

## QUARTERLY PROGRESS REPORT

**Report Title:** Field Demonstration of a Membrane Process to Separate Nitrogen from Natural Gas: Eighteenth Quarterly Progress Report (First Quarter 2006).

**Type of Report:** Quarterly progress report

**Reporting Period:** January 1, 2006 – March 31, 2006

**Contact:** Dr. Kaaeid Lokhandwala  
Tel: (650) 328-2228 ext. 140  
e-mail: kaaeid@mtrinc.com

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**DOE Award Number:** DE-FC26-01NT41225

**Submitting Organization:** Membrane Technology and Research, Inc.  
1360 Willow Road, Suite 103  
Menlo Park, CA 94025

Tel: (650) 328-2228  
Fax: (650) 328-6580  
www.mtrinc.com

**Subcontractors:** None

**Other Partners:** ABB Lummus Global

**Project Team:** Project Officer: Anthony Zammerilli  
Contract Specialist: Keith L. Carrington

## **Disclaimer**

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## **Abstract**

The original proposal described the construction and operation of a 1 MMscfd treatment system to be operated at a Butcher Energy gas field in Ohio. The gas produced at this field contained 17% nitrogen. During pre-commissioning of the project, a series of well tests showed that the amount of gas in the field was significantly smaller than expected and that the nitrogen content of the wells was very high (25 to 30%). After evaluating the revised cost of the project, Butcher Energy decided that the plant would not be economical and withdrew from the project.

Since that time, Membrane Technology and Research, Inc. (MTR) has signed a marketing and sales partnership with ABB Lummus Global, a large multinational corporation. MTR is working with the company's Randall Gas Technology group, a supplier of equipment and processing technology to the natural gas industry. Randall's engineering group found a new site for the project at a North Texas Exploration (NTE) gas processing plant, and we are now negotiating with Atmos Energy for a final test of the project demonstration unit. Several commercial sales have also resulted from the partnership with ABB, and total sales of nitrogen/natural gas membrane separation units are now approaching \$2.6 million.

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## **Introduction**

The U.S. natural gas pipeline specification for inert gases is less than 4%. On this basis, about 17% of known U.S. reserves of gas are sub-quality due to high nitrogen content. Some of this gas can be brought to pipeline specifications by dilution with low-nitrogen-content gas; some is treated by cryogenic condensation and fractionation. Nonetheless, about 1.0 trillion scf of known reserves are currently shut in.

This project covers the first demonstration of a new membrane technology to treat this otherwise unusable gas. The objective of this project is to develop a membrane separation process to separate nitrogen from high-nitrogen-content natural gas. To demonstrate the process, a proof-of-concept plant was built for a North Texas Exploration (NTE) gas field in Texas. A short test of the unit was of limited success due to a smaller-than-anticipated feed stream at the test site. We are currently arranging for a final field test at a site operated by Atmos Energy, most likely in Texas.

## **Experimental Update, Results and Discussion**

We are actively pursuing alternate sites for the original demonstration system which is currently stored in Houston. We are hopeful that the ongoing negotiation with Atmos Energy will lead to placement of that unit at another facility in North Texas. If this happens, it will probably be installed in Q2 2006.

Results obtained from the limited time the system was operated at the NTE site were encouraging. We now have several commercial systems installed or in the process of being installed. Operational data from these units meet or exceed the design performance guarantees.

## **Commercialization Update**

MTR and ABB have now sold a total of six commercial nitrogen/natural gas membrane separation units related to the technology developed during this project. A brief update on the status of each unit follows.

- The Omaha Public Power District (OPPD) unit, our first commercial nitrogen/natural gas unit, and has operated with virtually no downtime since it was installed three years ago.
- The Twin Bottoms, KY, system installed for Interstate Gas in November 2004 remains in continuous operation and is now operating at its maximum design capability.
- Interstate Gas ordered a unit like the Twin Bottoms unit in 2005, and it was shipped to the client in February 2006.
- First National Bank of Omaha ordered a unit that was shipped on schedule in February 2006.
- Syntroleum Systems (Tulsa, OK) ordered a unit in late 2005. The unit is ready for installation, pending resolution of internal issues at Syntroleum.
- Hiland Partners (Dallas, TX) ordered a unit in 4Q 2005 for a site it operates in North Dakota. It is four times the size of the OPPD unit, and is the largest unit of this type ordered to date.

- Hiland ordered a second unit in the first quarter of 2006. Fabrication of both Hiland units began in February 2006, for May/June delivery.

Commercial sales of natural gas/nitrogen membrane separation units related to this project technology now total \$2.6 million.

### **Conclusions**

MTR has successfully tested the nitrogen/natural gas separation process in a commercial unit and demonstrated its performance at one wellhead site in Kentucky. The successful demonstration resulted in the sales of several additional commercial units. All installed commercial units are operating at or better than guarantee conditions and our clients have given us several good references for further development of this business. Total commercial sales of \$2.6 million have been made for the product line developed from this project. Further sales are expected in 2006.

### **References**

None cited.

U.S. DEPARTMENT OF ENERGY  
FEDERAL ASSISTANCE PROGRAM/PROJECT STATUS REPORT

**OMB Burden Disclosure Statement**

Public reporting burden for this collection of information is estimated to average 47.5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Office of Information Resources Management Policy, Plans, and Oversight, Records Management Division, HR-422 - GTN, Paperwork Reduction Project (1910-0400), U.S. Department of Energy, 1000 Independence Avenue, S.W., Washington, DC 20585; and to the Office of Management and Budget (OMB), Paperwork Reduction Project (1910-0400), Washington, DC 20503.

1. Program/Project Identification No. DE-FC26-01NT41225	2. Program/Project Title Field Demonstration of a Membrane Process to Separate Nitrogen from Natural Gas	3. Reporting Period January 1, 2006 through March 31, 2005
4. Name and Address Membrane Technology and Research, Inc. 1360 Willow Road, Suite 103 Menlo Park, CA 94025		5. Program/Project Start Date 10/01/2001
6. Completion Date 09/30/2006		
7. Approach Changes  Depending on the results of current discussions with Atmos Energy, we may request an additional no-cost project extension for further long-term testing of the demonstration unit.  <input checked="" type="checkbox"/> None		
8. Performance Variances, Accomplishments, or Problems The demonstration test unit is being slated for potential installation at another site in North Texas. The new site will be operated by Atmos Energy, a large natural gas utility headquartered in TX. We are expecting a final go ahead from the client in Q2 2006.  <input type="checkbox"/> None		
9. Open Items  <input checked="" type="checkbox"/> None		
10. Status Assessment and Forecast  We continue to make significant commercial progress selling membrane-based nitrogen/natural gas separation systems. We have completed the sale of six membrane units related to this project.  Incoming prospects and inquiries continue at a high level.  <input type="checkbox"/> No Deviation from Plan is Expected		
11. Description of Attachments Quarterly report attached.  <input type="checkbox"/> None		
12. Signature of Recipient and Date  04/11/06	13. Signature of U.S. Department of Energy (DOE) Reviewing Representative and Date	

## REQUEST FOR PATENT CLEARANCE FOR RELEASE OF CONTRACTED RESEARCH DOCUMENTS

TO:  For Technical Reports  
AAD Document Control  
MS F07  
U.S. Department of Energy - NETL  
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Morgantown, WV 26507-0880

◆Contract Agreement No.

DE-FC26-01NT41255

Name & Phone No. of DOE COR

Anthony Zammerilli  
(304) 286-4641

For Technical Reports  
AAD Document Control  
MS 921-143  
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For Technical Papers/Journal Articles/Presentations  
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9800 S. Cass Avenue  
Argonne, IL 60439  
FAX: (630) 252-2779

### A. CONTRACTOR ACTION (CONTRACTOR COMPLETES PART A. 1-5)

1. Document Title: Field Demonstration of a Membrane Process to Separate Nitrogen from Natural Gas

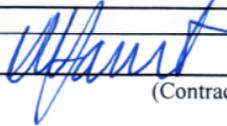
2. Type of Document:  Technical Progress Report  Topical Report  Final Technical Report  
 Abstract  Technical Paper  Journal Article  Conference Presentation  
 Other (please specify): 4Q 2005 (Quarter 17 of contract)

3. Date clearance needed: N/A

#### ◆4. Patent information.

Yes No

- Is any patentable subject matter disclosed in the report?  
  If so, has an invention disclosure been submitted to DOE Patent Counsel?  
If yes, identify disclosure number or DOE Case Number \_\_\_\_\_  
  Are there any patent-related objections to the release of this report? If so, state the objections.  
\_\_\_\_\_  
\_\_\_\_\_

◆5. Signed  Date April 20, 2006  
(Contractor)

Name & Phone No. Janet Farrant (650) 328-2228 ext. 114

Address 1360 Willow Road, Suite 103, Menlo Park, CA 94025-1516

### B. DOE PATENT COUNSEL ACTION

- Patent clearance for release of the above-identified document is granted.  
 Other: \_\_\_\_\_

Signed \_\_\_\_\_ Date \_\_\_\_\_  
(Patent Attorney)

◆ Must be completed by the contractor.