Wear-out Sensitivity Analysis Project Abstract

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NE3 ISS Safety and Mission Assurance

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During the course of the Summer 2015 internship session, I worked in the Reliability and Maintainability group of the ISS Safety and Mission Assurance department. My project was a statistical analysis of how sensitive ORU's (Orbital Replacement Units) are to a reliability parameter called the wear-out characteristic. The intended goal of this was to determine a worst case scenario of how many spares would be needed if multiple systems started exhibiting wear-out characteristics simultaneously. The goal was also to determine which parts would be most likely to do so.

In order to do this, my duties were to take historical data of operational times and failure times of these ORU's and use them to build predictive models of failure using probability distribution functions, mainly the Weibull distribution. Then, I ran Monte Carlo Simulations to see how an entire population of these components would perform. From here, my final duty was to vary the Wear-out characteristic from the intrinsic value, to extremely high wear-out values and determine how much the probability of sufficiency of the population would shift. This was done for around 30 different ORU populations on board the ISS.

The project yielded interesting and conclusive results. There were several ORU populations very sensitive to wear-out. These tended to be parts that had accrued a lot of operational hours on the active systems, and had few spares in reserves. If these parts started exhibiting wear-out behavior, it would be problematic for the operation of the ISS. Populations that had an exorbitant number of active systems and a moderate amount of accrued operational hours were also found to be sensitive to wear-out, though less so than the aforementioned group. Many ORU populations were very insensitive to wear-out, which is indicative of healthy future operation, and minimal maintenance work required.

Through the course of this project I gained a wealth of knowledge on many topics. Though I cannot list them all here, I will list the ones most relevant to my work, education and personal development. I learned a great deal about the reliability and maintainability aspect of engineering. I now have a wide variety of tools to help me predict failures or other engineering related events, and how this can be applied in the industry. I gained a great deal of insight into statistics as well. I now know much about the mechanical operation of the ISS; how power is provided, temperate conditions are maintained, and life support systems are supplied, repaired and operated. I have a great understanding of the myriad of engineering systems that help keep the astronauts safe in orbit. Beyond this, I learned a lot about being the most effective and productive employee you can be. My mentor and others in my department continually shared tips and tricks on how to maintain a work schedule, networking, and building a positive work

environment. I will forever be enriched as an employee by the mentoring and guidance Safety and Mission Assurance provided me.

From here, I have a far clearer vision of what I want out of my career. I want to work for NASA, or a NASA contractor working to develop propulsion systems, and spacecraft design. I have a new perspective on safety, and I could see myself as a safety engineer, ensuring that these devices are reliable enough to shuttle payloads and astronauts without incident or failure. I will be applying for graduate Co-ops and contractor internships, and hope to be a more permanent asset to NASA in the future.