

Title	分散型電力供給の耐故障性に関する研究
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Citation	
Issue Date	2003-03
Type	Thesis or Dissertation
Text version	author
URL	http://hdl.handle.net/10119/455
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A Study of Fault Tolerance of Distributed Electric Power Supply

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March 2003

Keywords: Distributed generator, electric power supply system, fault-tolerance

Recently, by the deregulations for electric power supply systems, the prevalence of the small-scale distributed generators and electric power storage devices are expected in the reduction of energy loss and the free competitive markets.

In this research, through computer simulations, we study the feasibility of power supply by distributed generators, comparing with the conventional centralized systems. In particular, we investigate the fault-tolerance for the size of damages in the point of connectivity. First, we describe a simulation model of the electric power supply system. Next, from the simulation result, we show the rate of propagation of the electric power in the distributed generators and the failure rate of the substation exerted the influence.

We summarize the main results as follows.

- The connectivity of the electric power supply system is very robust to random failure, (failure rate : $\sim 80\%$) but it is very fragile to the failure to Hub. (failure rate : 20%)
- In the random failure case, the biggest cluster remains until failure rate comes to 100% . In the Hub failure case, the biggest cluster disappears with 60% .

- For the 35% of the demand power supply become possible at the 10% distributed generation propagation rate. Moreover, it becomes about 1.5~5times, in the case of 5~20% failure rate which is realistic situations (random failure rate : 30~70%). These results suggest the usefulness of the distributed power supply for emergencies.

For more realistic situations, the load flow and capacity must be considered for cascaded failures. They are considered as the future subject.