December 2011 MSS/LPS/SPS Joint Subcommittee Meeting
ABSTRACT SUBMITTAL FORM

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ABSTRACT INFORMATION

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Unclassified Abstract

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

An important first step in cryogenic propellant loading is the chilldown of transfer lines. During the chilldown of the transfer line, the flow is two-phase and unsteady, with solid to fluid heat transfer and therefore a coupled thermo-fluid analysis is necessary to model the system.

This paper describes a numerical model of pipe chilldown that utilizes the Sinda/GFSSP Conjugate Integrator (SGCI). SGCI is a new analysis tool developed at NASA's Marshall Space Flight Center (MSFC). SGCI facilitates the solution of thermofluid problems in interconnected solid-fluid systems. The solid component of the system is modeled in MSC Patran and translated into an MSC Sinda thermal network model. The fluid component is modeled in GFSSP, the Generalized Fluid System Simulation Program. GFSSP is a general network flow solver developed at NASA/MSFC. GFSSP uses a finite-volume approach to model fluid systems that can include phase change, multiple species, fluid transients, and heat transfer to simple solid networks. SGCI combines the GFSSP Fortran code with the Sinda input file and compiles the integrated model. Sinda solves for the temperatures of the solid network, while GFSSP simultaneously solves the fluid network for pressure, temperature, and flow rate. The two networks are coupled by convection heat transfer from the solid wall to the cryogenic fluid.

The model presented here is based on a series of experiments conducted in 1966 by the National Bureau of Standards (NBS). A vacuum-jacketed, 200 ft copper transfer line was chilled by liquid nitrogen and liquid hydrogen. The predictions of transient temperature profiles and chilldown time of the integrated Sinda/GFSSP model will be compared to the experimental measurements.