Overview of Gas Research Institute Environmental Research Programs

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OVERVIEW OF

GAS RESEARCH INSTITUTE

ENVIRONMENTAL RESEARCH PROGRAMS

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Sixteenth Biennial Low-Rank Fuels Symposium

May 20-23, 1991

Billings, Montana

OVERVIEW OF GRI ENVIRONMENTAL RESEARCH PROGRAMS

I. Introduction

I want to thank the University of North Dakota Energy and Environmental Research Center (EERC) for inviting me here today. I feel at home in this audience, since my family has been associated with the coal industry for two generations.

I have been asked to talk to you today about the Gas Research Institute, where I am Senior Project Manager in the Environment and Safety Research Department.

I would like to tell you what GRI is, and how it is managed, then tell you about some of the ongoing research. When we finish, you will have a better idea of the philosophy, reasoning and techniques GRI uses to develop and move forward with its research programs.

II. What is GRI?

What then is GRI?

The Gas Research Institute (GRI) is a private not-for-profit membership organization of natural gas pipelines, distribution companies and natural gas producers. GRI's purpose is to plan, to manage and to develop financing for a gas-related research and development (R&D) program on behalf of its members and their customers. GRI does not do any research itself.

GRI's R&D program is designed to provide advanced technologies for natural gas supply, transport, storage, distribution and end-use applications in all markets. In addition, basic research is conducted for GRI in these areas to build a foundation for future technology breakthroughs.

A. Funding

Most of the funding for GRI is derived from the sales and transportation services of GRI's interstate pipeline company members. The Federal Energy Regulatory Commission (FERC) authorized these companies to include in their tariffs a charge based on gas used by their regulated customers and gas used by a major portion of their unregulated direct industrial and electrical utility customers. This money is collected on behalf of GRI. Because GRI's revenue comes directly from the ratepayer, the FERC approves GRI's R&D program and planned expenditures annually. For 1991 FERC has approved a funding unit of 1.46 cents per thousand cubic feet of natural gas. The GRI budget for 1991 is approximately $195 million. Funds are leveraged wherever possible.

B. Advisors

GRI is governed by a board of 39 directors chosen from the gas industry and two directors-at-large. In addition, there are four major advisory bodies, two representing the gas industry, one representing the ratepayer at large and one the scientific and governmental communities. Further, there are approximately 16 project advisory groups whose members come from the gas industry. There are also a number of task forces made up of project advisors, scientists and working industry experts who advise specific research operations.

C. Planning

Planning research at GRI is a major responsibility. The research must meet a real need and it must be important enough to compete for available funds, just as in the business world.

There are two planning cycles at GRI. The first involves the entire organization. This planning is on the concept or idea level and it is here that budgets are set. This planning cycle involves meetings between project managers and department directors, then a series of meetings with the Senior Research Committee, which consists of members of senior management. Finally, all concepts are run through a special computer program to assign priorities. Many fail this last step. Once priorities are set, a budget is drawn up and the plan submitted to FERC for approval. This cycle takes about 18 to 20 months from concept development to FERC approval.

The second planning cycle is at the contract or project level, and I will go into that in a few minutes.

D. Research Departments

Besides the normal support functions, GRI is partitioned into nine research groups. These include:

- Enhanced Recovery, Coal Seams, and Shales Research,
- Tight Sands and Gas Processing Research,
- Industrial Utilization Research,
- Power Generation and Transportation Research,
- Appliances and Building Systems Research,
- Space Conditioning Research,
- Transport and Storage Research,
- Physical Sciences Research, and
- Environment and Safety Research

III. Environmental and Safety Research Department Program

Today it is the Environment and Safety Research Department (E&SR) that I want to talk about.

Work in this department includes sections interested in:

- Supply Related Research,
- Air Quality Research,
- End Use Equipment Safety Research,

- Gas Operations Safety Research, and
- Gas Operations Environmental Research

The Environment and Safety Research Department serves several purposes at GRI. First, it interacts with other departments when new or ongoing projects contain aspects that might generate environmental, health or safety concerns. Second, we try to predict the direction in which environmental legislation and regulatory activities are moving, then extrapolate how these actions will affect the gas industry. The research issues that such legislation might raise are defined and research projects devised to provide insights into the problems. This research is designed to lead to the development of technology to cope with the problem.

A. Inter-Departmental Cooperation

Inter-departmental work may consist of reviewing the initial research contract or reviewing a project occasionally. Alternately, it may require a full-scale parallel research program. For example, the environmental departments participation in the Underground Coal Gasification (UCG) program at Hanna, Wyoming was of the latter type.

When the UCG project was first discussed with the advisory bodies in 1984, it was apparent that industry would not consider commercializing the process if it created environmental problems. The E&SR Department began a program to identify the environmental research issues, based on data and anecdotal information from past tests. Simultaneously, a program was developed to identify the most cost-effective means of treating water contaminated from UCG operations, again based on data from past operations.

Water contamination was identified as the primary environmental issue, and a hypothesis was developed that defined the mechanism by which this contamination occurred. WRI in Laramie, Wyoming began bench-scale research immediately to determine if this mechanism was correct, and if so, to find the steps that might be taken to reduce such contamination. The EERC acted as independent advisors. The EERC is also looking at long term process effects on the strata surrounding the coal seam.

The environmental plan submitted to the Wyoming Department of Environmental Quality (WDEQ) incorporated both the water treatment and the bench-scale results. The E&SR department remained involved in the project, overseeing the shutdown of the very successful UCG operation, and following the post-burn water monitoring. There are still two years left of the five year coal-seam water monitoring program requested by WDEQ. I am happy to say that the results to date suggest that none of the residual contamination created by the test has gotten to the monitoring wells. Even the original contamination has almost disappeared.

B. Regulatory Driven Research

The coalbed methane produced water research in Alabama's Black Warrior Basin is an example of regulatory driven research. In 1984 it was becoming evident that whole effluent toxicity testing would play a large part in determining the amount of process effluent water that could be discharged into a stream or other body of water. A series of projects were started:

- The first to define background conditions in streams around the Cedar Cove Field,
- The second to find if there were any effects of discharging water from coalbed methane development, and
- The third to define the in-stream biological effects of discharging increasingly concentrated water from a coalbed methane development.

The research showed that chloride and TDS limits imposed by the Alabama Department of Environmental Management (ADEM) for discharge of chloride containing waters were very conservative. This information and ADEM's acceptance of it has supported the growth of the coalbed methane industry in Alabama to date. Of course, now the industry is growing beyond the capacity of the local streams to assimilate the salt load. New techniques must be found for the disposal of produced water. GRI is working on several approaches to this problem.

IV. Natural Gas Supply Program

The Natural Gas Supply Program is the program that I am particularly interested in. Research is ongoing in such areas as:

- Restoration of Pipeline Right-of-ways;
- Cleaning Up Town Gas Manufacturing Sites;
- The Development of Methanogenic Bacteria for Soil and Groundwater Cleanup;
- Development of Biological Fluidized Carbon Units for Rapid Destruction of Carbonaceous Compounds;
- Research on Liquid Redox Sulfur Recovery for Sulfur Removal from Natural Gas;
- Research on Produced Water and Production Wastes Generated by the Natural Gas Industry;
- Environmental Effects of Coalbed Methane Production; and
- Subsurface Effects of Natural Gas Operations.

A. Western Coalbed Methane

In the coalbed methane program, the ES&R Department is not only doing the work described above in Alabama, but is also working with western coalbed methane producers. The department is now concentrating on the disposal of produced water in the San Juan Basin. The first project was to determine how much coalbed produced water the Entrada formation could accept; then estimate how this injected water would affect water flow out of the formation.

Before this project was barely underway, we began to hear tales of water well contamination resulting from the coalbed methane activity. Simultaneously, coalbed methane producers in the San Juan were saying that they were producing benzene and other light gas liquids with the coalbed methane.

The E&SR Department switched its efforts to trying to find the real cause of the groundwater contamination. While we haven't finished this work, it would now seem that the contaminants, including water, originates from abandoned oil and gas wells in the regions. A combination of corrosion, not recognizing that the coal formations needed to be sealed off when the wells were abandoned, and a very geologically active area, now seem to be the real reasons for the contamination. We will see how this research finally resolves the question.

B. Groundwater Program

The development of the subsurface effects of natural gas operations on groundwater is a good example of the way programs are developed at GRI.

It became apparent by 1984 that groundwater related problems would become a large and continuing issue in this country and that they would eventually affect the gas industry. The first work done was with the UCG program as outlined above. In 1988, a concept for further groundwater work was outlined in sufficient detail to obtain Senior Management Committee approval of the project. Several years before the Mining and Minerals Resource and Research Institute of the University of North Dakota had answered a Request for Proposal (RFP) and won. The EERC had also obtained 49.5 percent DOE cofunding of the project, on an annual basis. The project finally began in 1989.

First Task

The first task given to the EERC was to define the type of research that would provide the greatest return for the money to be spent. Thus, the object of the GRI Groundwater Program is "To develop an understanding of the interaction of inorganic and organic materials with unsaturated and saturated zone soils." This data will be of a quality to aid in the development of less expensive and more effective groundwater and soil remediation technologies.

Second Task

The second task was to develop an approach to the research that would consider the wide geographical spread of the natural gas industry, and the diversity of operations, including production, processing, transportation, and storage. Given that geologists will so often tell you that the interaction of chemicals with the soil is a site specific problem, this was a difficult assignment. It was decided that the United States mainland could be divided into a few zones where factors of climate, soil characteristics and general hydrology were essentially common. Then concentration on a minimum number of soil types would yield sufficient extra information to enable generalizations to be derived that would aid in defining site specific interactions of the soil with gas industry compounds.

Third Task

The third task was to define the products that would be produced by this project. The overall product is defined in the program objective. It was decided that this information could be best transferred through three media: (1) an electronic database, (2) a report of findings, and (3) a series of mechanistic mathematical models, to aid in the use of the data developed.

Since this program is not designed to develop models, it was decided that a stable of models should be identified that could be modified to incorporate the new data. This stable should include relatively simple models that could run on a personal computer with a minimum of data and expertise, and also one or two more sophisticated models that would require more data and experts to operate.

Thus, the direction of work was set, together with the form of the final project products. This defined the type of research to be undertaken, as well as the range and type of data required. However, GRI feels it is essential to be able to transfer information to the gas industry as it is developed.

Fourth Task

For the fourth task, a series of necessary and not immediately obvious tasks were identified, the data from which would keep the gas industry current with the project progress. These tasks included:

- Development of an annotated bibliographic database to keep track of reviewed literature.
- Development of abandoned well and injection well demographics.
- Review of today's techniques for handling drilling wastes, and of salt laden soil remediation techniques so that the program can be properly focused.
- Review of past and present groundwater research programs, which will help to prevent reinventing the wheel, and will permit incorporation of new data developed by others into this program. This study also aids in the identification of data gaps.
- A critical review of existing sampling and analytical techniques to aid in choosing the best and most effective techniques for each situation. This study also may identify the need for new sampling or analytical techniques.
- A critical review of existing groundwater models that might be used to achieve the program goals and be of use to the gas industry, even without modification.
- A critical review of the literature and data on fate and transport of the chemicals identified as being of interest to the gas industry.
- A critical review of bioremediation technologies, and
- A review of remote sensing technologies.

Reports and databases on each of these tasks should be available by the end of the year.

Fifth Task

The fifth general task is just being completed. That task was to define the organic and inorganic chemicals to be investigated. The program advisors provided a list of some 80 chemicals. Using data developed under other ongoing GRI projects, this list was pared down to about a dozen high priority chemicals, based on volume, human or ecological toxicity, and sometimes intuition. The chemicals currently under consideration include the RCRA metals barium,

mercury, arsenic, lead, strontium, and radium. The inorganics include benzene, ethylenzene, toluene, xylene, glycol, amines, low molecular weight hydrocarbons such as propane and hexane, phenols, and cresilic acid. Still, the material of overriding importance is salt. Salt is found in almost all water produced with gas, and produced water is by volume the largest waste the gas industry has.

Future Tasks

The next phase of the program is just being examined. It must be based on the results of these initial studies. The study of some items will be eliminated, due to the work of others, or time and money constraints. Some studies started by others will need to be extended. The need to understand the effects of mixtures has already been identified, since most groundwater studies have concentrated on single chemicals. The addition of salt to these mixtures and the influence salt might have on system properties must be understood. Understanding the fate of elemental mercury in the unsaturated and saturated zones is also a very high priority.

V. Summary

In summary, GRI is a not-for-profit organization doing research to benefit the gas industry and the gas rate payer. GRI plans, manages and develops funding for research. GRI's research program is financed largely by a FERC approved fee on gas used by the gas customer. While GRI personnel manage the research programs, the organization has an excellent hierarchy of industry and scientific advisors to help evaluate and direct the more than 500 ongoing research programs. The process used by GRI to choose, set priorities and manage research has received overwhelming approval by the National Research Council after a very thorough review requested by FERC on GRI's 10th anniversary. GRI has a better than 4.5 to one return in benefits to the gas industry and the ratepayer on the money spent in research.

GRI conducts research in many areas. I have concentrated here on a few of those programs that originate in the Environment and Safety Research Department program. While the programs I have discussed today consider gas industry needs, you can see that they will benefit many other industries, not the least of which is the coal industry.