ABSTRACT
NEVADA DOE EPSCoR
ROBUST RADIOGRAPHY DEVICE ISSUES AND STUDIES

Advanced, high quality, multi-pulsed, X-ray radiographic diagnostics are needed to study the dynamic properties of matter and energy close to those that occur in the detonation of nuclear weapons. These conditions will be achieved in a laboratory setting. Critical radiography device issues and studies pertinent to high quality, multi-pulsed, X-ray radiography are proposed. These were developed in conjunction with and complement ongoing DOE stockpile stewardship research initiatives at: Sandia, Los Alamos, Lawrence Livermore, and Bechtel Nevada. The critical issues of mutual interest are: 1) To further develop and benchmark magnetic insulated transmission lines (MITL) diagnostic codes against complex MITL configurations for energy transport, and 2) To inhibit flashover on plastic barriers and couplings and characterize plastics in harsh multi-component environments.

Due to the presence of the electron sheath, MITLs are difficult to analyze and have required two and three-dimensional particle-in-cell (PIC) codes. Although these codes exist, codes need to be benchmarked against and applied to complex MITL geometries finding application to X-ray radiography schemes currently being considered in the national laboratories. Electromagnetic, optic, and X-ray techniques will be employed to experimentally study the plasma sheath characteristics in bifurcated and bent MITLs. A three-dimensional hybrid mesh will also be incorporated in MITL and diode codes to enhance code performance especially in regions containing large plasma or plasma flow gradients.

Surface flashover is important in regions where three or more mediums intersect as voltage requirements increase. It is anticipated that flashover may be initiated in micro-cracks under appropriate loading forces. This shorting effect limits the current and voltage flow to a target compromising both the electrical and mechanical strength of the material. A means to inhibit or minimize flashover is of great interest to the research community. Flashover experiments will be conducted on plastics of interest over a large mechanical, chemical, temperature, and electrical parameter space. Electromagnetic, optic, and X-ray techniques are to be used in the study of plasma formation due to flashover. It is anticipated, with appropriate tracers absorbed in the surface of the plastic, that the evolution and initiation of the dendrites developed during flashover may be examined. Together with the novel techniques proposed, such studies will provide clues on how to inhibit or minimize flashover. Further, spectroscopic diagnostics are to be employed to study beam/target interaction in existing radiography devices.

Diagnostic experiments will be conducted at the Nevada Terawatt Facility at the University of Nevada, Reno, Bechtel Nevada in North Las Vegas and the University of Nevada, Las Vegas.

It is anticipated that the diagnostic techniques and tools developed in this research will have many industrial and medical research applications.