Paper ID: 27062
student

SPACE SYSTEMS SYMPOSIUM (D1)
System Engineering - Methods, Processes and Tools (1) (3)

Author: Mr. Martin Kubicek
University of Strathclyde, United Kingdom, martin.kubicek@strath.ac.uk

Ms. Elif Oguz
University of Strathclyde, United Kingdom, e.oguz@strath.ac.uk

RELIABILITY AND REDUNDANCY OF SPACE ANALOG HABITAT SYSTEMS – FAILURE MODES, EFFECTS AND CRITICALITY ANALYSIS OF PRELIMINARY DESIGN PHASE

Abstract

This study is focused on reliability studies of space habitats using FMECA (Failure Modes, Effects and Criticality Analysis) method. FMECA is a methodology for identifying and resolving the critical problems in a system before they occur. The main steps of this method are FMECA prerequisites, system structure analysis, failure analysis and preparation of FMECA worksheets, followed by team review and corrective actions. All data used in the study has been collected during the stay of the authors at the Mars Desert Research Station in the Utah desert, USA. Many critical systems are selected by researchers as a first step of this study such as the generator and the water tank. After the selection of these systems, all defined systems have been divided into suitable subsystems aspects of future reliability analysis. Each system has been analysed as a separate part and also as a part of the main system with considering its effect on the main system. In the frame of this study, criticality of the systems also has been calculated and counter measures are proposed. According to the FMECA guideline prepared by NASA, all necessary steps defined for the reliability analysis have been followed. The coefficients indicated for each system and failure probabilities needed for FMECA analysis are obtained from NPRD, Mil-HDBK-217F and FMD-91. Since everything works with electricity, the generator has been defined as the most important system in the habitat. The second most critical system is the gas distribution system, where an error could lead to a disastrous situation. Following this, water tank has been chosen as the third most critical component. The study pointed out critical problems during the design of extreme environment habitats. At the end of this study, all the critical failures of the habitat have been defined and all necessary prior solutions for the critical failures are suggested.The outcome indicates that the failures of these systems can be used to enhance the Mars Desert Research Station. There is still a significant amount of research required concerning reliability analysis of the space habitat in terms of the selection of optimum designs, the modification of the systems, as well as access, inspection and maintenance strategies, human factors and environmental impacts. This preliminary study will assist the design engineers with the selection of an optimum configuration for space habitats.