# The Importance of HRA in Human Space Flight: Understanding the Risks

Human performance is critical to crew safety during space missions. Humans interact with hardware and software during ground processing, normal flight, and in response to events. Human interactions with hardware and software can cause Loss of Crew and/or Vehicle (LOCV) through improper actions, or may prevent LOCV through recovery and control actions. Humans have the ability to deal with complex situations and system interactions beyond the capability of machines. Human Reliability Analysis (HRA) is a method used to qualitatively and quantitatively assess the occurrence of human failures that affect availability and reliability of complex systems. Modeling human actions with their corresponding failure probabilities in a Probabilistic Risk Assessment (PRA) provides a more complete picture of system risks and risk contributions. A high-quality HRA can provide valuable information on potential areas for improvement, including training, procedures, human interfaces design, and the need for automation.

Modeling human error has always been a challenge in part because performance data is not always readily available. For spaceflight, the challenge is amplified not only because of the small number of participants and limited amount of performance data available, but also due to the lack of definition of the unique factors influencing human performance in space. These factors, called performance shaping factors in HRA terminology, are used in HRA techniques to modify basic human error probabilities in order to capture the context of an analyzed task. Many of the human error modeling techniques were developed within the context of nuclear power plants and therefore the methodologies do not address spaceflight factors such as the effects of microgravity and longer duration missions.

This presentation will describe the types of human error risks which have shown up as risk drivers in the Shuttle PRA which may be applicable to commercial space flight. As with other large PRAs of complex machines, human error in the Shuttle PRA proved to be an important contributor (~12 percent) to LOCV. An existing HRA technique was adapted for use in the Shuttle PRA, but additional guidance and improvements are needed to make the HRA task in space-related PRAs easier and more accurate. Therefore, this presentation will also outline plans for expanding current HRA methodology to more explicitly cover spaceflight performance shaping factors.