Space-based Human Reliability Analysis Methodology

A NEW PARTNERING OPPORTUNITY

Reference No: NNJ14ZBH006L

Potential Commercial Applications: Department of Defense (DoD), commercial aircraft/spacecraft, and others

Keywords: human reliability, long duration space missions, low gravity physiological effects, human fatigue

Purpose:
NASA JSC seeks partners to better understand limitations and potential performance shaping factors (PSF) for a space-based Human Reliability Analysis (HRA) method. Cognitive Reliability and Error Analysis Method (CREAM) is a bi-directional analysis method that is used for both performance prediction and accident analysis. Unlike first generation error analysis methods such as Technique for Human Error Rate Prediction (THERP), CREAM represents a second generation tool allowing for better analysis by abandoning the hierarchical structure of previous methods and providing better separation between objective and subjective error. Assistance with breaking apart the current ground based PSFs and recombining with the additional long duration, space-based PSFs is needed.

Technology:
NASA JSC's current HRA methodology, as well as all other methods currently available, is based on ground data sources. The Space Shuttle Probabilistic Risk Assessment (PRA) was used to assess all known risk contributors, such as human/crew reliability, in support of the program's risk-informed decision-making process.

The Shuttle PRA used a combination of HRA techniques. Once the human actions were identified, the majority of them were initially quantified with an analysis methodology that is essentially based on the THERP, as described in NUREG/CR-1278, "*Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications*." The initial THERP-like quantification serves as a screening analysis to identify the risk-dominant human errors. The risk-dominant human errors are then evaluated in further detail using the extended CREAM.

For future space programs with 200 to 900 day missions, crew fatigue, low gravity physiological effects, and crew health may become more significant factors in assessing human reliability; thus, the need to expand the capability of the current ground-based HRA techniques.

The technology is in early development, i.e., Technology Readiness Level TRL-1.

R&D Status:
The current toolset includes both the CREAM and the THERP HRA approaches. Both of these approaches are based on humans tested on the ground. As human space missions head to Mars and asteroids, mission durations will last 400 to 900 days, which is much longer than any mission performed to-date. It is believed that long duration missions in low gravity can result in fatigue and physiological effects on human crews, which can

impact their reliability of performing human actions; thus, the importance for the vehicles and mission training to better account for these effects on the crew.

Intellectual Property (IP):
This Partner relationship may produce new IP that could be jointly owned by NASA and the partner or may become the property of the partner.