PROJECT FACT SHEET

CONTRACT TITLE: Perforation Permeability Damage - Creation and Removal (PARTNERSHIP)

ID NUMBER: P-25

B & R CODE: AC1005000

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CONTRACT PERFORMANCE PERIOD:
10/01/1993 to 07/05/1995

PROGRAM: Supporting Research
RESEARCH AREA: Partnership

FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	50	0	50
FISCAL YR 1996	0	0	0
FUTURE FUNDS	0	0	0
TOTAL EST'D FUNDS	50	0	50

OBJECTIVE: To investigate the damage imparted to reservoir rock during perforation treatment by shaped-charged perforation jets. Emphasis will be to combine existing numerical models for stress wave propagation, fluid pore pressure, and micro-mechanical fracture behavior into a numerical tool which will be able to predict perforation damage and to explain how permeability reduction is related to this damage. The ultimate goal is to define a comprehensive modeling methodology to enable exploration of the perforation process and its effects with application to realistic three-dimensional completion geometrys.

METRICS/PERFORMANCE:
Products developed:

PROJECT DESCRIPTION:

Background: The annual cost of inefficient well completion treatments performed by the oil and gas industry exceeds $100 million. A big portion of this inefficiency is attributable to perforation effects, such as created fines and sand production.

Work to be performed: The project is to define a tractable approach to assess perforation damage, evaluate ways to minimize damage, and to determine optimum cleanup options for varying reservoir conditions. Analysis combining field perforation experiments and laboratory perforation experiments together with developing a computational tool from existing numerical models will be pursued. The major damage imparted to the rock from a shaped-charged perforation will result from grain fragmentation in a small region around the perforation tunnel. These grain-grain scale interactions require a micromechanical numerical approach to model the process and quantify damage. Potential micro-mechanical models need to be identified and evaluated as to their ability to couple dynamic deformation, grain fragmentation, pore pressure and fluid flow effects. Definitive physics experiments to quantify grain damage and permeability reduction will be undertaken to support micro-model validation. A micro-damage permeability model will be developed by exercising the validated micro-model for varied reservoir conditions and rock type. The macro-model will then be implemented into a stress wave code for numerical simulations of laboratory and field perforation experiments mentioned above.

PROJECT STATUS:

Current Work: The process was begun in June 1994 with a limited amount of funding. An explicit Eulerian code has been examined to model grain-grain interaction. It can provide explicit fluid modeling but needs extensive improvement in rock fragmentation models, fluid constitutive models, and diagnostics to be a viable tool. Other micro-mechanical approaches are being examined. A visit to the Schlumberger Perforating Testing Center provided familiarity with laboratory perforation-flow experiments and insight on the phenomenology that occurs in such experiments. This information is now being utilized to plan some definitive physics experiments for perforation damage quantification and validation of micro-modeling.

Scheduled Milestones:

Description of a perforation test data base to help future perforation analyses	09/94
Definition of modeling approaches amenable to grain fragmentation modeling	09/94
Definintion of gas-gun flyer-impact recovery experiments	01/95
Definition of cylindrical impact-fluid flow experiments	01/95

Accomplishments: Several micro-mechanical modeling techniques have been identified. Definitive physics experiments to examine permeability have been identified.