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May 11, 2007

Ms. Jaclyn Brilling
Secretary of PSC
NYS Department of Public Service
Agency Building No. 3
Empire State Plaza
Albany, NY 12223

Subject: 2007 Research & Development Triennial Report and Expenditure Tables
Submitted by National Grid

Dear Ms. Brilling:

Please find the subject report attached for your information. If you have any questions regarding this document, please contact me at (315) 428-5996.

Sincerely,

Thomas Picciott

Thomas J. Picciott
Manager, Gas Engineering

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Attachment

2007 TRIENNIAL REPORT

GAS RESEARCH, DEVELOPMENT & DEMONSTRATION

Pursuant To:

State of New York Public Service Commission
***Case 98-G-1304**
"In the Matter of the Reporting Requirements Applicable to the Gas Industry's Research, Development, and Demonstration Programs"

April 1, 2007

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Introduction:

Natural gas plays a vital role in meeting the energy requirements of National Grid customers. Currently, National Grid delivers natural gas to over 550,000 customers across 4,500 square miles of Upstate New York.

The primary objective of National Grid's Gas R&D Program is to develop and demonstrate technology solutions targeted at improving the reliability and safety of the gas delivery infrastructure.

A second objective of the program is to deliver technology and methods that will lower the cost of gas delivery and improve worker productivity.

The third emphasis of the program is on safeguarding the environment. National Grid believes that the first step in addressing environmental issues and concerns is to obtain an in-depth scientific understanding of the problem and its impacts. By understanding the problem prior to implementing remedies, it is possible to obtain superior results while mitigating the risk of exacerbating the problem with incorrect solutions.

National Grid continually strives to become a more efficient and responsive organization to meet customer needs. Gas Research and Development activities are an integral part of the Energy Delivery Business's effort to meet these needs. This three-year plan reflects National Grid's continued desire to demonstrate and develop new technologies that benefit National Grid customers.

R&D Strategy and Focus:

National Grid's business is enhanced by its strategic use of R&D to prepare for the future. The overall strategy of the Gas Research and Development Program is to develop technologies and products that will provide both short and long-term value while meeting the strategic needs of National Grid and its customers. This is accomplished through an integrated forecasting, planning, development, and technology transfer process. As discussed above, there are three areas of emphasis, these are: Develop technologies that improve safety and reliability, develop technologies that lower gas delivery costs and improve worker productivity, and develop technologies that safeguard the environment. These activities are generally funded by the new Millennium Fund surcharge that took effect on January 2001.

The Millennium Fund was created to support R&D for medium to long-term operational and environmental activities of specific interest to New York State. This type of activity was once supported by the Gas Research Institute (GRI), now known as Gas Technologies, Inc. (GTI), on a national basis. With the decline in Federal Energy Regulatory Commission (FERC) funds, and GTI's changing mission, the state's gas utilities and the Public Service Commission (PSC) agreed to create the Millennium Fund to continue long-term Gas R&D that is important to New York State.

National Grid has regrouped the projects from the previous report. The three groupings now used are more general and reflect a slightly lower but more focused level of R&D effort. Each of the three research categories has a focus that serves as the guideline for project selection. These goals are reviewed every year to ensure that the projects in each category are properly directed to meet Corporate objectives, industry needs, and customer needs. The following table identifies the primary goal of each of the three research categories:

Category	Focus
Productivity Improvement	To support technology transfer and analysis applications that will lower the cost of natural gas delivery and improve safety.
Environmental	To support research that can have broad environmental implications to National Grid and the energy industry.
Operational	To support gas operational technology development and commercialization that can have applications in the three to ten year timeframe.

Program Management:

National Grid employs a project management approach to R&D. Ideas, problems, and issues that require an R&D initiative to resolve or develop are identified from a variety of sources including internal operations, industry groups, request for proposals from federal and state agencies, other utilities, regulations and legislation, and unsolicited proposals from outside. These initiatives are screened and those that warrant further consideration are evaluated for funding.

Actual contracting and management of the projects is handled on a case-by-case basis with the emphasis being on managing the scope and technology risk, and providing useful results in the shortest time possible. Whenever possible, opportunities to conduct research in a collaborative manner from both an intellectual and monetary perspective with others who share the same interests is pursued. Also, when it is appropriate or necessary to make a product useful to the sponsors, intellectual property rights are pursued and technology is licensed to a commercializer.

With the migration of the FERC funding to Millennium funding, National Grid has been able to more closely monitor spending and program accomplishments and thereby reduce overall R&D spending while at the same time maximize the benefits achieved. During this migration, we have reduced overall R&D spending in all categories and focused our efforts on research led by NYSEARCH. This research is primarily Millennium sponsored with some minor efforts in technology transfer and demonstration projects.

Interactions with Outside Organizations:

In order to ensure that National Grid's Gas R&D Program is involved in advanced technologies and emerging concepts, ongoing collaboration is maintained with outside organizations including government agencies and technical interest groups. These groups provide forums for National

Grid personnel to make needs known and to gain experience from others outside the company. The following is a brief description of these organizations:

Northeast Gas Association (NGA) Research Group (NYSEARCH):

Funded directly by National Grid and other gas utilities, NGA provides a forum for information exchange among northeast gas utilities. NGA activities are directed by an executive committee on which National Grid's Vice President serves. Reporting to the executive committee is the Research, Development, and Demonstration Committee (NYSEARCH), which acts as a focal point for joint R&D activities among the NGA members. Nysearch membership has recently grown to include gas distribution companies across North America including Canada and California. Projects funded under this program serve two major purposes. First, the collaborative effort afforded, leads to highly leveraged research – leveraging knowledge, experience, and resources. Second, with National Grid Millenium funding participation at approximately 90% of its overall collections, the millennium requirements for collaborative funding is easily achieved.

New York State Energy Research & Development Authority (NYSERDA):

As a result of a state mandate, National Grid is required to annually allocate $700,000 to $800,000 from its gas business to support the NYSERDA R&D Program. NYSERDA projects are selected and managed independent of National Grid in the interest of providing improved energy services in New York State.

Accomplishments:

Accomplishments of National Grid's Gas R&D Program take several forms. These include initiating new R&D projects in response to emerging issues, investigating new technologies to reduce operating and maintenance costs, addressing new regulatory requirements, compiling reports that provide enhanced direction for future research, conducting surveys to identify needs of R&D clients, and performing full-scale demonstrations of new products and technologies. Some of the important achievements during the last three years are described on Pages 6 through 11.

Completed Projects:

Gas Line Sensor Network– GASNET is in the has been field tested and accepted. It is currently installed and in use at several Northeast Utilities including National Grid. This system is a self-powered network of keyhole-installed field sensors that gather and transmit parameters, such as pressure, flow, and moisture content through a wireless network to a central control room (e.g. SCADA Control Room).

Modeling and Testing of Utility Cuts– In concert with the Department of Transportation, Army Core of Engineers and other gas utilities, National Grid has evaluated and studied methods to prevent settlement of roads when facilities are maintained. Traditional methods such as compaction and use of flowable fill remain feasible when performed properly.

Real Time Monitoring of Contacts to Pipe–Three technologies have been investigated that can be used to detect and warn an operator of encroachments and potential mechanical damage to pipe. These systems employ listening devices which detect ground movement, either by a remote fiber cable, direct contact with the pipe, or transmitted through the ground. Each detector system has distinct advantages and disadvantages. In general, all will need to develop signatures for signal recognition to enable the operator to distinguish between threatening and non-threatening activities. Although this project is deemed complete, more work in the signal processing area may be needed in the future.

Active and Planned Projects:

Notes:

1. Most of the projects listed below "carry forward" from the 2004 report and are so noted where they appear. The summary focuses on the changes since the last update.

2. This list of projects incorporates short-term and long-term projects, as well as projects from each of the three categories discussed earlier in this report. The category associated with each project should be apparent from the title.

Variable Length Repair Sleeve (Carry Forward) – The objective of this project is to develop an adjustable length plastic pipe repair sleeve that repairs damages of various lengths. The proposed first prototype is to be made of high density PE, 4" in size and rated at 124 psig. The project is currently structured in four tasks: 1) obtain manufacturing partner, 2) build prototypes, 3) perform laboratory testing, and 4) conduct field testing.

GECO of Italy was identified as the developer and commercialization partner. During the prototype phase, a second repair sleeve for butt fusions was initiated. This sleeve has been developed and lab testing of the prototyped units has been completed. Preproduction samples have been provided to Nysearch member companies for field testing purposes. Upon completion of the field testing, GECO will begin marketing the sleeve worldwide. The variable length repair

sleeve is lagging behind but it is anticipated that a preproduction prototype will be available for field testing before the end of 2007.

Cast Iron Joint Locator (Carry Forward) – The objective of this project is to test the ability of an innovative technology to locate cast iron joints and plastic pipes in a dense urban environment. The technology incorporates an entirely new approach to locating cast iron joints using very low frequencies and a totally different approach to signal analysis.

The developer of this technology is a small company, Harris, with extensive experience with military applications using ground probing radar. Initial field tests in an urban environment pointed to specific improvements to address problems found. The two key challenges were the ability to detect pipes in dense areas with multiple subsurface structures and the ability to function in confined spaces with a small modified antenna. The propriety material that is being used for the dielectric medium on the antenna allows an unusual advantage in terms of required physical size of the antenna to meet the antenna's electrical requirements. This project will design, develop and field-test an advanced, miniaturized antenna and a prototype tool.

Remote Leak Detector (Carry Forward) – This project involves the development of a mobile and/or air craft mounted device to remotely locate leaks based on infrared technologies.

One technology in this area which shows great promise is an airborne ethane infrared sensor currently under development by a company named Realsense. Unlike most leak detectors which detect methane that's comprised of ~97% natural gas, this system is claimed to detect ethane which is only makes up ~2% of the composition of pipeline quality natural gas. If successful, this detector will be uniquely capable of differentiating between pipeline (well) gas and naturally occurring organic decay methane. Testing of the device affixed to a helicopter may be performed as early as summer 2007.

Management of Impacted Sediments (Carry Forward) – Studies continue in this area to understand and develop mitigative measures that address contaminants in sediments associated with MGP sites. Current work is focused on gaining regulatory approval of the methods developed to distinguish between toxic and non-toxic compounds.

Pipeline Internal Inspection Tools for HP Mains (Carry Forward) – There are approximately 1,500 miles of gas transmission mains owned and operated by utilities in New York State. Many of these pipelines are over 50 years old, and as such, were not designed for modern internal inspection devices. This project focuses on developing second and third generation inspection devices that can navigate through obstacles in older pipes. This technology is extremely critical in light of the new federal pipeline integrity regulation. The chief investigators in this project are Automatika Inc. and Invodane Engineering

The objective of this project is to develop a robotic inspection platform with integrated sensors to measure corrosion and mechanical damage on internal and external surfaces of unpiggable transmission mains.The platform is based on the NYGAS Explorer ™ design and is an

untethered, modular and articulated battery powered robot system with an MFL sensor. The improved design is targeted at being applied to larger diameter and more varied pipe sizes that characterize the inventory of un-piggable mains. A prototype of a battery powered crawler capable of detecting pipe wall defects for 20-22 inch diameter pipe should be ready for field testing by late 2007.

Development of Corrosion Camera-The objective of the project is to develop optical techniques for the detection of corrosion in uncoated and coated metallic pipes used in the gas industry. To date, gas companies continue to experience the problem of metallic pipe corrosion in the natural gas distribution and transmission system. It is envisioned that this technology will detect the existence of corrosion under pipe coatings and potentially underground.
In addition to the underground inspection of pipelines using the above techniques, the development of a corrosion camera can facilitate the inspection of pipelines in above ground applications such as bridges or other exposed areas. Also the corrosion camera will have the ability to provide a history of images that may be able to, not only infer wall loss in the pipe but also determine the stage of corrosion that the pipe's surface area is experiencing. The research group is a division of the Polytechnic Institute of New York.

Weld Zone Butt Fusion Inspection (Carry Forward) – This project involves development of non-destructive testing techniques that can be used to verify the integrity of plastic pipe joints.

Pipeline Inspection for HP Mains (Carry Forward) – In addition to development of an internal inspection device for pipeline integrity, operators are interested in developing other inspection methods that can evaluate the condition of the pipe. This project investigates the feasibility of external techniques that serve this need with a focus on refining and developing aboveground techniques.

This is a multi-phased program that seeks to compare and validate various technologies and procedures, such as Direct Assessment (DA), that can detect coating damage on transmission lines.
This project includes:

1. Initial development and validation of External Corrosion Direct Assessment (ECDA) procedures through extensive collaboration and field testing,
2. Development of knowledge and application of ECDA and ICDA for challenging applications,
3. Evaluation and comparison of various remote inspection technologies such as long range guided ultrasonics, and,
4. Development of a spreadsheet-based model for aiding the operator in prioritizing digs associated with DA and suspected coating anomalies.

Explorer II Inspection Robot (Carry Forward) – This project will evaluate the addition of internal pipe sensors to the Explorer device. Sensors, such as magnetic flux, ultrasonic and eddie current are currently used to measure pipe wall thickness. By equipping Explorer with these sensors, distribution pipes that were not capable of inspection with these technologies may be inspected.

A prototype of this device for 6 and 8 inch diameter applications equipped with an eddy current sensor should be available for field testing by the end of 2007

Oracle Technology Investigation(Carry Forward) – Technology developed by other industries and research organizations may have applications in gas operations, construction, and maintenance. This project reviews data on new technologies and searches for ways to employ this technology in the gas utility business. This is an ongoing evaluation that yields new products for consideration on an annual basis.

Mitigating Cyanides at MGP Sites(Carry Forward) – Studies will continue to evaluate the impacts of cyanides and develop methods to mitigate their spread and control concentrations to acceptable levels.

Pipe Locator-handheld (Carry Forward) – NYSEARCH has previously assisted in the development of an underground probing radar pipe locator (Pipe Hawk). This device is commercially available but is bulky and difficult to use. A second generation device is being funded with the goal of simplifying operation, reducing size, and ultimately decreasing purchase price. This project has seen some delay over the past several years in transitioning from Pipehawk to a third party commercial partner. Expectations are that this will be resolved before the end of 2007.

Gas Interchangeability – With the reintroduction of LNG into the gas stream, the gas industry has become concerned with varying gas quality. To date, the constituents, diluents and general make up of what is termed pipeline quality gas has been generally loose. However, gas quality can effect end use appliances, processes and gas infrastructure. One example on the effects of gas infrastructure is the potential drying and subsequent shrinking of soft goods, such as gaskets, compression fittings, and o-rings. This project will study these effects and develop guidelines that the industry can use to limit exposure to concerns like this. The project is managed by NYSEARCH and the service provider is GTI (Gas Technical Institute).

Main Inspection Kit via access through service line – Slim Kit – The slim kit is an innovative technique that enables internal visual inspection of live gas mains through service lines. The application is typically for locating water intrusion but can be used for other internal visual inspections.

The unique feature of this system uses a miniature camera lens which will pass through a 1 ¼" diameter service and traverse up to approximately 100' in length. Using entry through services eliminates excavation and tapping of the main. By packaging this camera with other technology enables no blow applications for inspection of low pressure mains. This product is currently in the field testing phase. The developer is ULC Robotics and should be available for purchase by the end of 2007.

RIT Needle Bar – Bar holing as part of the leak investigation process is a routine gas function. However, driving in and pulling out bars is a strenuous activity that strains the back and quite often results in injuries. This project has evaluated the bar holing procedure and process and developed an ergonomic tool for bar installation and removal. The research organization is Rochester Institute of Technology. Prototypes have been field tested and final design accepted.

Commercialization partners are being sought with the goal of complete turnover of the project by the end of 2007.

Ionix PE Static Eliminator – Plastic pipe tends to collect static charges which can create an extremely hazardous condition if it dissipates when a gaseous atmosphere is present. Ionix has developed two products which dissipate the static electricity normally resulting from gas flows. One is a specialized filter and the other is a solution that is injected into the gas stream. Both products will be field tested and evaluated by NYSEARCH member companies as part of this project.

Internal Corrosion Direct Assessment – Validate the proposed NACE process for assessing the condition of transmission pipelines. This process consists of flow and elevation analysis coupled with critical angle determination. Through the use of sophisticated but commercially available computer flow models and highly accurate GPS mapping, develop an elevation and flow profile for the piping immediately downstream of each gate station. From this information determine the locations where moisture is likely to accumulate, therefore, most likely to promote internal corrosion; dig these locations, measure wall thickness and determine if this method accurately assess' the threat of internal corrosion.

Main Replacement Risk Assessment Tool – Evaluate the method used by National Grid U.K. in determining risk of cast iron pipe failures and consequences. Compare this technique to techniques currently used in the U.S. and specifically National Grid U.S. Determine if modeling in the U.K. is applicable or superior to the U.S. technique.

Test Bed – Develop an underground pipe network which is representative of pipe material and coating types. Install the pipe using traditional and representative construction techniques. Include typical pipe and coating defects with well documented size and location. Use this bed to test the ability of techniques such as guided wave and direct assessment to locate the size of these defects without the need to excavate.

Air Coupled Ultrasonic Sensing Device – With the advancement in ultrasonic sensor design and manufacturing, scientists now believe that meaningful data can be extracted from ultrasonic signals which transverse a highly attenuating air gap. Since most of the signal is lost in this air gap, the desired data only recently been discernable above the "noise" level of the return signal. Combining this information with advancements in guided wave and lamb wave interpretations could yield measurable defect sizing data. If proven reliable, power consumption and design limitations associated with current magnetic flux sensors can be diminished and some pipelines, which are currently deemed non-inspectable by existing technologies, may be examined. This project will pursue the further development of this technique and potential applications for use in conjunction with existing and developing inspection devices. The leading investigator for this project is a Los Alamos National Lab scientist.

Polyethylene Pipe (PE) Rock Impingement and Defect Study – Current standards limit the scratching of the external surface of polyethylene pipe to less than 10% and require rock-free backfill. The engineering refinements in resins over the past decade may have resulted in more resilience to these types of defects. This study will examine in further detail the effects scratching, rock impingement and internal defects have on the strength and service life of PE pipe.

The product of this testing should be test methods and evaluation results that can be used to determine what limits, defects and external loads have on pipe strength and service life. Several service providers are contributing to this research.

Keyhole- Develop techniques that minimize the size of the excavation required to perform typical gas O&M activities. This project will investigate both the development of excavation techniques, such as vacuum excavations, and tools for remote operation for use in conjunction with the keyhole excavation. Current activities involve GTI as the lead research organization.

National Grid's
Gas Research & Development

Expenditure Summary
($000)

Description of Research Projects	2004	2005	2006	2007	2008	2009	2010
Air Coupled Ultrasonic sensor	0	0	136	20	20	10	40
Butt Fusion Inspection	7	43	2	10	10	10	0
Cast Iron Joint Locator	34	22	0	20	10	20	0
Corrosion Camera	0	11	31	20	10	0	0
Cyanide at MGP Sites	82	0	0	20	10	5	0
Explorer II Inspection Robot	63	47	0	30	20	20	40
Gas Interchangeability	0	19	30	20	20	20	20
GASNET Sensor Network	38	0	9	0	0	0	0
Hand Held Pipe Locator	0	0	0	20	20	10	0
HP Pipe Inspection Techniques	80	21	30	30	20	30	30
HP Pipe Internal Inspection	141	31	77	50	40	40	40
Internal Corrosion DA	0	33	24	80	0	0	0
Keyhole	0	25	0	50	50	20	20
Main Replacement Risk Tool	0	86	0	0	0	0	0
Modeling of Utility Cuts	0	0	0	0	0	0	0
Oracle	5	0	0	5	5	5	5
PE Rock Impingement/Defect Study	0	0	0	9	10	10	10
PE Static Eliminator	0	0	3	3	0	0	0
Real Time Monitors of Contacts	40	0	0	0	0	0	0
Remote Methane Detector (mobile)	14	32	30	20	20	20	20
RIT Needle Bar	0	0	0	1	5	5	0
Sediment at MGP Site Study	4	19	51	30	30	40	30
Slim Kit	19	31	0	5	10	0	0
Test Bed	0	42	10	10	10	10	0
Variable Length Repair Sleeve	0	0	0	10	10	10	10
Total:	527	462	433	463	330	285	265

National Grid's
Gas Research & Development

Collections Summary
($000)

Description	2004	2005	2006	2007	2008	2009	2010
National Grid Labor	50	40	40	30	30	30	30
Administrative	57	25	25	20	15	10	10
Total:	107	65	65	50	45	40	40
Millennium Collections	350	500	400	350	500	400	350
Expense R&D Budget	115	100	100	100	100	100	100
GTI Allocation	484	0	0	0	0	0	0
Total:	949	600	500	450	600	500	450
NYSERDA	675	675	714	707	787	790	790