§ 2. Development of System Code and Reactor Design Database for Advanced Helical Reactor

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Fusion devices with external conductor systems have the possibility of high beta-value. Furthermore, they don't need plasma current to keep good confinement, which implies the possibility of power plant with low cost. COE (Cost of Electricity), used to assess the economic strength of power plants. Figure1 shows the beta-COE correlation with availabilities based on the Generomak Model. As indicated in fig.1, the COE is enormous in low-beta area while decreasing with increasing beta value, which indicates it important to achieve high beta value to some extent[1].

The helical confinement has a complicated coil system, which makes it difficult to maintain the inner system. If all components can be replaced independently, the plant availability can be calculated by using each component's maintenance time and failure rate independently. We calculated availabilities based on the following models to investigate the influence of these-like complex systems

(1)Simple model : all components is replaced independently.

(2) Complex Model: In case of the failure of blankets, the maintenance time includes primary coil replacement time.

We have already purposed remountable SC magnets[2] which can reduce maintenance time to improve the way of replacement and repair. It is assumed that this method can be available to two models (called 'short maintenance'), while called 'standard' in case of usual SC magnet.

The result in fig.2 corresponds to the simple model, which gives the only 3% higher average of the short type in comparison with that of standard. The short type, however, attained about 12% higher minimum availability and small dispersion. Furthermore we can have stable availabilities in the short type. In other words, the standard model, having the long maintenance time of SC magnet, is not good as a major power plant because of a broad dispersion of availability with small reliability. These tendency becomes much cleared in case of the complex model as shown in fig.3. Figures 2 and 3 indicate that standard types have broad dispersions to show low availability of the minimum value. The short types, however, shows little dependence on applied models, that is, a high reliability can achieve even in the complex models.

These results strongly suggest that development of some technology like the remountable SC magnet system to reduce the maintenance time is one of the key issues for the future fusion reactor.

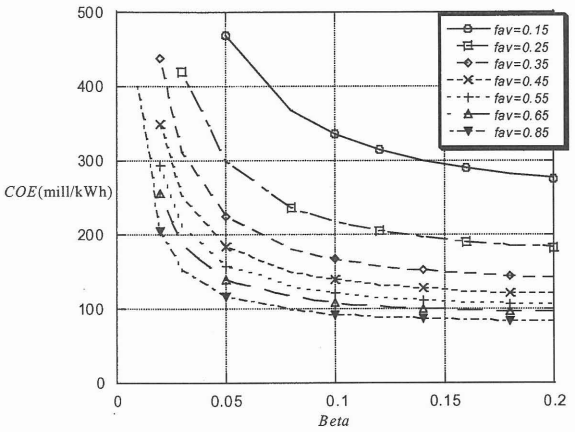

Fig. 1. COE dependence on beta value

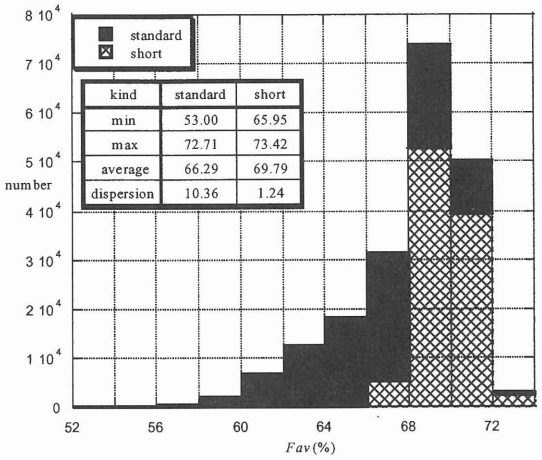

Fig. 2. Availability with Constant failure rate (standard model)

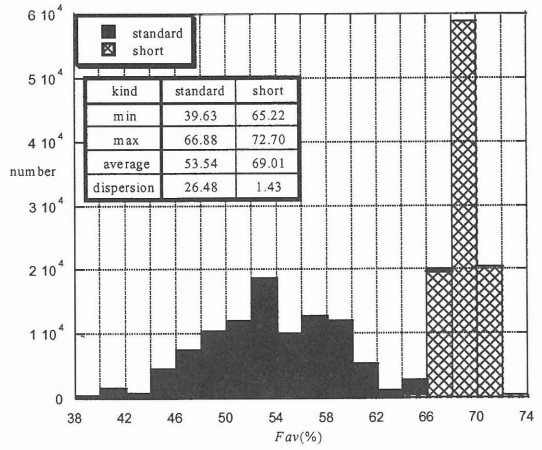

Fig. 3. Availability with Constant failure rate (complex model)

References

1) TOFE 2002, H. Hashizume et.al.
2) ISEM 2003, S. Itoh et al.