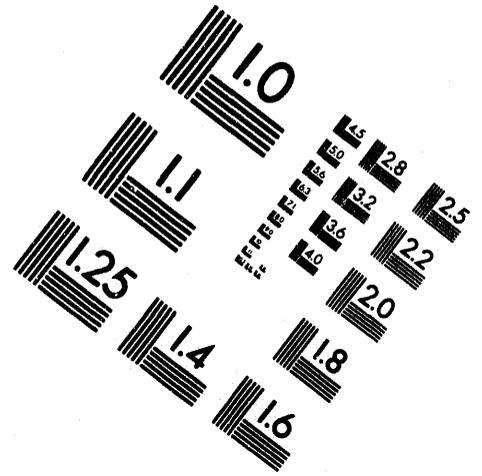
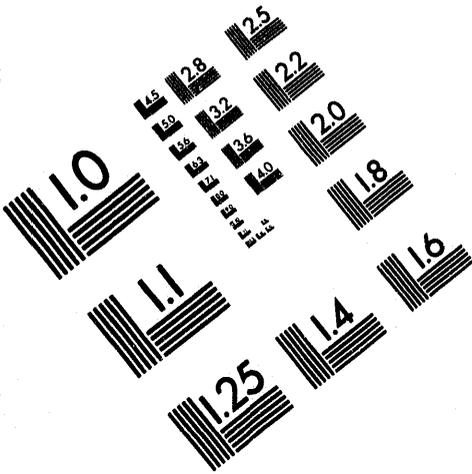




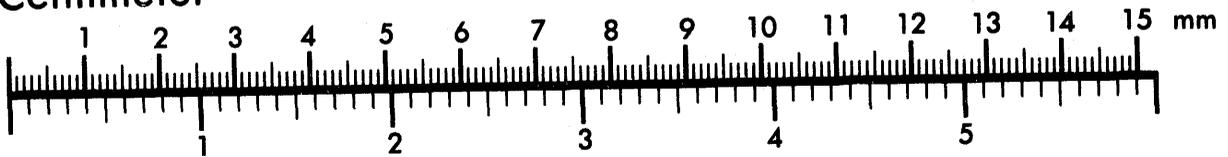
**AIM**

**Association for Information and Image Management**

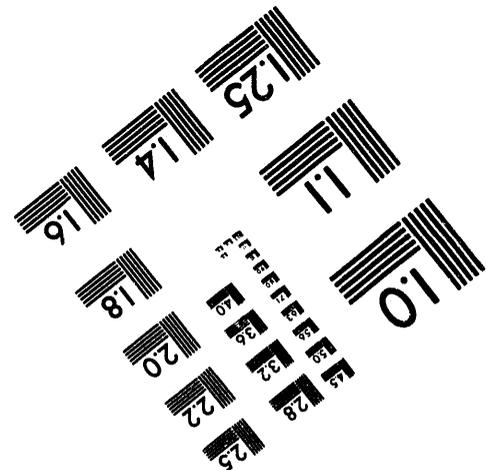
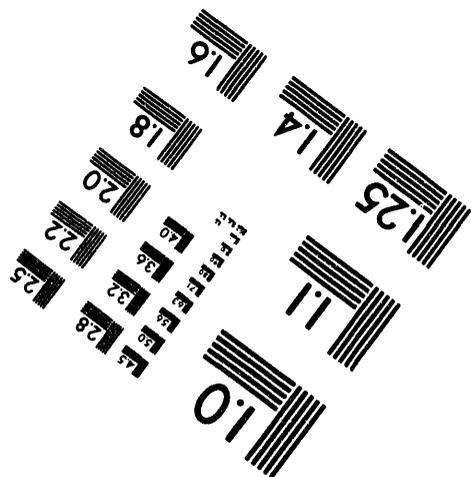
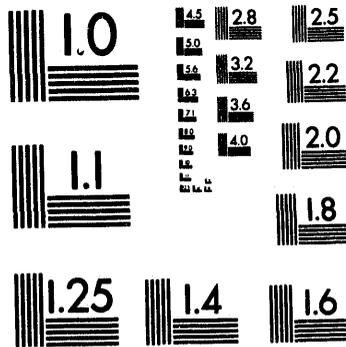
1100 Wayne Avenue, Suite 1100  
Silver Spring, Maryland 20910  
301/587-8202



**Centimeter**



**Inches**



MANUFACTURED TO AIM STANDARDS  
BY APPLIED IMAGE, INC.

**1 of 1**

2/24/94

PROJECT PRESENTATION ABSTRACT

TITLE: HYDROGEOCHEMICAL AND PRODUCTION CONTROLS ON NORM IN OIL- AND GAS-FIELD OPERATIONS

CONTRACT ID NO.: DE-AC22-92MT92011

INSTITUTION NAME: BUREAU OF ECONOMIC GEOLOGY  
THE UNIVERSITY OF TEXAS AT AUSTIN  
UNIVERSITY STATION, BOX X  
AUSTIN, TEXAS 78713-7508

REPORT DATE: APRIL 30, 1994

CONTRACT DATE: MAY 5, 1992

ANTICIPATED COMPLETION DATE: AUGUST 31, 1994

GOVERNMENT AWARD: \$160,500

PROGRAM MANAGER: DR. R. STEPHEN FISHER

PRINCIPAL INVESTIGATOR: DR. R. STEPHEN FISHER

TECHNICAL PROJECT OFFICER: DR. BRENT SMITH

REPORTING PERIOD: JANUARY 1, 1994 - MARCH 30, 1994

No presentations were made during the reporting period.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

RECEIVED  
USDOE/PETC  
94 MAY -5 PM 1:36  
ACQUISITION & ASSISTANCE DIV.

MASTER

rb

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

TECHNICAL PROGRESS REPORT

TITLE: HYDROGEOCHEMICAL AND PRODUCTION CONTROLS ON NORM IN OIL- AND GAS-FIELD OPERATIONS

CONTRACT ID NO.: DE-AC22-92MT92011

INSTITUTION NAME: BUREAU OF ECONOMIC GEOLOGY  
THE UNIVERSITY OF TEXAS AT AUSTIN  
UNIVERSITY STATION, BOX X  
AUSTIN, TEXAS 78713-7508

REPORT DATE: APRIL 30, 1994

CONTRACT DATE: MAY 5, 1992

ANTICIPATED COMPLETION DATE: AUGUST 31, 1994

GOVERNMENT AWARD: \$160,500

PROGRAM MANAGER: DR. R. STEPHEN FISHER

PRINCIPAL INVESTIGATOR: DR. R. STEPHEN FISHER

TECHNICAL PROJECT OFFICER: DR. BRENT SMITH

REPORTING PERIOD: JANUARY 1, 1994 - APRIL 30, 1994

TABLE OF CONTENTS

	Page
Executive Summary .....	1
Introduction .....	1
Project Description .....	2
Project Status .....	2
Planned Activities .....	3
Summary .....	3
Report Distribution List .....	3

RECEIVED  
USDOE/PETC  
94 MAY -5 PM 1:36  
ACQUISITION & ASSISTANCE DIV.

## **EXECUTIVE SUMMARY**

**This project is designed to investigate the geochemical, geological, and production parameters that control the occurrence of naturally occurring radioactive material (NORM) in oil-and gas-field operations. Relations between reservoir setting and NORM content of brine and scale will be interpreted on the basis of the geochemistry of natural radioactivity in oil and gas reservoirs, the compositions of produced water and production-equipment scale, and geochemical modeling to determine the type and amount of scale that can form as produced waters are transported from reservoir to land surface. Our goal is to develop screening criteria that will enable oil- and gas-field operators to identify geologic, geographic, and production characteristics that can lead to high NORM accumulations in equipment and waste.**

**Efforts during the first quarter of 1994 focused on 5 activities. First, we continued to add data to our file of produced- and formation-water chemistry from wells throughout Texas. Second, we received Ra-226 analyses for 36 produced-water samples from wells in the Texas Panhandle and central Texas. Third, we coordinated with API and EG&G, Idaho, to obtain NORM scale samples for mineralogical analysis. Fourth, we arranged and completed a trip to west Texas to sample oil and gas wells from the Central Basin Platform/Midland Basin area. Fifth, we continued data synthesis and interpretation and began preparing our draft final report. In order to be able to include results of mineralogical and radiological analyses of NORM scale in our final report, we will have requested a no-cost contract extension.**

## **INTRODUCTION**

**The purpose of this project is to interpret the geochemical, geological, and production parameters that control the distribution of naturally occurring radioactive material (NORM) in Texas oil- and gas-field operations. This will be accomplished by using published and new data on the chemical and radiological composition of produced brines; the chemical and mineralogical composition of production-equipment scales; a knowledge of the mineralogical composition, burial depth, and temperature of the reservoir; and thermodynamic modeling to quantify radium coprecipitation in production-equipment scale. Our goal is to develop screening criteria that can be used both by regulatory agencies and by the oil and gas industry to identify geographic regions and geologic formations that are likely to produce water with high levels of natural radioactivity and to identify production methods that cause NORM scale to form.**

## **PROJECT DESCRIPTION**

**This project consists of four tasks: (1) Data Compilation and Identification of Field-Sample Sites, (2) Field Sampling, (3) Data Analysis, and (4) Technology Transfer. The Data Compilation and Identification of Field-Sample Sites task includes a literature search of the occurrence of radioactive scale and brine in Texas; a literature search of the geologic occurrence and geochemical behavior of uranium, thorium, and radium; identification of major reservoir types in Texas that contain NORM; identification of operators in areas of interest for sharing data and as candidate sites for sample collection; and selection of field-sample sites. The Field Sampling task consists of preparation for field work, travel to sites, and collection of produced waters at selected fields in Texas. The Data Analysis task includes compilation of analytical results for brines, scale, reservoir and production data; geochemical modeling of analytical results to determine saturation states of NORM-containing minerals and to compare brine and scale chemistry; and statistical evaluation and integration of geochemical, reservoir, and production data. The Technology Transfer task involves tabulation of factors that can be used to predict the occurrence of NORM in scale, publication of conclusions in scientific journals, and presentations of results at professional meetings.**

## **PROJECT STATUS**

**During the reporting period we expanded our database of produced water chemistry, received additional measurements of Ra activity in produced water, and arranged to obtain NORM scale for mineralogical analysis.**

**Our file of produced- and formation-water chemical data now contains analytical results for several hundred samples from wells in north, east, central, and Gulf Coast Texas. We are using these analyses to identify major produced-water types. Selected, high-quality analyses of representative water types will be input into the geochemical modeling program SOLMNEQ to thermodynamically predict the type and amount of scale that will form as produced water is moved from reservoir to production facility conditions.**

**We have collected all available literature reports of Ra activity and water chemistry from oil, gas, and geothermal wells along the Texas Gulf Coast. In addition, we have obtained new measurements of Ra-226 in brine samples from wells in the Texas Panhandle and in central Texas. Arrangements have been made with ARCO, Exxon, and Oryx personnel for a sampling trip to fields in Andrews County, west Texas. We collected 12 produced-water samples from 7 formations for chemical and radiological analyses. All these data will be integrated to evaluate regional variations in the Ra content of produced water.**

Through conversations with API and EG&G, Idaho, staff we have received permission to perform mineralogical analyses on NORM scale samples to be collected by EG&G personnel and analyzed for radioactivity. Combining our mineralogical data with the radiological measurements will provide DOE with valuable information that would not otherwise be obtained if we conducted our project separately from that of EG&G, Idaho. To ensure that both mineralogical and radiological analyses can be included in our final report, we have requested a no-cost project extension.

Data interpretation is continuing, and we have begun to prepare our draft final report.

#### **PLANNED ACTIVITIES**

We expect to receive the results of all outstanding requests for chemical, mineralogical, and radiological data during the next two months. Data synthesis and interpretation, and preparation of the draft final report, should be completed during the second quarter of 1994.

#### **SUMMARY**

We have established a database of produced-water chemistry from wells in north, east, central, west, and Gulf Coast Texas and are examining these data to establish regional patterns in produced water compositions. This database contains Ra-226 analyses for approximately 50 water samples, including both data reported in the literature and results of new analyses performed as part of the current project. Arrangements are being made to obtain and perform mineralogical analyses on NORM scale samples. All these various types of information will be combined to investigate the geochemical, geological, and production parameters that control the occurrence of naturally occurring radioactive materials (NORM) in oil-and gas-field operations.

#### **REPORT DISTRIBUTION LIST:**

**BPO Office of Technology Transfer**

**PETC Budget and Financial Management Division**

**PETC Property Administration**

**PETC Small/Disadvantaged Business Specialist**

**DATE**

**FILMED**

**7/18/94**

**END**

