December 2011 MSS/LPS/SPS Joint Subcommittee Meeting

ABSTRACT SUBMITTAL FORM

The submission of an abstract is an agreement to complete a final paper for publication and attend the meeting to present this information. Complete all information requested in the author and co-author information sections; the first author listed will receive paper acceptance notices and all correspondence. Abstracts must be submitted electronically; submittal instructions are located in the call for papers. **The abstract deadline date is June 13, 2011.**

ABSTRACT INFORMATION

Title: Experimental Determination of the Dynamic Hydraulic Transfer Function for the J-2X Oxidizer Turbopump-Part One-Methodology

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MANAGEMENT APPROVAL

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ABSTRACT SUBMITTAL FORM

Unclassified Abstract

(250-300 words; do not include figures or tables)

Experimental Waterflow Determination of the Dynamic Hydraulic Transfer Function for the J-2X Oxidizer Turbopump-Part One-Methodology

An advanced methodology for extracting the hydraulic dynamic pump transfer matrix (Yp) for a cavitating liquid rocket engine turbopump inducer+impeller has been developed. The transfer function is required for integrated vehicle pogo stability analysis as well as optimization of local inducer pumping stability. Laboratory pulsed subscale waterflow test of the J-2X oxygen turbo pump is introduced and our new extraction method applied to the data collected. From accurate measures of pump inlet and discharge perturbational mass flows and pressures, and one-dimensional flow models that represents complete waterflow loop physics, we are able to derive Yp and hence extract the characteristic pump parameters: compliance, pump gain, impedance, mass flow gain. Detailed modeling is necessary to accurately translate instrument plane measurements to the pump inlet and discharge and extract Yp. We present the MSFC Dynamic Lump Parameter Fluid Model Framework and describe critical dynamic component details. We report on fit minimization techniques, cost (fitness) function derivation, and resulting model fits to our experimental data are presented. Comparisons are made to alternate techniques for spatially translating measurement stations to actual pump inlet and discharge.