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: Sloshing in the liquid hydrogen and LOX propellant tanks after Main Engine Cut Off

Submitted for consideration to: ☒ MSS ☐ LPS ☐ SPS

For inclusion in Technical Area: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

Security Classification of Presentation: ☒ Unclassified

Security Classification of Paper: ☒ Unclassified

Contract Number(s) Under Which Work was Performed: ☐ IR&D

Is this paper an update? ☐ Yes ☒ No Has it been presented elsewhere? ☐ Yes ☒ No Is this a student paper? ☐ Yes ☒ No

AUTHOR INFORMATION

Author/Presenter Name: Sura Kim
Affiliation ER42, MSFC/NASA
Address
City Huntsville State AL Zip
Telephone 256-544-0717 Telefax
e-mail: sura.kim@nasa.gov

2nd Author:
Affiliation
Address
City State Zip
Telephone Telefax
e-mail:

3rd Author:
Affiliation
Address
City State Zip
Telephone Telefax
e-mail:

Additional Author(s):
Affiliation
Address
City State Zip
Telephone Telefax
e-mail:

MANAGEMENT APPROVAL

The individual below certifies that the required resources are available to present this paper at the above subject JANNAF meeting.

Responsible Manager authorizing presentation:

Title/Agency:

Telephone Number: e-mail: Date:

December 2011 MSS/LPS/SPS Joint Subcommittee Meeting

ABSTRACT SUBMITTAL FORM

Unclassified Abstract

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

NASA Marshall Space Flight Center is designing and developing the Main Propulsion System (MPS) for Ares launch vehicles. The objective of this study is to calculate the sloshing forces and moments in the LH2 and LO2 propellant tanks using a CFD/VOF analysis under realistic flight conditions. Propellant sloshing in the liquid hydrogen (LH2) and the liquid oxygen (LO2) propellant tanks after Main Engine Cut Off (MECO) was modeled using the Volume of Fluid (VOF) module of the computational fluid dynamics code, CFD-ACE+. The present simulation shows that there are substantial sloshing side forces acting on the LH2 tank during the deceleration of the vehicle after MECO. The LH2 tank features a side wall drain pipe. The side loads result from the residual propellant mass motion in the LH2 tank which is initiated by the stop of flow into the drain pipe at MECO. The simulations show that radial force on the LH2 tank wall is less than 50 lbf and the radial moment calculated based up the center of gravity of the vehicle is predicted to be as high as 300 lbf-ft. The LO2 tank features a bottom dome drain system and is equipped with sloshing baffles. The remaining LO2 in the tank slowly forms a liquid column along the centerline of tank under the zero gravity environments. The radial force on the LO2 tank wall is predicted less than 100 lbf. The radial moment calculated based on the center of gravity of the vehicle is predicted as high as 4500 lbf-ft just before MECO and dropped down to near zero after propellant draining stopped completely.