PHOTOVOLTIC SYSTEMS FOR LUNAR SURFACE SURVIVABILITY DURING THE LUNAR DAY AND NIGHT. J. S. McNatt[1], [1]NASA Glenn Research Center

While photovoltaic systems will not be operating during the lunar night, it is still important to ensure that the cells, structure, and other components are able to survive the extreme low temperature conditions during times of low to no illumination. This presentation will focus on the work at NASA GRC on low temperature solar cell operation, thermal cycling of solar cell coupons and array components, and lunar solar array designs for long duration lunar surface missions.

Based on mission parameters, most in-space solar arrays will experience thermal cycling due to periods of illumination and eclipse. These arrays are tested to survive going between these thermal extremes for a factor greater than the expected mission lifetime at temperatures higher than and lower than the maximum and minimum expected operational temperature. This gives a high degree of confidence to our use of solar arrays on the lunar surface but the temperature extremes expected during the lunar day and night exceed typical solar array thermal cycling. Testing is necessary to confirm solar array component survivability throughout these extremes. Past efforts at GRC have included thermal cycling and solar cell performance at low temperature conditions.

Current efforts involve an understanding of high off angle solar cell performance to better predict array output at periods of lunar dusk and dawn. While not expecting to see extreme cold temperatures, the Commercial Lunar Payload Services (CLPS) Photovoltaic Investigation on the Lunar Surface (PILS) project will aim to measure high off angle cell performance (current, voltage, and operating temperature) of a variety of solar cells during its upcoming lunar surface mission. Solar simulator ground testing will be used to validate the PILS flight data. Information about the PILS payload will be included in this talk.

Additionally, this presentation will include descriptions and an overview of capabilities of the solar simulators at NASA GRC. The photovoltaic group currently has five tunable solar simulators including xenon arc based and led based systems. One simulator includes a small vacuum chamber with both heating and cooling capabilities with illumination through a quartz window for testing individual cells and small coupons. Another system is combined with a thermal vacuum chamber with a liquid nitrogen cold wall which allows for thermal balance testing of photovoltaic coupons up to approximately 25 cm x 25 cm. The test coupon is cooled too low temperature and then allowed to heat up to operating temperature using the solar simulator as the heat source.