state components. Time to recover is distributed exponentially. After failure system cannot be repaired.

On the basis of system dynamic fault tree the state and event model is composed (fig. 2*a*). This model mathematically describes states in which the system may be, and events that can occur in the system, but without specific distributions recognition.

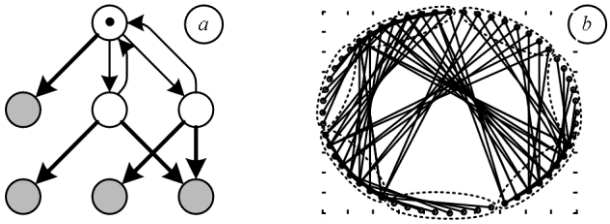

Fig.2. State and transition diagram for system: ordinary (*a*), split (*b*)

Based on system state and event model the split homogeneous Markov model is generated (fig. 2*b*). This model takes into account distribution type and can "remembers" load history. Using reliability characteristics that calculated by Markov model the content and probability indexes for all four cuts is determined.

III. CONCLUSION

The mathematical model of electrical system with component load-sharing redundancy for cut probability indexes determination is proposed. Such model is provided adequate taking into account load changes for components that time to failure distributed by Weibull.

IV. REFERENCES

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