DOI: 10.34854/ICPAF.51.2024.1.1.209

DEFINING THE REQUIREMENTS FOR RAMI-ANALYSIS OF ITER DIAGNOSTICS *)

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To increase the availability of ITER, a set of measures called RAMI-analysis was developed [1, 2]. RAMI is an abbreviation for reliability (the probability that the system will perform its functions without failures during a given time interval), availability (the probability that the system will be able to perform its functions at a given time), maintainability (the possibility of repair, maintenance and modernisation), inspectability (the possibility to perform inspections). RAMI-analysis is carried out at the design stage and begins with a conceptual design. Already at the very initial stage it is possible to propose actions aimed, for example, at changing the design or element base, preparing a set of specific, not provided by industry standards tests, drawing up a list of spare parts, etc. with the ultimate goal of increasing system availability and sometimes even minimising manufacturing costs.

The ITER design and construction requirements, in particular the availability requirements for various subsystems, are given in the top-level project documents (Project Requirements). As for the diagnostic complex - a set of diagnostic systems that allows measuring and controlling plasma and tokamak parameters - the reliability requirements are defined in terms of minimum availability. The diagnostic complex includes about eighty different diagnostics and allows measuring more than one hundred parameters. All parameters are divided into four groups depending on their role: machine protection (MP), basic and advanced control (BC and AC) and physics (Ph). The project documentation defines only the minimum availability target for a group of parameters. The availability requirements of individual diagnostic subsystems are not defined. At present, when defining the diagnostic availability, the developers assume that the global requirements apply to a subsystem without considering the fact that a parameter can be measured simultaneously by several diagnostics and that the contributions of each diagnostic to the parameter measurement are unequal. This approach results in inflated requirements for the availability factors of the final subsystems, as it does not consider the existing duplication of measurements.

To solve the problem described above, a mathematical model and a computational algorithm based on it were developed [3]. The results of calculations performed by this algorithm can be used by the developers of various diagnostic subsystems of ITER in the form of specific requirements.

References

[1]. Van Houtte D., K. Okayama, and F. Sagot. 2010. RAMI Approach for ITER. J. Fusion Engineering and Design, 85(7-9):1220–1224. doi: 10.1016/j.fusengdes.2010.03.007.

[2]. Konovalov G. 2016. Methodology of reliability calculation of international thermonuclear experimental reactor and optimization of risk mitigation actions. J. Systemy i Sredstva Infomratiki – Systems and Means of Informatics vol 26 no 1:166-181. doi:10.14357/08696527160111.

[3]. Konovalov G. 2020. The problem of setting availability targets for ITER diagnostics: problem statement and solution algorithm. J. Systemy i Sredstva Infomratiki – Systems and Means of Informatics vol 30 no 2:89-102. doi:10.14357/ 08696527200209.

*) abstracts of this report in Russian