

Atlas Liner Technology (ALT) for Pulsed Power Hydrodynamics

Principal Investigators: R.E. Reinovsky, I.R. Lindemuth, R.J. Faehl, W.L. Atchison, G. Rodriguez (LANL), A. M. Buyko, A. A. Petrukhin, V.N. Mokhov, and V.K. Chernyshev (VNIIEF)

Project Description

The Pulsed Power Hydrodynamics Program at Los Alamos National Laboratory (LANL) has constructed the Atlas capacitor bank (23 MJ, 30 MA, 240 kV) at the Nevada Test Site to magnetically drive high velocity implosions of cylindrical metal liners to obtain high-temperature and high-pressure conditions for high energy density physics impact experiments in a convergent geometry. The All-Russian Institute of Experimental Physics (VNIIEF) has developed pulsed power systems based on a multi-element disk explosive magnetic generator (DEMG) at similar current levels. A joint US/Russian series of advanced liner technology experiments at Atlas parameters (ALT-1, ALT-2) was conducted with the VNIIEF DEMG generator to simulate the performance of the Atlas capacitor bank and liner dynamics. Additionally, these experiments provided an opportunity to diagnose both generator performance and liner dynamics under extreme conditions involving effects such as melt, asymmetry, instability growth, drag, etc., that ultimately affect the fidelity of any liner implosion experiment. The ALT experiments were successfully conducted in 1999 (ALT-1) and 2001 (ALT-2) in Sarov, Russia. The VNIIEF DEMG generator and a foil opening switch were used to produce an electrical current waveform that reached peak values of over 32 MA and imploded aluminum liner velocities of 12 km/sec.

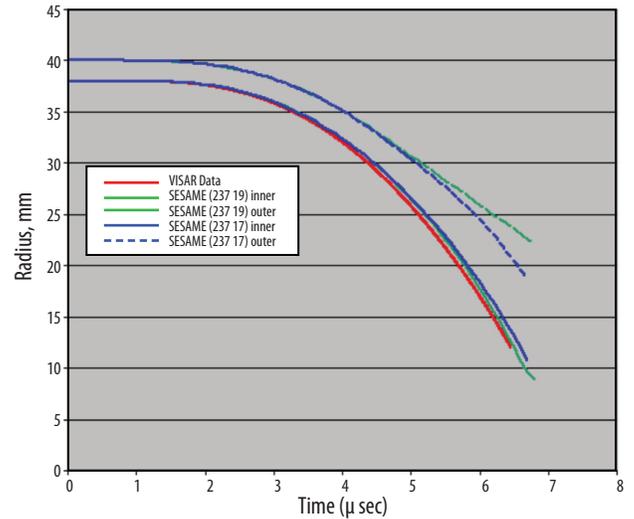
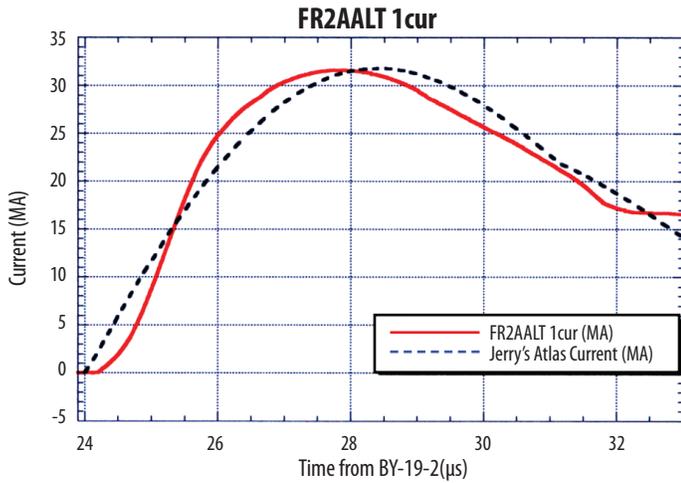
Photograph of the ALT-1 device on the firing point. The disk explosive generator (DEMG) is visible inside the heavy steel frame. Above the frame is the cylindrical transmission line, and above that is steel shielding surrounding the imploding liner experimental unit. Two radiographic x-ray sources are to the left of the shielding. Below the generator, not visible in this photograph, is the explosively driven helical electromagnetic generator (HEMG) that provides the seed current for the disk generator.



Technical Purpose and Benefits

Both laboratories (LANL and VNIIEF) seek to understand the technological issues of high-current magnetically-driven high velocity liners. This project mutually benefits both institutions by providing valuable liner performance information, leading to validation of MHD models. These MHD models, incorporated

into integrated codes are used as design tools for experiments involving materials under high current and pressure conditions. The results of these early experiments affected design decisions and performance for subsequent Atlas and non-Atlas pulsed power physics experiments.



Results of ALT experiments designed to duplicate Atlas implosion conditions using VNIIEF DEMG system.



Collaboration between Los Alamos National Laboratory (LANL), Los Alamos, NM, USA, and the Russian Federal Nuclear Center – All Russian Research Institute of Experimental Physics (RFNC-VNIIEF), Sarov, Russia

