SYSTEMS APPROACH FOR HEALTH MANAGMENT DESIGN: JET NEUTRAL BEAM SYSTEM – A FUSION CASE STUDY

M. Khella[1], J. Pearson[2], R.Dixon[1], D Ciric[3], I Day[3], R King[3], J. Milnes[3], R Stafford-Allen[3]

[1] *Systems Engineering Innovcation Centre (SEIC), Loughborough University, Leicesterhsire, LE11 3TU, UK*
[2] *Electronic and Electrical Engineering, Loughborough University, Leicesterhsire, LE11 3TU, UK*
[3] *EURATOM/CCFE Fusion Association, Culham Science Centre, Oxfordshire, OX14 3DB, UK*

Corresponding author: M.Khella@lboro.ac.uk

The maturation of any new technology can be coarsely divided into three stages of a development lifecycle; 1) fundamental research, 2) experimental rig development and testing through to 3) commercialisation. With the enhancement of machines like JET, the building of ITER and the initiation of DEMO design activities, the fusion community is beginning to move from stages 1 and 2 towards stage 3. One of the consequences of this transition will be a shift in emphasis from scientific achievement to maximizing machine reliability and availability. The fusion community should therefore be preparing itself for this shift by examining all methods and tools that might help to improve these fundamental performance parameters. To this end, the Culham Centre for Fusion Energy (CCFE) have proactively engaged with UK industry to examine whether the development of Health Management Systems (HMS) could help improve the reliability and availability of both existing machines (such as JET and ITER) and future reactors.

This paper describes an initial HMS case study on the JET Neutral Beamlines undertaken by a systems engineer from the SEIC (a Systems Engineering organization set up between BAE Systems and Loughborough University). Following an analysis of the failures leading to significant downtime of the facility (e.g. due to loss of vacuum), a Systems Engineering Approach was employed to analyse the fault diagnostic practices currently employed by the operations team as well as the available range of sensor data which could potentially be fused in support of an HMS design. The results of this analysis are presented here.

The primary output of this study was the development of a methodology and architecture that captures existing experience in fault detection, classification and isolation as well as new methods for fault diagnosis. A summary of the methods used and the potential benefits are presented here in a context that should be of maximum benefit to the next generation of reactors such as ITER and DEMO.