

NATURAL GAS STAR



Summer 2001

PARTNER UPDATE

Identification and Evaluation of Opportunities To Reduce Methane Losses at Four Processing Plants

Recent findings reveal that significant opportunities exist for cost-effectively reducing natural gas losses at gas processing plants through the control of leaking equipment components and leakage of process gas into vent and flare systems. The study, led by the Gas Technology Institute (GTI, formerly the Gas Research Institute) in cooperation with EPA's Natural Gas STAR Program and industry participants, was conducted in late 2000 at four gas processing facilities that varied in terms of age, types, and throughputs. The selected facilities were expected to offer a range of opportunities for cost-effective reduction of natural gas losses.

Directed inspection and maintenance at gas processing plants is among several best management practices and partner reported opportunities recommended by the Gas STAR Program for reducing methane emissions. The objective of the study was to demonstrate with actual field data that a comprehensive leak detection and repair program could reduce gas losses while enhancing profits. GTI's Hi-Flow™ Sampler technology was used to gather data on emissions from continuous vents, combustion equipment, and flare systems. Assessment of the emissions data coupled with diagnostic checks of natural gas-fueled equipment provided an opportunity to examine whether reductions in methane gas emissions could be achieved sensibly, could be verified, and could create an economic opportunity for the industry.

Most leak detection and repair programs in the natural gas industry rely on EPA's Method 21, which measures the concentration of methane leaked into the air and then uses a correlation

equation to estimate the leak rate. In conventional leak programs, Method 21 is used to screen the facility at a prescribed frequency such as annually or quarterly. Based on the method's specifications, all components that produce screening values greater than 10,000 parts per million (ppm) are required to be repaired. Because the Method 21 equations are applicable only between 10,000 and 100,000 ppm, any leak that screens beyond this upper concentration results in the same estimated leak rate. In contrast, the methodology employed by GTI in this and other studies differs from Method 21 in that a special device (the Hi-Flow™ Sampler) is used to measure the actual leak rate by volume. These volumetric measurements can then be used as reliable data in a cost-benefit analysis to decide which leaks are cost-effective to repair.

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The 8th Annual Natural Gas STAR Workshop will be held on October 23-25, 2001. Register now! Workshop details are provided on page 4.

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Data from GTI studies show that only about 10 percent of the fugitive emissions that screen above the 10,000-ppm threshold are cost effective to repair. This is due to the fact that leaks with a high concentration reading may actually have a low leak rate. Therefore the gas savings alone may not justify high repair costs. On the other hand, 20 percent of the components that screen at values less than 10,000 ppm are cost effective to repair, but would not be repaired based on the Method 21 criteria. GTI's method relies on cost-efficient leak detection techniques and on its Hi-Flow™ Sampler—a leak measurement device—which accurately measures leak volume. This method significantly reduces the cost of leak programs at natural gas facilities. Their data have shown that implementing this procedure at natural gas compressor stations can reduce emissions by 80 to 90 percent with a payback period of 6 to 12 months. They have also shown that 10 percent of the leaks are responsible for 80 to 90 percent of the emissions, and thus, significant reductions can be achieved by repairing a relatively small number of leaks.

The intensive fugitive-component and screening-measurement program conducted by GTI targeted facilities that process sweet and sour gas and use compression, separation, stabilizing, deep cryogenic recovery and rejection, mole sieve and triethylene and diethylene glycol dehydration, and other gas-refining

techniques. The four plants had been operating from 20 to 50 years. Table 1 provides the type, age, throughputs (mmscfd), and the number of components for the four plants. The survey at each facility included screening to detect leaks; measuring emission rates from leakers and from continuous flows and emergency vents during passive periods; counting surveyed equipment components; measuring residual gas flare rates; testing natural gas-fueled combustion equipment; sampling process and waste streams; developing an emissions inventory; determining site-specific average emission factors for fugitive leaks; and preparing cost-benefit analyses to identify control opportunities.

Equipment components on all process, fuel, and waste gas systems were screened for leaks. Surveyed components included flanged and threaded connections, valves, pressure relief devices, open-ended lines, blowdown vents, instrument fittings, regulator and actuator diaphragms, compressor seals, compressor crankcase vents, engine crankcase vents, sewer drains, and sump and drain tank vents. Leak detection was conducted with bubble tests using soap solution, portable hydrocarbon gas detectors, and an ultrasonic leak detector. Bubble tests were performed on most components because that is the most rapid screening test. Values greater than 10,000 ppm were considered to be leaks. Leaking components were tagged; the specific source and date were noted; and measurements were taken.

The Hi-Flow™ Sampler was the primary method used to determine emission rates. This device was developed by GTI as an economic means of measuring the emission rate from leaking components with sufficient accuracy to allow an objective cost-benefit analysis of each repair opportunity. Relative to the two-orders-of-magnitude error rates (plus or minus) of the Method 21 correlation equations, the

Table 1 Summary of Surveyed Plants

Plant No.	Type	Age	Throughput (mmscfd)	Number of Components
1	sweet	35	54	16,050
2	sweet	50	60	14,424
3	sweet	20	210	56,463
4	sour	35	120	14,168

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PROGRAM TOOLS

New Natural Gas STAR Tools

The Natural Gas STAR Program is developing three new Web-based tools that will allow companies to analyze benefits of the Best Management Practices (BMPs) and Partner Reported Opportunities (PROs); enable partners to submit their annual reports online; and facilitate the emissions reduction tracking process for partner companies. These tools are expected to be available on the Natural Gas STAR Web site in the fall of 2001.

Analyze and Evaluate BMPs and PROs

The Online Analytic Tool will allow companies to perform economic evaluations of the Program's BMPs and PROs and estimate potential gas savings. Users will be able to do a customized site-specific or company-wide evaluation of selected BMPs and/or PROs that they may be interested in implementing. These evaluations can then be used in the decision making process to determine the optimal level of implementation of a specific BMP or PRO.

For each BMP or PRO that is being selected, users will be prompted to enter operational information and economic parameters, such as capital cost, operating costs, and current gas price. Where available, the user will be able to select default values for both economic and operational inputs. Using this information, the tool will perform an economic analysis for the selected BMP or PRO, providing details on the total cost, return on investment, payback period, and net present value.

Annual Reporting on the Web

The Online Reporting Tool will provide yet another option for partners to submit their annual reports. This Web-based tool will guide the user through the reporting process, making annual reporting even easier than before. The tool will prompt users to enter company-specific emission reduction data and then perform various calculations, such as total emission reductions and the value of the www.epa.gov/gasstar gas saved. Online reporting will be password protected to ensure security of all information. Partners will be able to return to partially completed reports and finish them as time allows. Once the report is complete, partners will be able to print the final form and also submit the report to the Natural Gas STAR Program at the click of a button. Partners who choose not to use the Online Reporting Tool will still have the option of filling out the form by hand, filling out the standard form in MS Word, or using their own reporting format.

Collect and Track Company Data from the Field

In response to requests from partner companies, the Natural Gas STAR Program is developing an emission reduction tracking and data collection tool. This tool will enable implementation managers with a simple Web-based mechanism to collect information from different facilities across their companies, aggregate these data, analyze the results, and generate and submit an annual report. The tool will allow individuals from different facilities across the company to record project-level emission reduction information. All data entry can be done at the facility level via the Internet. This password-protected system will allow the implementation manager to run summary reports of the company's emission reduction activity, including summaries of individual practices as well as company-wide activities. Reports can be shared internally or submitted to the Natural Gas STAR Program as part of the annual reporting process.



PARTNER EXPERIENCES

Lessons Learned from GAS STAR Partners

Lessons Learned Summaries serve as effective guides for implementing Best Management Practices (BMPs) and Partner Reported Opportunities (PROs). In these summaries, Natural Gas STAR partners share their experiences in implementing methane emission reduction technologies and practices. Cost/benefit information, helpful implementation tips, and reference sources are provided. Twelve Lessons Learned Summaries are currently available on the Natural Gas STAR Web site, under Technical Support Documents. The following are synopses of the two most recently released Lessons Learned Summaries.

Convert Gas Pneumatic Controls to Instrument Air

Pneumatic instrument systems powered by high-pressure natural gas are used across the natural gas industry for process control. Typical process control applications include pressure, temperature, liquid level, and flow rate regulation. The constant bleed of natural gas from these controllers is collectively one of the largest sources of methane emissions in the natural gas industry, estimated at approximately 24 billion cubic feet (Bcf) per year from the production sector, 16 Bcf from the processing sector, and 14 Bcf per year from the transmission sector.

Companies can achieve significant cost savings and methane emission reductions by converting natural gas-powered pneumatic control systems to compressed instrument air systems. Instrument air systems substitute compressed air for the pressurized natural gas, eliminating methane emissions and providing additional safety benefits. Cost-effective applications, however, are limited to those field sites with available electrical power, either from a utility or self-generated source. Instrument air conversion is most economical when a large number of pneumatic devices are consolidated in a relatively small area.

Natural Gas STAR Workshop

Join us at the 8th Annual Natural Gas STAR Implementation Workshop October 23-25, 2001 in Houston. During the workshop, EPA will provide an overview of the program's accomplishments, introduce new tools, and present awards to outstanding partners. Participants will exchange ideas on research and emission-reduction successes during round tables and in small sector-oriented discussions. EPA Administrator Christine Todd Whitman has been invited to give a keynote address and to present this year's awards, and Mr. Arthur E. Smith Jr., VP of Environmental Health & Safety and Environmental Counsel for NiSource Corporation will give the industry keynote address. A registration form is provided on page 11 of this update. We look forward to seeing you there!

Natural Gas STAR Partners have reported savings of up to 70 million cubic feet (Mmcf) per year per facility by replacing natural gas-powered pneumatic systems with instrument air systems. This represents annual savings of up to \$210,000 per facility. Partners have found that most investments to convert pneumatic systems pay for themselves in just over one year. Individual savings will vary, depending on design, condition, and specific operating conditions of the controllers. Per year, individual companies have recovered an average of 20 Mmcf of methane gas worth \$60,000, while their costs of implementation averaged \$50,000. The value of gas saved is based on the assumption that methane gas is worth \$3.00 per thousand cubic feet (Mcf). The implementation costs include the cost of installing a compressor, dryer, and other accessories, as well as the cost of annual electricity requirements.

Using Hot Taps for In Service Repair

Natural gas transmission and distribution companies often need to make new connections between pipelines to expand or modify their existing system. Historically, this has necessitated shutting down a portion of the system and purging the gas to the atmosphere to ensure a safe connection. This procedure, referred to as a shutdown interconnect, results in methane emissions, loss of product and sales, customer inconvenience, and costs associated with evacuating the existing piping system.

Hot tapping is an alternative procedure that makes a new pipeline connection while the pipeline remains in service. The hot tap procedure involves attaching a branch connection and valve on the outside of an operating pipeline, and then cutting out the pipeline wall within the branch and removing the wall section through the valve. Hot tapping avoids product loss, eliminates methane emissions, and prevents disruption of service to customers.

While hot tapping is not a new practice, recent design improvements have reduced the complications and uncertainty that operators may have experienced in the past. Several Natural Gas STAR transmission and distribution partners report using hot tap procedures regularly—small jobs are performed almost daily while larger taps (greater than 12 inches) are made two or three times per year.

By performing hot taps, Natural Gas STAR Partners have achieved methane emission reductions and increased revenues, while avoiding transmission and distribution service interruptions. Gas savings are generally sufficient to justify making all new connections to operating lines by hot tapping. Per year, individual companies have recovered 24,440 Mcf of methane gas worth \$80,160, while their costs averaged \$79,200 the first year, and \$43,000 the

following years. The average payback is 12 months. Savings include \$3.00 per Mcf of gas saved and other expenditures avoided when operators use hot taps instead of shutdowns. The costs included capital costs and other costs (e.g., O&M and contract services cost).

New Gas STAR Partners

Natural Gas STAR is pleased to welcome new partners **North Carolina Natural Gas** and **Columbia Natural Resources**.



North Carolina Natural Gas Company (NCNG) is based in Fayetteville, North Carolina and is a subsidiary of Progress

Energy. NCNG provides natural gas services to 173,000 customers in southcentral and eastern North Carolina. The company's primary business is the sale and transportation of natural gas to residential, commercial, and industrial customers located in 86 towns and cities and on four municipal gas distribution systems. Visit NCNG's Web site at www.ncng.com.



Columbia Natural Resources (CNR), headquartered in Charleston, WV, is the exploration, production, and gathering company of NiSource Inc. CNR is one of the

largest producers of natural gas and oil in the Appalachian Basin, with more than three million net acreage holdings, a reserve base of one trillion cubic feet equivalent and nearly 8,500 natural gas and oil wells located in nine states and two Canadian provinces. As an ISO-certified company, CNR is committed to an environmental, health, and safety management system of the highest standard. "We are proud to join EPA's Natural Gas STAR program," said Jim Abcouwer, President and CEO of Columbia Natural Resources. "This gives us a formal mechanism to continue the progress we have made over the last decade in reducing methane emissions. It is also a great match to our environmental management system, which sets forth a goal of continual improvement." For more information, contact CNR at (304) 353-5000. Information about NiSource Inc. can be found at www.nisource.com.



IN THE SPOTLIGHT

Natural GAS STAR Case Studies

The Natural Gas STAR Program is continuing its series of case studies focusing on the mechanisms that partner companies have used to successfully promote and implement a profitable methane emission reduction program. These case studies provide insights as to how companies effectively overcome administrative and organizational barriers to joining and implementing the program. The following are short summaries of the most recent case studies highlighting the implementation efforts of Kerr-McGee Corporation, Columbia Gas and Gulf Transmission, and Unocal Gulf Region USA. The complete versions of these and other case studies (Keyspan, El Paso Natural Gas, and Texaco Exploration and Production, Inc.) are available on the Natural Gas STAR Web site, under Technical Support Documents (http://www.epa.gov/gasstar/case_studies.htm).

Kerr-McGee Corporation



Kerr-McGee Corporation, based in Oklahoma City, Oklahoma, is one of the largest U.S.-based independent oil and gas exploration and production

companies. Kerr-McGee operates key facilities onshore in the United States, in the Gulf of Mexico, and in the United Kingdom sector of the North Sea. In 2000, the company's natural gas sales averaged 531 Mmcf.

Kerr-McGee joined the Natural Gas STAR Program in September 1996. The company's operations and environmental staff developed an implementation plan to focus the company's Gas STAR efforts. The plan included (1) identifying program best management practices (BMPs) that the company could integrate into all new facilities where practicable; (2) evaluating the usefulness of the BMPs and partner reported opportunities (PROs) at older facilities; and (3) conducting inventories of existing facilities to determine and document past methane emission reduction activities.

Since 1992, Kerr-McGee has reduced methane emissions by more than 10.8 billion cubic feet (Bcf), of which over 6 Bcf were identified from an inventory of prior reductions. This inventory was instrumental in helping them understand and improve efficiency at newly acquired properties. At the 2000 Annual Gas STAR Workshop, EPA honored Kerr-McGee as the Gas STAR Production Partner of the Year in recognition of its methane emission reduction accomplishments. Kerr-McGee attributes its success with Gas STAR to these main principles: building alliances among environmental, health, and safety staff, as well as operations, construction, and maintenance divisions; maintaining open communications to ensure program awareness throughout the company; and involving field personnel to keep them informed on the issues and the importance of their efforts to the success of the environmental programs.

Columbia Gas and Columbia Gulf Transmission



Formerly subsidiaries of Columbia Energy Group, Columbia Gas Transmission and Columbia Gulf

Transmission are now part of NiSource Inc. NiSource is a holding company with headquarters in Merrillville, Indiana, whose operating companies engage in virtually all phases of

the natural gas business from exploration and production to transmission, storage, and distribution,



as well as electricity generation, transmission, and distribution. NiSource companies serve a high-growth energy corridor from the Gulf of Mexico to the Midwest to New England.

Before joining the Natural Gas STAR Program, Columbia Gulf Transmission and Columbia Gas Transmission created a Natural Gas STAR Steering Team, composed of representatives from all levels of the company. The Team considered the costs of implementing the program, the level of participation to which the pipelines could commit, and whether the partnership could have a positive environmental impact.

Columbia Gulf Transmission and Columbia Gas Transmission joined the Natural Gas STAR Program in 1999. The Steering Team began contacting field managers and technicians to assess and catalog methane emission reduction opportunities company-wide. The Steering Team worked with Columbia's Environmental Excellence Program, which "promotes best practices and innovative ideas that protect the environment and bring benefit to the company." The Environmental

Excellence Program, created in 1996, has saved more than \$7.1 million and generated more than 100 new ideas.

Columbia attributes its success to four key elements of the Gas STAR implementation plan:

- Integrating the Gas STAR program into existing practices and programs promotes participation and gives Gas STAR instant credibility.
- Creating a leadership team composed of employees from all levels and all divisions ensures company-wide buy-in.
- Carefully considering up front the program's ultimate goals and how it fits into the existing corporate structure.
- Setting goals and objectives, measuring them, and following through to maintain and increase momentum are essential.

Unocal Gulf Region USA

Unocal Gulf Region USA,



formerly Spirit Energy, is an exploration and production unit of Unocal Corporation. It focuses on oil and gas resources in the Gulf of Mexico and onshore in Texas, Louisiana, and Alabama. Unocal Gulf Region operates more than 200 offshore platforms and about 1,500 active wells in numerous onshore and offshore fields. In 1999, Unocal Gulf Region's net gas production was 747 Mmcf per day, and net crude oil production reached 40,000 barrels per day.

Unocal Gulf Region had already implemented several best management practices before it joined the Natural Gas STAR Program in 1998. These activities included: installation of flash tank separators on glycol dehydrators; replacement of high-bleed pneumatic devices; use of compressed air, rather than natural gas, in instrument systems; installation of vapor recovery units; installation of flare systems, consolidation of production tank batteries; and

performance of fugitive emission tests. From 1991 to 1999, Unocal Gulf Region recovered 640 Mmcf of methane emissions, worth \$1.9 million.

When Unocal Gulf Region joined the Natural Gas STAR Program, the company began promoting the Natural Gas STAR partnership internally by sending its employees reports on the company's successes in reducing methane emissions and by encouraging them to think about other methane reduction opportunities. Unocal Gulf Region attributes its success with the Natural Gas STAR Program to four key fundamentals:

- **Stress revenue gains:** Many companies do not realize that reducing methane emissions saves money.
- **Gain management support:** This is important for implementing voluntary programs because it adds significance to the program and ensures employee cooperation.

- **Share results:** Sharing success stories encourages teamwork and enthusiasm company-wide.
- **Form a team:** It is often easier to achieve good results when employees work together on targeted issues.

Unocal Gulf Region also attributes its success to the implementation of pilot projects to test new methane emission reduction activities. The company conducts a four-step analysis to evaluate the cost-effectiveness of pilot projects. The steps are (1) establishing the technical feasibility, (2) estimating capital costs, (3) estimating potential savings, and (4) evaluating the economics of the project. Pilot projects allow the company to establish which practices will be the most cost effective to incorporate on a larger scale (i.e., corporate wide). These projects also help determine associated costs and savings, timeframes, staffing, and operational requirements before the company invests in large-scale improvements.

Partner Reported Opportunities

The Natural Gas STAR Program encourages partners to identify, implement, and report on the additional activities they have undertaken to reduce methane emissions that are outside the program's core set of Best Management Practices (BMPs). Many of these activities, referred to as Partner Reported Opportunities (PROs), have been summarized in one-page fact sheets and are available on the Natural Gas STAR Web site under Technical Support Documents.

To date, over 40 PRO Fact Sheets are available, with additional fact sheets in development. Recently, the PRO Fact Sheets were improved and updated with more detailed economic and operational information.

Partners can use the PRO Fact Sheets as a guide when analyzing additional options for reducing methane emissions cost-effectively and improving operational efficiency. The new fact sheets are organized by emission source (e.g. compressors/engines, pipelines, wells) and by industry sector, and they provide detailed information in three major areas. The first section describes the PRO, giving details on cost, economics, and any special operating conditions. The second section explains how the methane reductions are achieved and gives information on the potential methane emission reductions available by implementing the PRO. The third section presents an economic analysis of the PRO, including information on costs and any additional benefits of the PRO, such as reduced maintenance or increased operational efficiency.

The following 10 PROs are the most recent fact sheet additions and are now available on the Gas STAR Web site.

- **Insert Gas Main Flexible Liners.** Pulling flexible plastic piping through leaking cast iron and unprotected steel lines prevents underground lines from leaking and can save 225 Mcf of methane gas annually, per mile of leaking pipeline.
- **Isolation Valves by Design.** Designing a compressor station so that isolation valves are placed to minimize venting by reducing the length of gas-filled piping can save 130 Mcf of methane gas per year, based on 2 isolation valves positioned to exclude 1,000 feet of 24" pipeline at 600 psia.
- **Install Excess Flow Valves.** Excess flow valves activate upon detection of high-pressure drops (due to a ruptured or severed pipeline) to shut off gas flow in the line, saving about 16 Mcf of methane gas per year, based on 1 activation per 350 valves in a 1/2" 50 psig service line.
- **Move Fire Gates In at Compressor Stations.** Moving fire gate valves closer to compressor stations reduces emergency gas venting and can save 1,700 Mcf of methane gas per station per year, based on fire gate valves positioned to avoid blow down of 2,000 feet of 24" pipeline at 900 psia.
- **Install Evactor.** Evactors transfer gas to adjacent, operating pipelines during pipeline outages, saving 700 Mcf of methane gas per year, based on 2 miles of 18" pipeline reduced from 600 to 50 psig through bleeder vents.
- **Replace Glycol Dehydrators with Separator/In-line Heater/Dehydrator.** Cyclone separators and in-line heaters or dehydrators reduce methane gas venting from glycol processing operations and can save 130 Mcf of methane gas per dehydrator per year, based on dehydrating 10 MMcf/day of gas to a level of 4-7 lbs of water per MMcf.
- **Require Improvements in Gas Quality.** Revising gas processing and compression agreements with producers to require reduced levels of contaminants can reduce line cleanings and, therefore, gas vented during maintenance operations and can save up to 50 Mcf of methane gas per year, based on 16 fewer filtration unit blow downs per year at 600 psia.
- **Main/Unit Valves Closed.** Closing main and unit valves prior to blow down prevents venting of gas between the main and unit valves, saving 4,500 Mcf of methane gas per year, based on excluding 1 mile of 24" pipeline at 900 psia 4 times per year.
- **Clock Spring Repair.** The use of clock spring repair to repair pipeline leaks eliminates gas venting and allows for continuous operation of the pipeline. This practice can save 5,400 Mcf of methane gas per year, based on repairing a 10-foot section of a 10-mile 20" pipeline at 800 psi. (although partners have reported savings up to 27,500 Mcf per application).
- **Install Velocity Tubing Strings.** Replacing existing tubing with smaller diameter, high-velocity tubing prevents venting during well unloading and can save 4,680 Mcf of methane gas per well per year, based on one well blown to the atmosphere bi-weekly.

**Cost and benefits will vary based on site circumstances.*

Gas-Plant Tests

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Sampler yields more accurate data—with an error range of 10 to 15 percent. Its operating principle is based on a variable-rate, induced-flow sampling system that captures the emissions from a leaking component. Special attachments ensure total emissions capture and help prevent interferences from nearby sources. A dual-element hydrocarbon detector directly inserted into the main sample line measures hydrocarbon concentrations ranging from 0.01 to 100 percent. Background measurements allow the samples to be corrected for ambient gas concentrations. A thermal anemometer monitors the mass flow rate of the sampled air-hydrocarbon gas mixture.

Emission rates from open-ended lines and vents were measured with a precision rotary meter, diaphragm flow meter, or rotameter, depending on the flow rate. In some cases, flows were determined by measuring the velocity profile across the vent line and flow area at that point, using a pitot tube, hot-wire anemometer, or thermal dispersion anemometer. Screening at open-ended lines and vents was conducted with a hydrocarbon sensor.

Flows in flare lines were determined by one of two methods—measuring the velocity profile and flow area in the line, or back-calculating based on pressure drops between the flare tip and an upstream point on the flare line. A portable combustible-gas detector or a detailed lab analysis of the flare gas determined the hydrocarbon concentration.

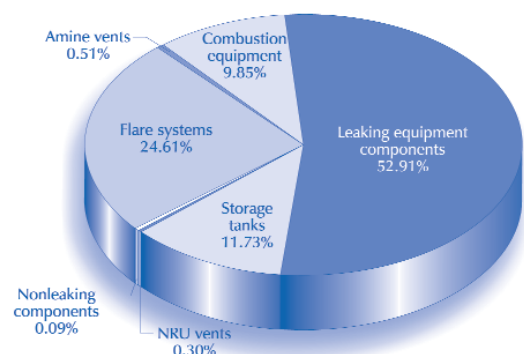
Performance testing involved testing each natural gas-fueled engine and process heater or boiler to identify avoidable inefficiencies resulting in excessive fuel consumption and emissions. The focus was on identifying situations in which equipment needed tuning or repairs, or was mismatched for the current process demands. Testing involved analyzing the flue gas, measuring the flue gas temperature, obtaining an analysis of the fuel gas composition, and where possible, measuring the flow rate of the fuel gas, combustion air, or flue gas.

Average emission factors were determined for each type of equipment component in service at the surveyed sites. These factors were calculated by dividing the total emissions from all tested components by the total number of components of that type. Emissions from non-leaking components were based on values taken from the literature. There were some discrepancies between the counts in this study and those provided by the facilities, resulting in emission factors that are generally higher than those published in EPA's protocol for estimating equipment leak emissions.

Total natural gas losses at the four plants are approximately 501 Mmcf per year, worth \$2,225,590 per year (based on \$4.50 per Mcf, the long-term contract price for natural gas at the time the study was completed). Figure 1 shows the relative distribution of natural gas losses at the case study sites by source category. The losses include direct leakage or venting of natural gas to the atmosphere and losses in the process that yield no benefit. Leaking equipment components and leakage into flare systems are the major sources of natural gas losses at the plants. Open-ended lines

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Fig. 1 Distribution of Natural Gas Losses by Emissions Source



Gas-Plant Tests

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contribute most of the emissions from equipment leaks, although valves, connectors, and compressor seals are also important sources as shown in Figure 2.

Fig. 2 Emissions from Fugitive Equipment Leaks

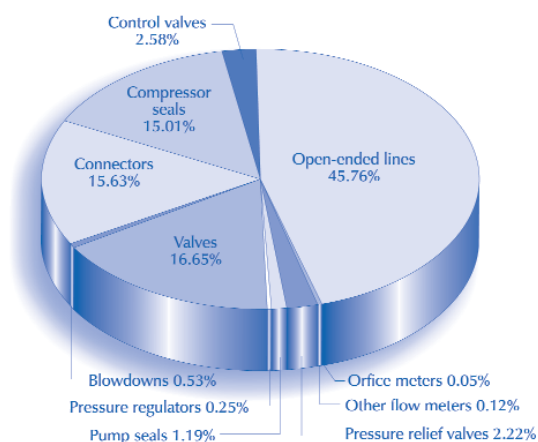
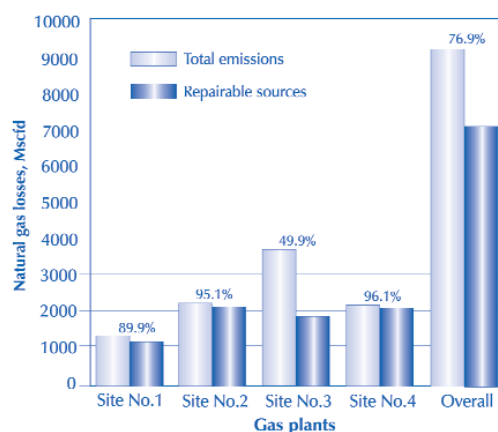


Fig. 3 Methane Emissions from Economically Repairable Sources



Practical opportunities for reducing emissions from fugitive equipment leaks and process venting were identified and assessed on a source-by-source basis. The sources with the greatest emissions were not necessarily the most economical to repair or replace. About three-quarters of the identified natural gas losses at the surveyed gas plants were economical to avoid or recover, based on preliminary estimates of repair costs, as presented in Figure 3. Once leaks are repaired, however, they are assumed to leak again at some point. The mean time between failures depends on the type, style, and quality of the component; the demands of the specific application; component activity levels (number of valve operations); and maintenance practices at the site. In a formal leak detection and repair program, mean times between failures are tracked continuously and used to identify problem service applications and to evaluate the potential need for changes to component specifications and maintenance practices.

"Identification and Evaluation of Opportunities To Reduce Methane Losses at Four Processing Plants," a Draft Report from the Gas Technology Institute and Clearstone Engineering, May 25, 2001.

For more information, contact Jeff Panek at GTI, 847-768-0884, or Carrie Henderson at EPA, 202-564-2318. Copies of the study report will be made available when finalized.

8TH Annual Natural Gas STAR Implementation Workshop

October 23-25, 2001
Crowne Plaza Medical Center
Houston, Texas



Registration

Please mail or fax your completed registration form to:

Attn: Natural Gas STAR Workshop
Eastern Research Group, Inc.
110 Hartwell Avenue
Lexington, MA 02421-3136
FAX: 781 674-2906

Please check one:

- Workshop Fees: \$100/person (includes all workshop functions and awards luncheon)
- Awards Luncheon only: \$35/person (no admittance to technical sessions)

If no box is checked, ERG will assume workshop registration.

**Make checks payable to:
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Overnight Accommodations

A block of rooms has been reserved at the Houston Crowne Plaza Medical Center for workshop participants. The group room rate is \$73/night plus 17% tax for single or double occupancy. To make reservations, please contact the hotel directly at (713) 797-1110 and reference the "Natural Gas STAR Workshop" room block. To receive this discounted rate, you must make your reservation no later than Tuesday, October 9, 2001. After this date, reservations will be accepted on a space and rate available basis only.

Name _____

Nickname/First name for badge _____

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Check the corresponding natural gas industry sector you represent:

- Production Gathering and Processing
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Please indicate your participation in the following Natural Gas STAR workshop functions:

Yes No Will you be attending the evening reception on **Tuesday, October 23?**

Yes No Will you be attending the awards luncheon on **Wednesday, October 24?**
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 Natural Gas
 STAR Program at
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PLEASE INDICATE WHICH MATERIALS YOU WOULD LIKE TO RECEIVE:

LESSONS LEARNED

- _____ 1. Directed Inspection and Maintenance at Compressor Stations
- _____ 2. Directed Inspection and Maintenance at Gate Stations and Surface Facilities
- _____ 3. Options for Reducing Methane Emissions from Pneumatic Devices in the Natural Gas Industry
- _____ 4. Installation of Flash Tank Separators
- _____ 5. Reducing Methane Emissions from Compressor Rod Packing Systems
- _____ 6. Reducing Emissions When Taking Compressors Off-Line
- _____ 7. Installing Vapor Recovery Units on Crude Oil Storage Tanks
- _____ 8. Replacing Wet Seals with Dry Seals in Centrifugal Compressors
- _____ 9. Reducing the Glycol Circulation Rates in Dehydrators
- _____ 10. Replacing Gas-Assisted Glycol Pumps with Electric Pumps
- _____ 11. Installing Plunger Lift Systems in Gas Wells
- _____ 12. Using Pipeline Pump-Down Techniques To Lower Pipeline Pressure Before Maintenance
- _____ 13. Convert Gas Pneumatic Controls to Instrument Air
- _____ 14. Using Hot Taps for In Service Repair

STAR IMPLEMENTATION TOOLS

- _____ Video-Production
- _____ Video-Transmission/Distribution
- _____ Case Study-El Paso Natural Gas
- _____ Case Study-Brooklyn Union/Keyspan Energy
- _____ Case Study-Texaco Exploration and Production, Inc.
- _____ Case Study-Columbia Gas and Columbia Gulf Transmission
- _____ Case Study-Kerr-McGee Corporation
- _____ Case Study-Unocal Gulf Region USA

OUTREACH MATERIALS

- _____ Natural Gas STAR Program Brochure
- _____ Natural Gas STAR Marketing Package
- _____ Natural Gas STAR Communications Toolkit
- _____ STAR Partner Update, Summer 1998
- _____ STAR Partner Update, Spring 1999
- _____ STAR Partner Update, Winter 1999
- _____ STAR Partner Update, Fall 2000
- _____ STAR Partner Update, Winter 2001

Most of these materials are available on the Internet at www.epa.gov/gasstar