SBIR 06.2 PHASE I - AWARD DETAILS	
ORGANIZATION	AMRDEC (M)
TOPIC NUMBER	A06-018
CONTRACT NUMBER	
YEAR OF AWARD	
AWARD START DATE	
AWARD COMPLETION DATE	
PROPOSAL NUMBER	A062-018-0741
TITLE	Computational Fluid Dynamics Modeling for Electrically Conducting Flows
PROJECT MANAGER	Neeraj Sinha (215) 766-1520 sinha@craft-tech.com
COMPANY	Combustion Research and Flow Technology, Inc. 6210 Keller's Church Road Pipersville PA 18947-2010 Minority Owned: No Woman Owned: No Veteran Owned: No Number of Employees: 35
KEYWORDS	Computational Fluid Dynamics (CFD), Computational Electromagnetics Modeling (CEM), Magnetohydrodynamics (MHD), Radar Cross Section (RCS), Coupled CFD/CEM, e-Beam Energy Deposition, Flow Control, Multi-Disciplinary Simulations
ABSTRACT	The solution of the 3D unsteady Navier-Stokes fluid mechanics equations, coupled to the Maxwell's equations for electrical propagation, is being conducted utilizing an innovative Multi-Physics Simulation (MPS) Architecture. The MPS Architecture provides efficient resolution of a key technical problem that arises in the formulation of numerical solution schemes for these coupled equation sets, namely the definition of the solution grid space by: (1) enabling utilization of overlapping/non-overlapping grids; (2) dynamic and adaptive grid development to achieve adequate grid resolution both spatially and temporally to capture the flowfield features; (3) implements hybrid structured and/or unstructured grids, as appropriate; and, (4) optimal selection of individual numerical algorithms for fluid dynamic and Maxwell's equation sets to resolve numerical stiffness arising out of widely disparate time-scales. The MPS architecture incorporates state-of-the-art solution techniques from computational electromagnetics, as well as intelligent processor control for domain decomposition among multi-processors. The numerical developments are based on the framework of a well-tested and extensively validated, time-accurate, three-dimensional, finite-volume, structured and unstructured grid, Reynolds-averaged, Navier-Stokes flowfield solution methodology that includes detailed models for two- and three-phase gas/particle/liquid droplet flows, and

	generalized finite-rate chemical kinetics. The new model will be applicable to magnetohydrodynamics, electrohydrodynamics and Radar Cross Section predictions.
BENEFITS	The coupled CFD/CEM software is of key interest to aerospace primes that are currently supporting assessment of threat missile plume RCS signatures for the Missile Defense Agency (MDA). Innovative software and hardware technology developments have been proposed that are focused on evolution of space-based and sea-based kinetic energy intercept concepts and accurate prediction of RCS signature is a critical enabling technology for detection and tracking of threat targets. The coupled CFD/CEM model can also be utilized for performing studies that will help support the harnessing of electromagnetic fields for space vehicle power generation, specially for long-range missions where magnetohydrodynamics (MHD) can be gainfully employed.