Public Executive Summary

Title: Advanced Steady-State and Transient, Three-Dimensional, Single and Multiphase, Non-Newtonian Simulation System for Managed Pressure Drilling

Name of Offeror: Stratamagnetic Software, LLC
Project Director/Principal Investigator: Wilson C. Chin

Solicitation Number: RFP2008DW2502 (08121-2502-01)

Project Start Date: October 19, 2009
Project End Date: April 18, 2011

Total Estimated Cost:	$	460,000.00
RPSEA Maximum Share:	$	355,400.00
Stratamagnetic Software Cost Share:	$	100,000.00

Stratamagnetic Software, LLC, Houston, in "Advanced Steady-State and Transient, Three-Dimensional, Single and Multi-phase, non-Newtonian Simulation System for Managed Pressure Drilling" led by Wilson C. Chin, Ph.D., M.I.T., Project Director and Principal Investigator, will provide predictive, rigorous models of the complete circulation system, unencumbered by empirical and unproven practices.

Managed pressure drilling, in part due to advances in rig site hardware and monitoring, has introduced impressive efficiencies in drilling, formation evaluation and reservoir productivity. The key is precise annular pressure control and the ability to respond rapidly. Despite these achievements, efforts to strengthen the weakest link in the technology chain remain unexploited – that link, fluid flow modeling, long an area of industry interest, is cloaked in empirical methods based on lab and field experiments with inconsistent or contradictory results, plus models whose assumptions cannot be justified. Several commercial packages, for instance, de-emphasize flowfield analysis of the annulus (where the greatest pressure losses and subtleties are found), and instead use the simplest formulas for pipe and concentric annular flow. The highly eccentric annulus, the mainstay in deviated and horizontal wells, is simply not considered; even in academic research, unrealistic simplifications are the rule, with vague concepts like "mean hydraulic radius" and "slot flow annuli" used in lieu of rigorous scientific approaches.

The P.I.'s Borehole Flow Modeling (Gulf Publishing, 1992) used detailed boundary-conforming curvilinear meshes to describe eccentric annuli with cuttings beds, washouts and fractures, and solved the complete momentum equations without approximation. It was first, using fully predictive math models, to correlate important cuttings transport databases, first to demonstrate the role of apparent viscosity in jarring, first to show why flow rate increases with pipe rotation, and first to explain why vortex bubbles form in inclined holes with barite sag. Over the years, the P.I. extended these researches with support from Halliburton, Brown & Root, the Department of Energy and others, to cover effects like pipe rotation and axial movement, multiphase flow, holdup propagation, borehole curvature, pipe-to-annulus transition, variable eccentric annular geometry along the flowpath, and convective and diffusive mixing. These fully predictive methods, experimentally validated, bear direct importance to reservoir productivity, drilling efficiency, well control and safety – improved pressure predictions, higher confidence and reduced risks.

We will extend our capabilities in more directions, augmenting them with proven empirical techniques as necessary, to provide an integrated suite of simulation tools capable of modeling the complete gamut of fluid flow problems encountered in MPD. To enhance usability, a state-of-the-art graphical user interface with automated problem setup, integrated color graphics and movie displays, assisted interpretation, report generation and speech output will be offered in an aggressive eighteen month development program, which will define new standards in scientific rigor, practical utility and user friendliness. The aim is fast, intelligent and reliable software that teaches without overwhelming.

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