23rd World Gas Conference June 5-9, 2006 Amsterdam, The Netherlands

Report of Working Committee 4

« *Distribution* »

Rapport du Comité de travail 4

« *Distribution* »

Chairman/Président

Peter Cistaro

USA

ABSTRACT

This report presents the work conducted during the 2003-2006 triennium by Working Committee 4 and its three Study Groups:

- Study Group 4.1 “Distribution Pipeline Integrity”
- Study group 4.2 “Implementation of Leading Practices for Construction, Maintenance and Operations of Gas Distribution Systems”
- Study group 4.3 “Role of R&D & Technology in Gas Distribution”

The first part of the report explains the context that forms the backdrop to our work. It is followed by a full presentation of the reports of each Study Group.

The list of WOC 4 members is given in annex.

RESUME

Ce rapport détaille les travaux réalisés pendant le triennium 2003-2006 par le Comité de travail 4 et ses 3 Groupes d’Etudes :

- Groupe d’Etudes 4.1 «L'integrite De Pipe-Line De Distribution»
- Groupe d’Etudes 4.2 «Exécution de principales pratiques pour la construction, l'entretien et les opérations des systèmes de distribution de gaz»
- Groupe d’Etudes 4.3 «**“**Rôle d’I&D et de la Technologie dans la Distribution de gaz**”**»

La première partie du rapport explique dans quel contexte de dérégulation du marché les groupes ont travaillé. Elle est suivie par une présentation complète des rapports de chaque groupe.

La liste des membres du WOC 4 est indiquée en annexe.

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WORKING COMMITTEE 4 REPORT

1. FOREWORD

Deregulation continues as a major issue within our IGU member companies. It is especially noticeable within the United Kingdom (UK), which used to be composed on one very large gas company under the name British Gas, but is now split into several smaller entities. In light of the changing regulatory and economic scenarios, what are some of the aspects of gas distribution that are impacted? Three areas of study selected by WOC 4 include: The safety of the System (distribution integrity); using Best Practices to achieve improved results; and trends in funding R & D.

Pipeline Integrity is a new issue, starting recently within the United States. This subject incorporates several sub issues including 3d party damage prevention, corrosion control and inspection/ leak surveying of facilities. Studies and data have shown that 3d party damage poses the greatest threat to the integrity of our gas systems. Addressing that threat should be the highest priority in pipeline integrity programs. Within the U.S., the “Common Ground Alliance” (CGA) sponsored by the U.S. Department of Transportation, addressed the issue of damage prevention starting in 1998 by forming an Alliance including all of the major players having underground facilities. The Alliance also included the protection related organizations such as “one-call systems”. The Alliance continues today keeping all pertinent parties aware of potential hazards to underground facilities and the “best practices” to protect the integrity of those facilities.

As many companies “down-sized’ during the 1990s, cost control became a key issue. It was during this period within the US that the AGA Best Practices program was born. Using this tool, companies exchanged ideas on how to best perform the various functions of planning, building, operating and maintaining their gas distribution systems. The key was-- who does the best job of a particular function at the lowest cost. This program went a step beyond normal “benchmarking”, which usually concentrates only on data exchange. In Best Practices the content experts exchanged details on actual practices, which have produced the low cost- high performance indicators. One might ask, “How can we share these Best Practices in our International venue?

As our gas distribution systems have become more “mature“ in many countries, there appears to be a trend to spend less national dollars on Research & Development (R&D). While Asia continues to invest heavily in R&D, European company R&D expenses,are less, and are very low in the US and Australia. In most cases R&D expenditures tend to be focused on “short term” research successes. Fundamental/ long term research to support gas utilities does not appear to be well funded in many countries. Large national research programs, where both short and long term research programs are supported, appears to remain strong only in two of the countries surveyed.

2. THEMES AND SELECTED CONCLUSIONS OF WORKING COMMITTEE 4

The three themes chosen by Working Committee 4 “Distribution” for the 2003/2006 triennium were:

Theme 1: Distribution Pipeline Integrity

Coordinator: Mel Ydreos, Union Gas Limited, Canada
Vice-coordinator: Jeremy Bending, National Grid Transco, United Kingdom

With Transmission pipeline integrity in place in the US and other countries, the next logical step was to look at Distribution integrity.

Currently well established external and internal standards and procedures exist that ensure the operational reliability and safety of the distribution networks.

Legislation and laws around Distribution Pipeline Integrity requirements and "rules" are still evolving. Non-prescriptive regulations and legislation are preferred as they allow for the application of proper risk based models to be used in the development of appropriate and effective approaches.

Key Integrity Conclusions:

- Existing national codes and standards, as well as company standards and procedures, ensure safe and reliable gas distribution systems.
- More efforts are needed to communicate to all “stakeholders” the excellent safety records and standards already established that ensure integrity of our distribution networks.
- Third Party Damage is the number one contributor to gas distribution incidents. Additional efforts should be directed toward educating and controlling offending parties in this area, rather than concentrating on the gas utilities.
- Collaborative efforts between the gas industry and the regulatory authorities are necessary to develop any additional “rules” that may be needed for improving distribution integrity management.

Theme 2: Implementation of Leading Practices for Construction, Maintenance and Operations of Gas Distribution Systems”

Coordinator: Jorge Doumanian, Gas Natural BAN, Argentina
Vice-coordinator: Fergal Geoghegan, BORD GAIS, Ireland

The subject is the “Implementation of Leading Practices for Construction, Maintenance and Operation of Gas Distribution Networks in IGU countries”.

The study seeks to determine Leading Practices for Construction, Maintenance and Operation of the Gas Distribution system and how companies implement them, in order to:

- Improve Safety
- Improve Service Quality
- Achieve Cost Reductions whilst in compliance with all Safety Standards Regulatory Requirements.

Surveys were conducted on this subject and the results are included in this report.

Additional information on this subject will be discussed during the Technology Forum.

Key Best Practices Conclusions:

- Some common criteria exist in companies deploying best or leading practices. These include: Reducing costs; maximizing productivity; improving safety for customers, employees; maintaining the integrity of the gas system; and using new technologies and innovative practices.
- Numerous Leading/ Best Practices have been identified in construction, maintenance and operations of our gas distribution systems
- Currently there is no known international forum for sharing of performance measurement data and Leading/Best Practices.

Theme 3: Role of R&D & Technology in Gas Distribution

Coordinator: Juan Puertas, Gas Natural SDG, S.A. Spain
Vice-coordinator: Alessandro Soresina, AEM, SpA, Italy

Over the last few years, the gas industry worldwide has been seeing a downward trend in its investments in research and development. This trend is particularly significant in research projects concerning distribution studies. In parallel with this, the last decade has brought a liberalization drive that has fragmented the value chain in gas industries.

This report seeks to investigate whether these two circumstances are linked as cause-and-effect or whether they are two independent phenomena coming at the same time, and also whether their impact is comparable in all geographic areas or whether it is focused on certain specific areas. The future of research and development in the gas-distribution sector is also analysed, and potential pathways in developing future projects for the new context encountered in the sector are considered

R&D Conclusions:

- While R & D funding remains high in two countries in Asia and Europe, they appear to be declining in the rest of Europe and the U.S. Current funds are targeted on cost reduction and system safety initiatives.
- There is a need to balance future R&D investments between short term projects and fundamental long term research.
- Authorities must be convinced about the value of R&D in order to allow mechanisms that permit funding in the rate approval process.

Additional details are included in the three Study Group reports that follow this general summary.

Appendix A

Members of WOC 4 for the 2003-2006 Triennium

Note: Active WOC 4 members were also assigned as Study Group (SG) Members (SG 4.1 Integrity; SG 4.2 Best Practices; and SG 4.3 R&D)

Name	Country
Leadership	
Peter CISTARO, WOC 4 Chairman	USA
Jeremy BENDING, WOC 4 Vice Chairman and SG 4.1 Vice Coordinator	UK
Larry T. INGELS, WOC 4 Secretary	USA
Mel YDREOS, SG 4.1 Coordinator	Canada
Jorge DOUMANIAN, SG 4.2 Coordinator	Argentina
Fergal GEOGHEGAN, SG 4.2 Vice Coordinator	Ireland
Juan PUERTAS, SG 4.3 Coordinator	Spain
Alessandro SORESINA, SG 4.3 Vice Coordinator	Italy
Members	
Abdat DJILLALI	Algeria
Mededjel KARIMA (Alt)	Algeria
Michael EBDON	Australia
Peter BUCK (Alt)	Australia

Christian SCHICKETMULLER, SG 4.2	Austria
Walter KRECHT (Alt.)	Austria
Mehdedalija SIJARIC, SG 4.2	Bosnia and Herzegovina
Jian Xun LI	China
Hongwei WANG	China
Liangcheng JIANG (Alt.)	China
WwiCheng SU	China
Haiyan ZHENG (Alt.)	China
Roman SVETEC	Croatia
Zoral PUL	Croatia
Libor CAGALA, SG 4.1	Czech Republic
Petr STEFL, SG 4.2	Czech Republic
Svend BOMHOLT, SG 4.1	Denmark
Flemming JENSEN (Alt), SG 4.2	Denmark
Jean-Max BAILLARD, SG 4.1	France
Jean-Piette CAPDEVIELLE (Alt.) SG 4.3	France
Andreas HENNING, SG 4.1	Germany
Dietmar SPOHN (Alt.) SG 4.2	Germany
Claus OBHOLZER, SG 4.3	Germany
Zoltan CSALLOKOZI, SG 4.2	Hungary
Naser EBRAHIMI	Iran
Rasool SABZEVARI (Alt.)	Iran
Stefano CAGNOLI (Alt.)	Italy
Tomoaki YOKOYAMA, SG 4.1	Japan
Koji YOSHIZAKI, (Alt.) SG 4.1	Japan
Yoichiro OZAKI,	Japan
Itsuo YOSHIDA (Alt.) SG 4.2	Japan
Seita SHIMIZU (Alt.) SG 4.3	Japan
Kairat SHOTBAKOV	Kazakhstan
Soo Kyung KIM	Korea
Suk Hyung LEE (Alt.)	Korea
Muhamad Noor HAMID	Malaysia
Ron VANAKKEREN, SG 4.1	The Netherlands
Shaikh SIRAJUDDIN	Pakistan
Aril LATIF	Pakistan
Elzbieta DZIRBA, SG 4.3	Poland
Marius NENISANU	Romania
Kirill SELEZNEV	Russia
Evgeny PRONIN	Russia
Alexander MIKHEEV	Russia
Dragan VUCUR, SG 4.3	Serbia & Montenegro
Bozidar MIJOVIC, (Alt.)	Serbia & Montenegro
Miroslav DUJNIC, SG 4.1	Slovak Republic
Marian KERUL-KMEC, SG 4.2	Slovak Republic
Franc CIMERMAN, SG 4.1	Sllovenia

Jose Luis ESQUIVIAS (Alt)	Spain
Sigvard TRONELL, SG 4.2	Sweden
Walter GIRSBERGER	Switzerland
Sergey VARGA, SG 4.2	Ukraine
Victor SPAS	Ukraine
John FRANTZ, SG 4.2	US
Steve GAUTHIER, SG 4.3	US

Associates

Johan Van KERREBROECK	Belgium
Daniel HEC	Marcogaz
Steve VICK, SG 4.2	UK
Richard FORD (Alt)	UK

23nd World Gas Conference June 5-9, 2006 Amsterdam, The Netherlands

Report of Study Group 4.1

DISTRIBUTION PIPELINE INTEGRITY

Rapport du Groupe d'études 4.1

L'INTEGRITE DE PIPE-LINE DE DISTRIBUTION

Coordinator / Vice-Coordinator
Coordinateur / Vice-coordinateur

Mel Ydreos / Jeremy Bending

Canada/United Kingdom
Canada/Royaume Uni

WOC 4.1 – DISTRIBUTION PIPELINE INTEGRITY

Abstract

The report prepared by WOC-4.1 captures the merging trends related to the issue of Distribution Pipeline Integrity. While much work has been undertaken on Transmission Pipeline Integrity, regulations and approaches to Distribution Pipeline Integrity are still evolving.

The report concludes that distribution networks are operated reliably and safely as network operators have extensive internal and external standards and procedures which ensure the integrity, reliability and safety of these networks. The largest single risk identified in the area of Distribution Integrity is in the area of plant damage, with the single greatest issue contributing to this risk, being, improper operator excavations.

The report also concludes that it is preferable to establish non-prescriptive regulations and legislation around Distribution Pipeline Integrity compliance as this approach allows for the effective application of risk based approaches in view of the diversity of age and condition of distribution networks. In addition, the report recommends that skill set upgrading of excavators can reduce plant damage and as such help protect the integrity of these networks.

Résumé

Le rapport préparé par WOC-4.1 indique les tendances concernant l'intégrité des gazoducs de distribution. Même si beaucoup de travaux ont été entrepris dans les domaines de l'intégrité des gazoducs de transport, les règlements et les méthodes relatifs à l'intégrité des gazoducs de distribution continuent d'évoluer.

Le rapport conclut que les réseaux de distribution sont exploités de façon fiable et sécuritaire puisque les exploitants de ces réseaux ont des normes et des modalités externes et internes exhaustives qui en assurent l'intégrité, la fiabilité et la sécurité. Le plus important risque décelé pour l'intégrité des gazoducs de distribution touche les dommages aux installations, les travaux d'excavation mal exécutés par les exploitants étant le plus grand facteur contribuant à ce risque.

Le rapport souligne qu'il est préférable d'établir des lois et des règlements non prescriptifs concernant la conformité relative à l'intégrité des gazoducs de distribution, puisque cette méthode permet d'appliquer de façon efficace des approches axées sur les risques en tenant compte de la diversité de l'âge et de l'état des réseaux de distribution. Le rapport souligne également que l'accroissement de l'ensemble des compétences des personnes qui font l'excavation peut diminuer les dommages aux installations et ainsi améliorer l'intégrité de ces réseaux.

Report of Study Group 4.1

DISTRIBUTION PIPELINE INTEGRITY

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CONCLUSIONS

Following review of the work completed, Working Group 4.1 of WOC 4-Distribution, reached the following conclusions:

1. In view of the evolution of the gas industry and the networks that exist to deliver and distribute natural gas, a variety of pressure tiers and/or pipeline specified minimum yield strengths are used to define the facilities that would be covered by a Distribution Integrity plan.

2. Currently well established external codes & standards and internal company standards and procedures exist that ensure the operational reliability and safety of the networks.

3. Legislation and regulatory "rules" around Distribution Pipeline Integrity requirements are still evolving. Non-prescriptive regulations and legislation are preferred as they allow for the application of proper risk based models to be used in the development of appropriate and effective approaches. It is critical for the gas industry to be involved as early as possible in the development of regulations. The American Gas Foundation (AGF) study "Safety Performance and Integrity of the Natural Gas Distribution Infrastructure" (summary at Attachment 1) is one example of a cooperative effort between the industry and regulators in preparing for possible distribution integrity regulations.

4. Relatively good data exists on the effectiveness of operating and maintenance practices. However, this information must be communicated effectively to all pertinent parties to demonstrate its linkage with integrity management.

5. Efforts to improve the skill-set and competency of excavators so as to reduce poor and improper excavating must be ongoing.

6. Reports such as the AGF study referenced above have shown that 3d party damage poses the greatest threat to the integrity of our gas systems. Therefore, the single most important component of an integrity management program has to be an effective damage prevention program.

1.0 INTRODUCTION

Working group 4.1 of WOC 4- Distribution was formed to study and report on the emerging trends and issues related to the area of Distribution Pipeline Integrity.

Much work, study and implementation of pipeline integrity plans and approaches have been developed for the Transmission systems. However, in terms of Distribution networks, approaches and implementation to pipeline integrity are still evolving.

The focus of the study group's work was to report on the latest developments in this area by looking at the emerging integrity drivers, the integrity performance requirements and the cost benefit approaches to the integrity plans. In addition, the group reviewed issues relating to plant damage and plant damage prevention and investigated best practices and evolving technologies supporting Distribution Pipeline Integrity.

A total of 17 countries participated in the study. These countries included,

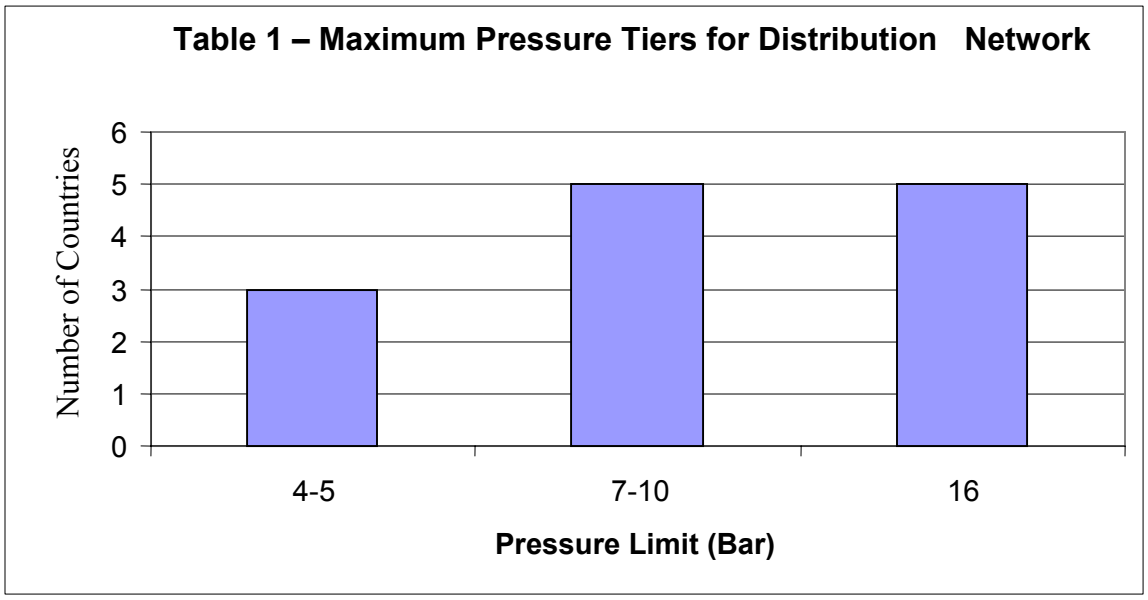
Bosnia	Italy
Canada	Netherlands
Czech Republic	Serbia
Denmark	Spain
France	Slovenia
Germany	Spain
Greece	Switzerland
Ireland	UK
	USA

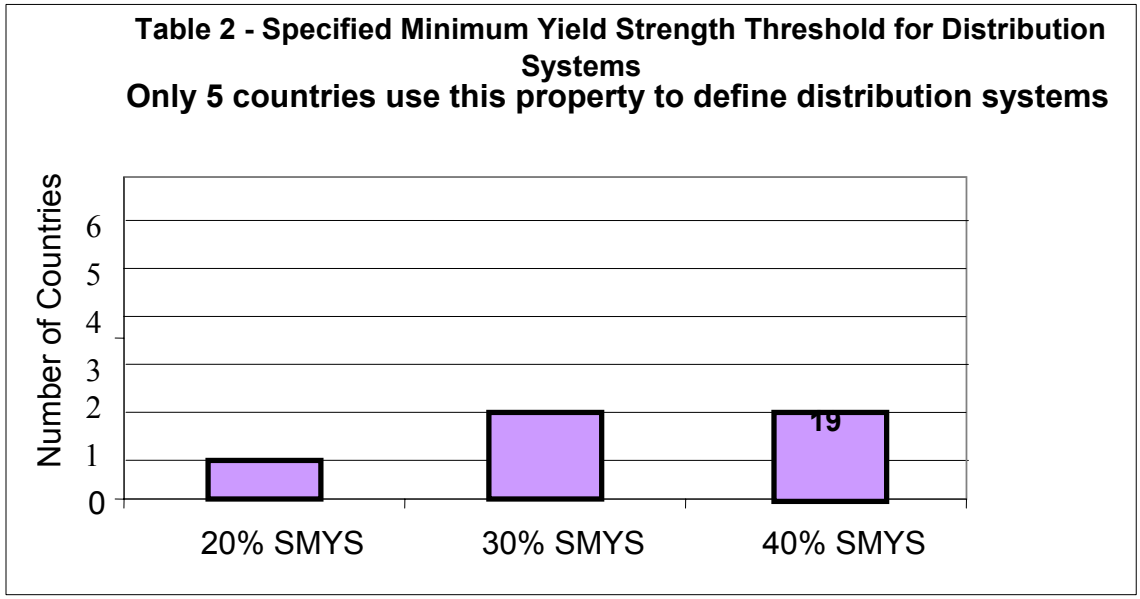
2.0 DEFINITION OF DISTRIBUTION PIPELINE INTEGRITY

Distribution networks have generally been defined as those systems down stream of the city gate stations, or generally the piping networks that deliver gas within cities and towns. These piping networks would include all of the facilities required to deliver the gas from the transmission delivery point or city gate station to the end-use consumer and would include regulating gate stations, and distribution mains and services.

In terms of defining Distribution Pipeline Integrity, a much more technical definition is used to define the necessary requirements, plans and approaches. A variety of technical definitions exist to define what elements of the network would be considered under Distribution. These technical definitions fall under the category of design or operating pressure tiers or the specified minimum yield of the piping system.

Generally European jurisdictions define Distribution networks by design or operating pressure tiers, while in North America, the approach of using specified minimum yield is the preferred approach. Below are two tables that demonstrate this finding. What is of interest is that there is some relatively wide range of technical standards that define the parameters of the Distribution systems around the world. The upper limit for European Distribution networks is 16 bar.



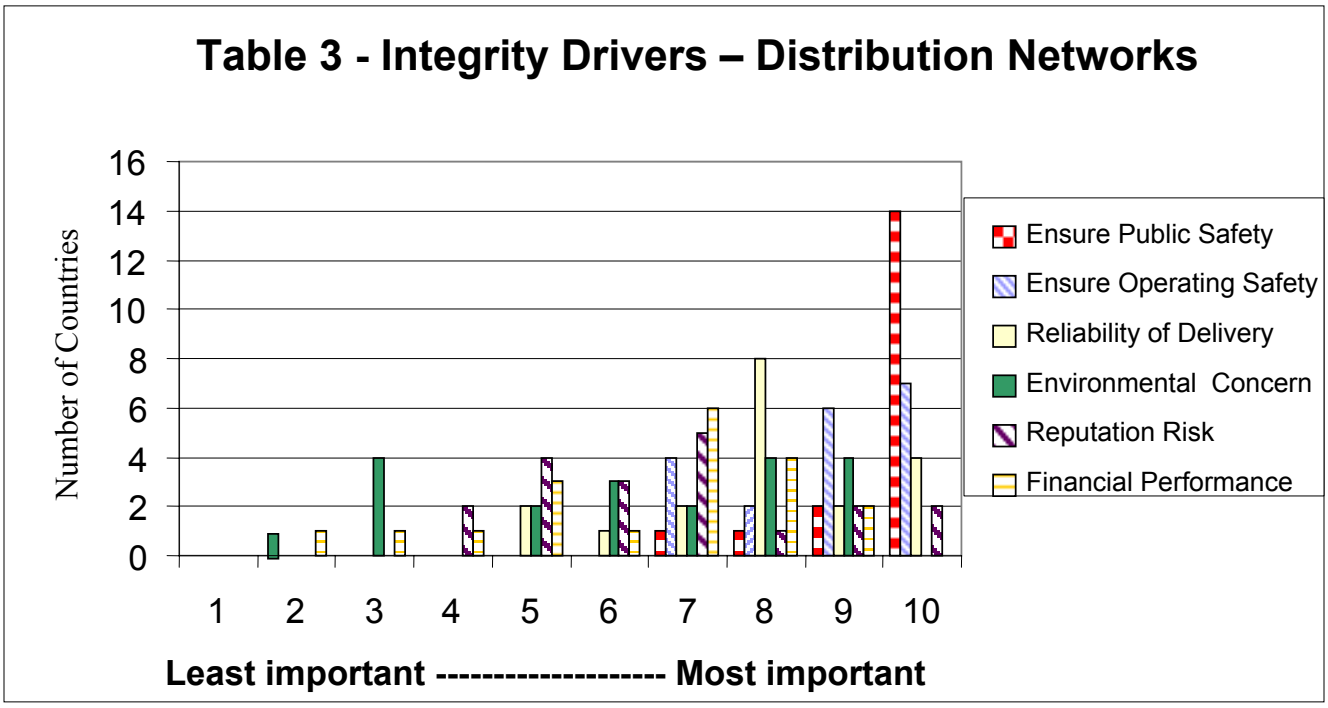


It should also be noted, that within the definition of Distribution networks, typically, a number of pressure subcategories are used to differentiate certain parts of the system. Most commonly, three pressure subcategories are used with the lowest pressure system operating at pressures of

less than 1 bar. Detailed breakdowns of the different pressure systems that exist within each country are listed in Appendix I.

1.0 INTEGRITY DRIVERS – DISTRIBUTION NETWORKS

The study group reviewed the primary drivers to the development of distribution integrity pipeline plans and approaches. These results are presented in Table 3 below.



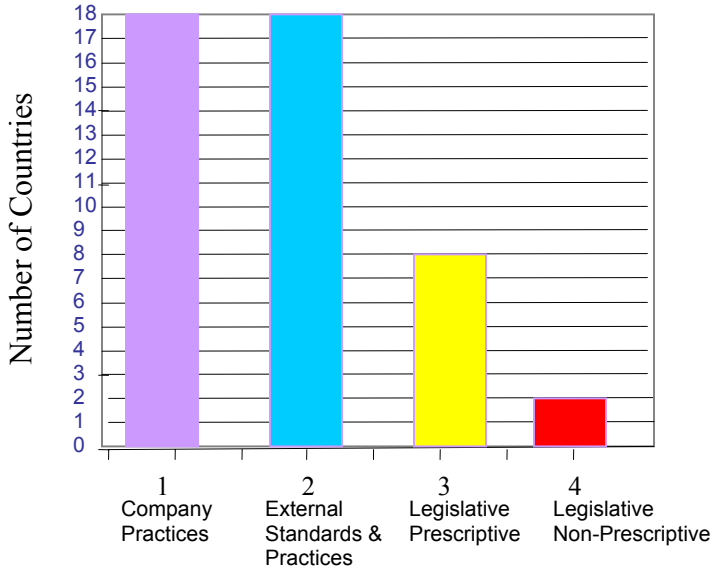
As can be seen from the graph above, the most important drivers that lead to the development of a Distribution Pipeline Integrity plan centre around the need to ensure that Public and Operational safety risks are well managed and mitigated. On the other hand, implications to the financial performance of an organization and environmental risk issues with respect to the impact of the integrity plan tend to be the least important drivers.

2.0 INTEGRITY PERFORMANCE REQUIREMENTS – DISTRIBUTION NETWORKS

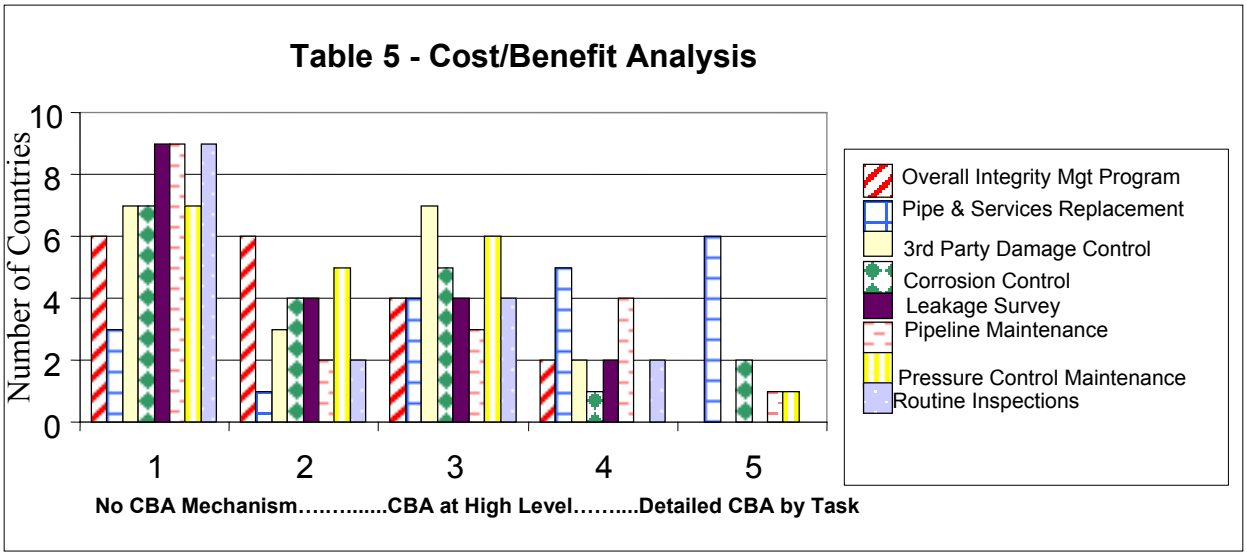
Of interest to the study group was also the area of the performance requirements that require to be met as part of the Distribution Integrity plans and whether these requirements are defined by prescriptive or non-prescriptive legislation, external or internal company standards and practices.

As can be seen from Table 4 below, generally there is a wide range of how the performance requirements of the integrity plan are defined. In all cases, well established internally and externally developed standards and/or practices are used to ensure that the networks are operated safely and reliably. While specific legislation is still in development and is evolving, it appears that the tendency is for the development of prescriptive type legislation as opposed to non-prescriptive. In view of the excellent safety record that the industry has, it is questionable if prescriptive type of legislation is the most effective and efficient way to approach this issue. The nature and history of the networks is such, that greater consideration should be given to the application of risk based approaches when trying to design an effective and applicable integrity plan. This approach to defining the specific elements of the integrity plan would be better supported by the development of non-prescriptive type legislation around this issue.

Table 4 - Integrity Performance Requirements - Distribution Networks



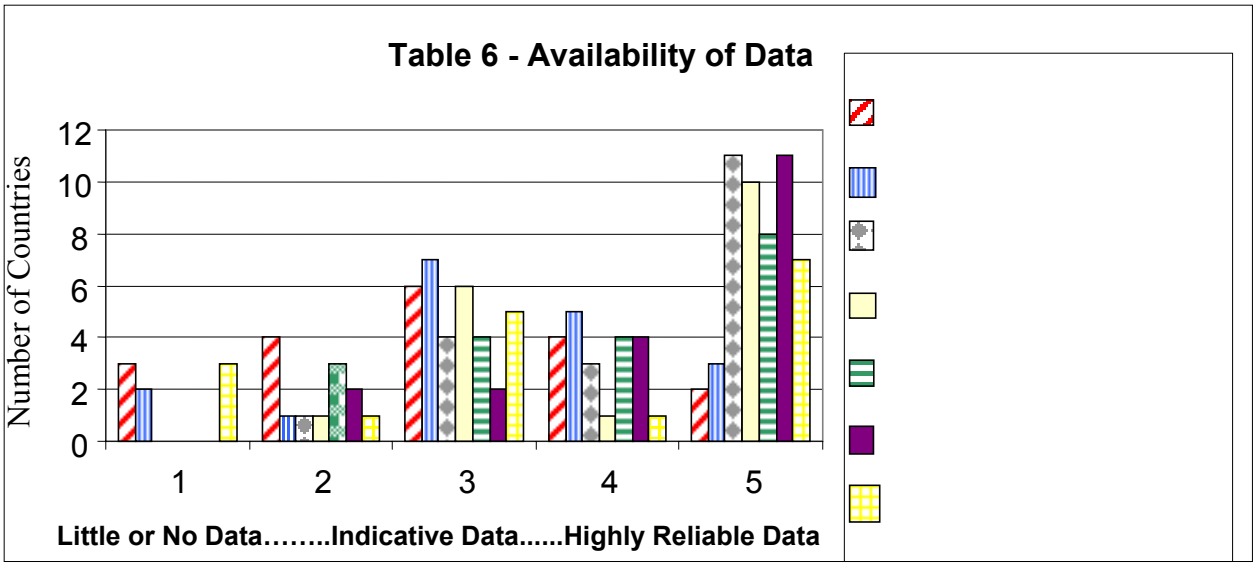
such as routine inspections, pipeline maintenance, leakage surveys and 3rd Party control generally do not use a detailed cost/benefit analysis to identify the frequency or approach to operational compliance. Generally a detailed cost/benefit analysis is not used where external or internal standards mandate the specific requirements or frequencies to be used. The general conclusion that is reached is that the elements that make up the integrity plans are based on the historical view towards safety and reliability as opposed to detailed cost/benefit approaches.



6.0 AVAILABILITY AND QUALITY OF DATA – DISTRIBUTION NETWORKS

One of the most significant issues, particularly as it relates to the development of a Distribution Integrity plan is the availability and quality of the system data and records. Although many of the Distribution networks predate automated mapping systems, the availability and quality of data related to safety is highly reliable and available. Certainly some systems can be categorized as “prior to records” systems, however, the elements that relate to the safe operation of those systems is generally of high quality. Table 6 below illustrates this point.

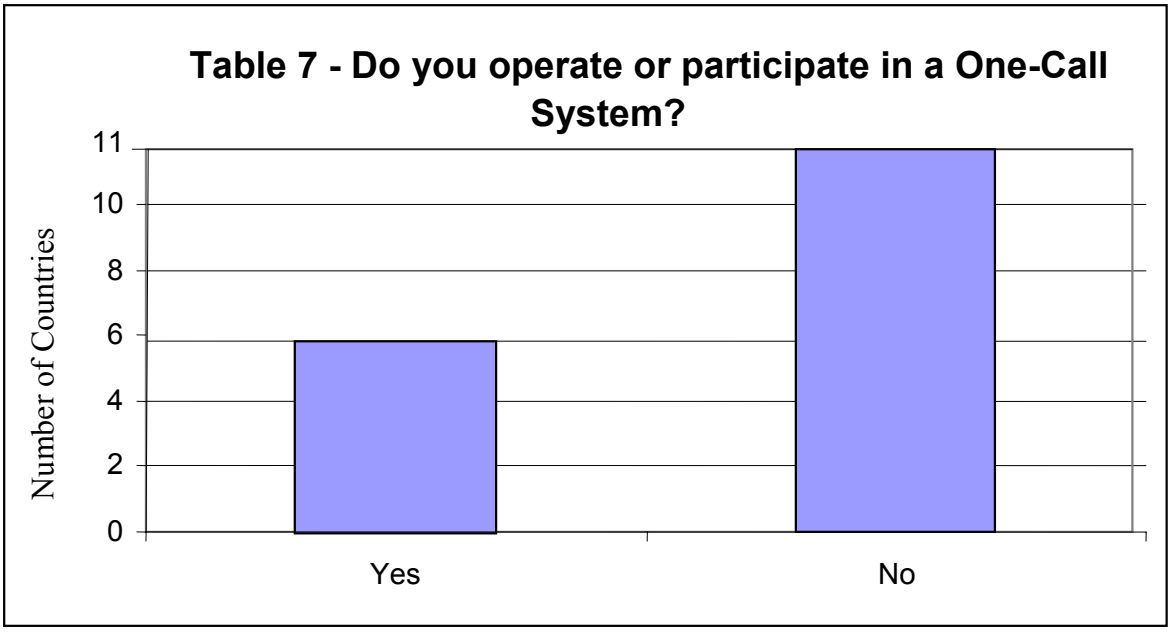
While the high quality data exists on the operating and maintenance aspects of integrity, currently, there is a lack of high level data that can demonstrate the over all effectiveness of the overall integrity plan. There is active work in several countries to attempt to develop an “index” that can be used to demonstrate the effectiveness of the overall integrity plan.



7.0 PLANT DAMAGE PREVENTION

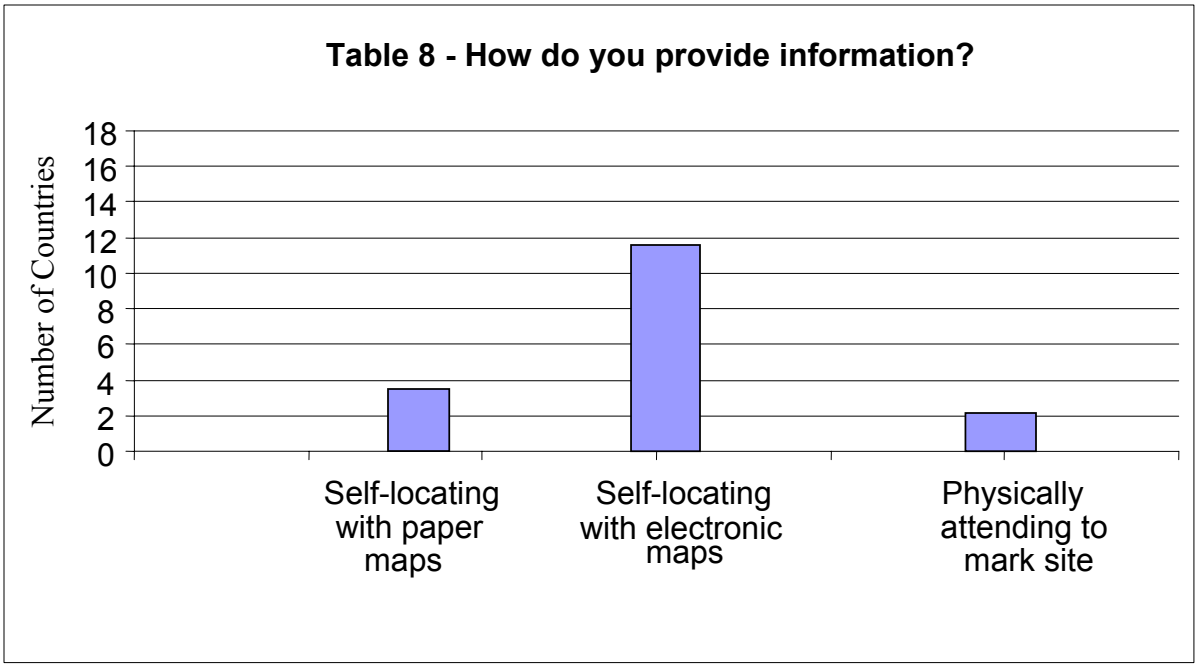
Plant damage is considered to be one of the major issues related to the integrity of distribution networks. The frequency of excavations is such that a very effective and efficient approach to preventing accidental damage to the plant is necessary. The group explored the area of plant damage prevention as it is clearly one of the most important areas related to integrity. The group explored the effectiveness of the approaches used widely in order to determine if any trends could be established from a best practices perspective. It is recognized that there has been significant effort put towards plant damage prevention around the world, and that effort continues to evolve. The intent of the group's study was to look at plant damage prevention from a high level and not engage in a detailed best practices review.

The first area that was the explored was the use of "One-Call" systems. We define a One-Call system as one where a single contact number (telephone, fax, web) exists that excavators can call to arrange for physical line locates or obtain mapping information for self locating. As can be seen from Table 7 below, over half of the study participants do not use a One-Call system, while the rest of the countries do use a One-Call system to effectively and efficiently handle requests for line locates or mapping information for self locating from all underground facility owners. It is however interesting to note, that while many One-Call systems exist, they are mostly non-legislated operations. The use of legislated One-Call systems appears to be primarily a North American phenomenon.



Another interesting area that was explored was on how the locate information is provided to the excavators. Interestingly, there are a variety of methods that are used, including the provision of physical locates by either company personnel or a contracted locate service provider, as well as a number of self locating approaches through the provision of paper or electronic maps.

While all means of providing information to excavators are used by all of the countries who participated in this study, there is however a “predominant” method that is used in each county. Table 8 below illustrates this point, and presents the most predominant manner in which this information is provided by the study group participants. A good example of the significant difference in this area is to look at Canada, where over 95% of the requests are handled by physically marking the location of the underground plant, where us in the UK, over 85% of these requests are handled by providing either electronic or paper maps, as opposed to physically locating the plant. Less than 10 % of these requests are handled by providing physical locating by the network owner.



In terms of causes of plant damage where a locate request has been made, the largest factor contributing to damages is poor or improper excavation techniques. It is interesting that the least factor is that of the quality or accuracy of the information or the accuracy of the physical line locate where one is provided. The area that is of most concern remains the area of damages that are caused due to lack of respect for underground facilities. Clearly an area of focus must be the improvement of the skill and competency of excavators. Reducing improper excavating will lead to the reduction of plant damage.

Finally, the group wanted to explore in relative terms, how significant is the issue of third party damage of facilities. In relative terms, third party damage represents the most significant risk to distribution systems. While routine maintenance and inspections of the network proactively identifies circumstances that could comprise reliability or safety, plant damage is the greatest "unplanned" activity that has the potential to impact both the reliability and safety of the network.

8.0 PRIORITIES FOR NEW TECHNOLOGIES AND SYSTEMS

This section of the report captures the emerging technologies that the study participants are planning or hoping to develop in support of Distribution Pipeline integrity management. Consideration was given for the evolving developments in the areas of risk assessments, technology/process, emergency response/third party damage and finally, leakage surveys/cathodic protection.

8.1 Risk Assessments

Canada (Ontario)
Currently developing a management system approach to integrate the various activities that are currently being performed related to Integrity Management. This would include the following key components:

- Working Records
- Risk Assessment
- Condition Assessment and Monitoring
    - Potential us of inline inspection devices
    - Direct assessment techniques and processes
- Mitigation

The priorities for the next five years will focus on establishing the integrated program described above and addressing issues that are identified through the process to sustain continuous improvement in order to ensure the integrity of the Distribution system is maintained.

Germany
Strategy for maintenance including key data

Netherlands
Developing a “pipeline safety indicator”. The safety indicator enables the comparison of sections of a network in relation to safety. The detailed renovation and repair program will be based on the combination of the indicator and the risk analysis model.

Serbia
Plan to collect foreign experience in this field and following analysis will implement as system with the necessary adoptions to the networks. Together with other countries in the region, an analysis is currently being carried out of the DVGW norms and German legislation

Spain
Plan to continue working in statistical methods to support proposals to the authorities to reduce the surveying frequencies, especially in the case of polyethylene networks. The same applies for inspection periods in Pressure Reduction Stations.

UK
A number of specific areas are being investigated including,

- Risk models linked to decision support and CBA tools
- Field data capture for maintenance repair and pipe laying
- Local area based replacement of Cast Iron pipes
- Replacement of steel pipes less than or equal to 2” diameter on leakage (don’t repair)
- Condition assessment of steel risers in multi-story blocks

8.2 Technology/Process

Bosnia
Attempting to implement a pipeline integrity management process following the experience of gas distributors in Deutschland which operate similar gas networks. Also, developments are occurring in computer applications and development of new software applications to increase the productivity of the workforce. In addition, commercial software such as GIS or CAD is being used to improve the quality of information available.

France
"CAMM" (Computer Assisted Maintenance Management) is a national system to collect:

- All the maintenance actions and visits
- All the failures (during the corrective and preventive maintenance
- The corresponding costs on each component

This tool will provide data to do an efficient risk and economical analysis. The aim will be to optimise the policy of maintenance and partial replacement of the distribution infrastructure.

Germany
Non destructive testing of PE butt fusion and electrofusion joints – enquiry of new developments and their application.

Ireland
Considering a post construction survey on building sites, to verify that requested construction depths are achieved. This is a problem, as contractors are in charge of finished ground levels. Pipe is installed in a pre-excavated trench, and sometimes third party damage occurs due to lack of sufficient cover to the service pipe.

Switzerland

- Data capture on regulators (network regulators only)
- Increased use of portable IT systems
- Improved database usage for leakage control and maintenance scheduling
- Fully automatic welding sets Changing the material from PE 80 to PE 100
- Safety audit (for the technology and organization)

UK
Sprayed pipe lining systems
New PE pipe raisins and technologies

USA
Micro-excavation for direct assessment of coating integrity
MapInfo systems for utility co-ordination
Along with the MapInfo products using MapInfo to graphically plot planned projects as well as planned street repave locations. Having geographic view to planned work will allow for better utility coordination in the future

8.3 Emergency Response/Third Party Damage

Czech Republic
Emergency service is now fully centralized to the dispatching department at the Distribution Company's Headquarters. Emergency calling is analysed and transmitted to the local departments in a plant. The responsible plant's operator and in view of the real situation, localizes the failure and can repair the pipe using the applicable tools. Special tools are divided for using on pipelines and technologies according to their pressure levels and specialty. After that, the operator relays the information, with descriptive specifications, back to emergency dispatcher. The dispatcher inputs the information about the damage to the SCADA system, for the next analysis. Fully centralized distribution data in SCADA and SAP modules appear to be very effective and provide an efficient way to reach a sophisticated Distribution Integrity Program.

8.4 Leakage Survey/Cathodic Protection

Germany
Implementation of leak survey supported with digital GIS

Italy
Geo radar, Interactive maps, Laser Leakage detection

Japan
Expecting to develop a new technique to detect corroded points of cathodic protected pipelines.
Lining system for corroded branch main pipes and service pipes

Netherlands
Technology for leak forecast method (multi client research program)
Life-cycle research on PE pipes and electro fused joints (multi client research program)
Leakage control with digital fields data capture with automatic production of a leakage repair program
Programs to increase the safety and reliability of the gas network.

9.0 EXISTING BEST PRACTICES

The study group requested the study participants to identify what best practices in the areas of systems, tools, techniques, or approaches they believe would be categorized as a good or best practice in the gas industry. The following is a brief outline of what was identified. It was difficult to group these practices and as such the information is presented on a country by country basis.

Czech Republic
The Czech gas industry is going to a fully liberalized gas market by January 2007. The best practice identified is to centralize activities according to their significance. To this end, it is necessary to organize and split activities and support into a few areas:
1. Distribution
2. Finance
3. Services

1. Distribution Departments:

- Asset management – all information about plant and future needs (investment analysis)
- Operation and maintenance – all information about real service needs, technical information about pipeline integrity
- Technical dispatching – monitoring and control or all distribution grids, management of distribution data (SCADA) on-line monitoring of distribution capacity
- Metering – management of metering data concerning delivery points and take-off points

France
Definition of the current Maintenance policy using the method of "optimisation regarding reliability" (RCM).

Germany
The system of technical standardization practised in Germany is worth mentioning. The technical standards are set by the gas industry themselves, organized within DVGW. A short description of DVGW can be found at the following web-site (http://www.dvgw.de/en/index.html)

We are setting the signals in Germany and in Europe at the DVGW (Deutsche Vereinigung des Gas- und Wasserfaches e.V. – Technisch-wissenschaftlicher Verein = DVGW German Technical and Scientific Association for Gas and Water) through the transfer of know-how and communication. On the basis of high technical competence we choose an open dialogue. We are transparent, and we are neutral.
The DVGW is indispensable for the industry self-regulation in the gas and water supply industry. Our technical rules set the standard in both Germany and within Europe the utmost safety combined with the best possible efficiency.
The staples water and energy always have to be secure and available in high quality. This requirement has been the incentive and continuous basis for the technical rules of the DVGW - for more than a century.
Long-term experience combined with our current knowledge result in our motives and our daily work:
- technical and hygienic safety
- optimising gas- and water- supply technology from an economic point of view
- protection of resources and environmental care
- quality management, quality assurance and control
- regulation and standardisation
- controlling and certification
- vocational training
- information and transfer of know-how

In these matters, we are independent, non-profit making and neutral in accordance with industrial self-regulation."

Ireland
We progressively publish leaflets to the Construction Industry Federation on safety and best practices to be observed during construction. Particular emphasis is placed on depth of cover and separation from other utilities. There is nothing in law to support this, but we keep a high level of awareness out there in the public domain.

Japan
Lining system for cast iron pipes, risk-based replacement program for cast iron pipes

Netherlands
The "Pipeline Safety Indicator" based on accidents, incidents and leaks gives information about the safety of network sections
A leakage control system electronic mapping and digital field data capture

Spain
The distribution system is, on average, very young (almost half the total length has been laid over the past 5 years). Most of the "old" materials (cast iron, PVC, fibre-cement, thin wall steel, etc.) have been replaced or renovated. Pipeline integrity is not (yet) an issue for in Spain. On the other hand, Spanish Regulations set specific frequencies for surveys and inspections that must adhere to, with little to no alternatives. However, as pipeline integrity management systems are being introduced for high pressure transmission lines, one can expect that ultimately a similar approach will be adopted for the Distribution network as well.

Switzerland
Pipe replacement (cast iron, old steel pipes mainly) by tubing existing pipes and converting from BP or MP to HP. This procedure not only replaces failure sources but adds capacity, flexibility and safety to the distribution network
Earthquake precaution
Safety audit (examination of companies through external)

UK
Risk assessment system (MRPS) for all metallic pipes – informs replacement and leakage survey prioritisation, Cost Benefit Analysis and regulatory rate reviews. See attached PowerPoint presentation "Distribution Mains Replacement Sept 04"
Contracting Strategy – Alliance with Construction industry partners to deliver locally-based main replacement projects designed in conformance with national replacement policy and procedures
Widespread use of replacement by insertion of PE pipes into metallic pipes. Techniques include dead and live insertion; close fit lining, pipe bursting. Developing use of guided moling techniques for new and replacement pipe laying.
Pressure profiling of LP distribution systems

USA
Key-hole coring technology
Cured-In-Place Pipe Lining
Ground Penetrating Radar for Under Ground Utility Verification
Mapping of facilities to make integrity decisions -
Mapping products are built on a non-earth coordinate system. Development of a cross-reference grid between facility coordinates and real world coordinates has allowed for the development of a number of desktop applications in MapInfo. These applications include:
Cast iron main break database - used to track breaks and prioritize mains scheduled for replacement
Third party conflicts - used to track digs near cast iron main, this data is layered over the cast iron main data to determine if the digs may have resulted in a break
Geocoding of leak history – used to determine areas for bulk bare steel service replacement
Capacity constrained areas – Used to graphically communicate, to other departments' areas of the distribution system that are capacity constrained.

Water Main Breaks – Used to track One Call tickets for water main breaks to determine if the breaks may have resulted in water infiltrating low-pressure mains
Without the availability of a corporate GIS, MapInfo has filled the gap by allowing the layering of third party products along with facilities data. MapInfo has allowed the movement into the geospatial world without the investment of a full-blown GIS system. All data entered into MapInfo can easily be converted to a corporate GIS at a later point. It is also allowing Gas Engineering to become familiar with working with a GIS system
Based on the development of the cross-reference this has allowed the process of developing an emergency valve inspection tool utilizing GPS and wireless data communication
Actively utilize live CCTV technology to identify water intrusion in inaccessible locations
Actively utilize liner technology to extend service life of deteriorated

Belonging to Common Ground Alliance (CGA)

APPENDIX I – DEFINITION OF STANDARDS

Bosnia
Low pressure < 1 Bar, Medium pressure 1 – 4 Bar, High Pressure > 4 Bar

Canada (Ontario)
The high level thresholds are defined by Regulations (Ontario Regulation 210/01) through adoption of Standards (CSA Z662), with some company-specific adjustment. The sub-categories are defined by Company Practice.

Czech Republic
Czech distribution systems operate according to European technical standards ČSN EN 12327 (up to and including 16 Bar) and ČSN EN 1594 (for maximum operating pressure over 16 Bar to 100 Bar included).

Denmark
By Legislation.

France
By Legislation (Safety Legislation 13/07/2000 and 02/08/1977)

Germany
They are defined by Legislation e.g. "Verordnung über den Zugang zu Gasversorgungsnetzen (Gasnetzzugangsverordnung – GasNZV)"

Ireland
Company Practice. Standards (IS 329) would allow up to 15 Bar pressure as distribution pipe. However, the skills associated with steel pipe i.e. welding etc. were kept in Transmission.

Italy
National Legislation

Japan (Osaka & Tokyo)
The thresholds described above are defined by legislation.

Netherlands
The thresholds are defined by external European standards (CEN 12007) and *former* National Directives. From the old the maximum distribution pressure in our country is 8 Bar. The maximum distribution pressures in accordance with our recent standards, based on CEN, are: Steel – 16 Bar, PE 80 SDR 17.6 – 4.8 Bar, SDR 11 – 8 Bar, PE 100 SDR 17.6 – 6 Bar, SDR 11 – 10 Bar, ductile iron – 8 Bar, cast iron – 1 Bar, PVC/CPE or PVC,or AC - 200 mBar. High impact PVC, hard PVC & AC – 200 Bar.

Serbia
Thresholds described are defined by Legislation (Energy Law and State technical regulation and company regulation based on technical regulation, but technical regulation will be (will have to be) unified with Energy Law).

Spain
The thresholds are defined by the "Regulations on Mains and Services for Fuel Gases".

Slovakia
Law Nr. 656/2004 – Energy law, Slovak technical standards- STN, and technical rules for gas –TPP. Three pressure systems are used, low pressure up to 0.05 bar, medium pressure over 0.05 to 4 bar, and high pressure over 4 to 40 bar.

Sweden
Swedish standard contain level over 4 Bar and below 4 Bar. Our standard has a close connection to standard I Canada.

Switzerland – Service du Gaz:
SSIGE standards for Switzerland

Switzerland – WB:
Rules of technology of SUGW, leakage control under and over 1 Bar, frequency every 6 years

United Kingdom
Generally Industry Practice formalised by External Standards.

USA - PECO
Company policy in accordance with United States Gas Federal Safety Standard 49 CFR-Part 192.

USA - PSEG
Terms Transmission and Distribution are defined by Federal Legislation (U.S.). The Distribution sub-categories are defined by Company Practice.

APPENDIX II- EXECUTIVE SUMMARY-"SAFETY PERFORMANCE AND INTEGRITY OF THE NATURAL GAS DISTRIBUTION INFRASTRUCTURE" BY THE AMERICAN GAS FOUNDATION-2005

SAFETY PERFORMANCE AND INTEGRITY OF THE NATURAL GAS DISTRIBUTION INFRASTRUCTURE

Executive Summary

The study sponsored by the American Gas Foundation was performed to provide an independent technical insight into natural gas distribution system safety performance and integrity features. The study performed a detailed analysis review of the natural gas distribution industry's safety performance; an overview of current regulations and industry practices that address threats to the natural gas distribution infrastructure; a description of the unique characteristics that differentiate natural gas transmission pipelines from distribution pipelines; and identification of industry and government initiatives that are currently in-place to ensure continual improvement in regulation and practices affecting distribution integrity.

The safety performance review involved a detailed statistical analysis of distribution incidents in the U.S. Department of Transportation (DOT), Office of Pipeline Safety (OPS) database over the period of 1990 through 2002 (the most recent time period meaningful data was available at the time of the study). The following summarizes the main findings:

- Of the total 1,579 incidents for gas distribution, 601 were "serious incidents" - namely those involving a fatality or an injury.
- There was a statistically determined downward trend in serious incidents of approximately 40%.
- Outside force damage to the infrastructure was the major cause (47%) of serious incidents during the study period.
- Except for cast iron pipe, the predominant component of outside force damage was third party damage, (typically excavation damage inflicted on distribution facilities by a third party not related to the gas system operator or its surrogate), contributing nearly 35% to the total number of serious incidents.
- Incidents due to construction/operating error and incidents accidentally caused by the operator each accounted for less than 10% of the serious incidents.
- Corrosion caused a little over 6% of the serious incidents.
- Of the total 601 serious incidents, 46% occurred on distribution mains, while 34% of the incidents occurred on service lines and meter sets combined.

A number of gaps in the DOT database were identified that prevent a deeper insight into the mechanisms by which specific threats affect the integrity of distribution systems. In addition, incidents categorized by operators as "Other" or "No Data" account for the remaining 27% of serious incidents and may include parts of the gas delivery system that are not under the jurisdiction of the pipeline safety code. This suggests the need to further investigate these categories to determine exact causes and identify incidents that do not reflect the safety of the utilities' distribution systems.

The results of a survey of 23 gas utility operators representing a cross-section of the industry indicate that operators address threats to distribution system integrity through pipeline safety regulations and industry practices. The following are the survey's main findings:

- From the operator responses received, there were no clearly visible gaps between specific threats to distribution integrity and pipeline safety regulations or industry practices that address the threats. However, the effectiveness of the regulations in addressing such threats was not covered in the survey nor were government regulators surveyed in the questionnaire.
- The top five processes having the highest impact on distribution integrity are (1) cathodic protection systems, (2) leak surveys, (3) operator qualification programs, (4) one-call systems, and (5) planned pipe replacement programs. The programs and processes in this group are consistent with indications from the incident statistics that address four of the five major causes identified by the DOT incident database.
- Operators use additional prevention and mitigation measures that exceed the requirements of the federal pipeline safety code to address specific threats to the integrity of distribution pipelines. These measures are generally consistent with the perceived significance of the threat as indicated in the industry practices survey results.
- Operators address the dominant threat of third party damage with prevention and mitigation measures that include those required to meet pipeline safety regulations and additional ones that exceed the pipeline safety code requirements.
- Over 80% of the respondents reported employing risk-ranking tools to evaluate their distribution infrastructure.
- Over 65% of the responding companies have planned replacement programs for cast iron and almost 80% have such programs for bare steel. The survey also ascertained that most operators do not have fixed timeframes for such replacements.
- Pipe replacement between 1990 and 2002 has reduced the amount of cast iron main mileage by 21% and the amount of bare, unprotected steel main mileage by 7%. During the same period the number of bare, unprotected steel services has been reduced by 13%.

This project provided a comprehensive review of key integrity-related technical and safety performance differences between natural gas distribution systems and gas transmission pipelines:

The study showed that transmission and distribution systems had essentially the same number of serious incidents and fatalities and injuries between 1990 and 2002, when compared on a per-mile basis.

The study further identified significant differences between transmission and distribution piping including type of infrastructure, size of pipelines, system pressures, mix and types of materials of construction, typical failure mechanisms, type and frequency of inspection, gas odorization, location of facilities and connection to customers. The significant differences between transmission and distribution pipelines are indicative of the challenges faced in addressing and ensuring the integrity of the nation's gas distribution infrastructure.

American Gas Foundation

Founded in 1989, the American Gas Foundation is a 501 © (3) organization that focuses on being an independent source of information research and programs on energy and environmental issues that affect public policy, with a particular emphasis on natural gas. For more information, please see www.gasfoundation.org or contact Gary Gardner, AGF's Executive Director at ggardner@gasfoundation.org.

APPENDIX III

MEMBERS OF STUDY GROUP 4.1

I wish to acknowledge the following members of WOC 4.1 Distribution Integrity, for their work towards this report:

Mel Ydreos – Coordinator	Canada
Jeremy Bending – Vice Coordinator	United Kingdom
Libor Cagala	Czech Republic
Svend Bomholt	Denmark
Jean-Max Baillard	France
Andreas Hennig	Germany
Tomoaki Yokoyama	Japan
Koji Yoshizaki	Japan
Ron van Akkeren	The Netherlands
Miroslav Dujnic	The Slovak Republic
Franc Cimerman	Slovenia

23rd World Gas Conference June 5-9, 2006 Amsterdam, Netherlands

Report of Study Group 4.2

"Implementation of Leading Practices for Construction, Maintenance and Operations of Gas Distribution Systems"

Rapport du groupe d'études 4.2

«Exécution de principales pratiques pour la construction, l'entretien et les opérations des systèmes de distribution de gaz»

Coordinator/Vice-Coordinator

Jorge Doumanian/Fergal Geoghegan

Argentina/Ireland
Argentine/Irlande

"Implementation of Leading Practices for Construction, Maintenance and Operations of Gas Distribution Systems"

ABSTRACT

This report details work undertaken by Study Group 4.2 of working committee 4 during the Triennium 2003-2006.

The subject is the "Implementation of Leading Practices for Construction, Maintenance and Operation of Gas Distribution Networks in IGU countries".

The study seeks to determine Leading Practices for Construction, Maintenance and Operation of the Gas Distribution system and how companies implement them, in order to:

- Improve Safety
- Improve Service Quality
- Achieve Cost Reductions whilst in compliance with all Safety Standards Regulatory Requirements.

Surveys were conducted on this subject and the results are included in this report.

Additional information on this subject will be discussed during the Technological Forum.

RESUME

Ce travail de détails de rapport entrepris par le Groupe d'étude 4.2 du le Comité Travaillant 4 pendant le triennaux 2003-2006.

Le sujet est l'exécution de principales pratiques pour la construction, l'entretien et l'exploitation des réseaux de distribution de gaz dans des pays d'IGU (union internationale de gaz).

L'étude cherche à déterminer de principales pratiques pour la construction, l'entretien et l'exploitation du système de distribution de gaz et comment les compagnies les mettent en application de :

- Améliorez La Sûreté
- Améliorez La Qualité De Service
- Réalisez les réductions des coûts tandis que conformément à toutes les conditions de normalisation de normes de sûreté.

Des aperçus ont été conduits à ce sujet et les résultats sont inclus dans ce rapport.

L'information additionnelle à ce sujet sera discutée pendant le forum technologique.

"Implementation of Leading Practices for Construction, Maintenance and Operations of Gas Distribution Systems"

STUDY GROUP 4.2

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1.0 FOREWORD

The International Gas Union WOC4 Distribution Committee in its Triennium Action Plan (2003-2006) agreed a programme of work which involved examining specific subjects of particular interest for distribution companies.

Three Study Groups (SG`s) were set up and SG 4.2 was asked to examine the “Implementation of Leading Practices for Construction, Maintenance and Operation of Gas Distribution Systems“ on the main activities of gas distribution companies in IGU countries.

Members of SG 5.3 were:

Jorge Doumanian - Coordinator	Argentina
Fergal Gheoghan- Vice Coordinator	Ireland
Dietmar Spöhn	Germany
Itsuo Yoshida	Japan
John Frantz	U.S.A.
Flemming Jensen	Denmark
Petr Stefl	Czech Republic
Mehmedalija Sijaric	Bosnia Herzegovina
Christian Schicketmüller	Austria
Claus Obholzer	Germany
Kerul Kmec Marian	Slovakia
Sigvard Tronell	Sweden
Steve Vick	UK

It is important to bear in mind at the outset, that gas distribution companies operate in an environment of increasing changes in Regulation, liberalisation of the market, globalisation, and growth of the gas industry.

Therefore safety performance and the security of the gas distribution system is critical to the overall success of the gas industry, which has long experience in construction, maintenance and operation of distribution systems, and has reached a very high technical and quality standard.

Up to now, standards and specifications in the different countries have been mainly based on safety considerations, and IGU studies have been mainly focused on safety related matters. In the near future, regulatory processes and the development of new markets will require the industry to focus more on cost control, efficiency and customer satisfaction.

In order to reach these goals, the concept of benchmarking operational performance data and finding leading practices to improve results, will be key elements to support gas distribution companies success and support natural gas as a fuel of choice.

The objective of SG 4.2 was to determine leading practices for construction, maintenance and the operation of gas distribution systems and to study how companies implement them, in order to improve safety, service quality, and achieve cost reductions, whilst staying in compliance with safety and regulatory requirements.

The study describes the process of evaluation and determination of leading practices used in the industry for construction, maintenance and operation of the gas distribution system. These leading practices are based on reviewing commonly defined metrics of operational performance.

In addition to trying to identify the leading practice, the process seeks to incorporate suggestions for implementing and tracking the results.

Determination of leading practices will help influence customers and regulators alike in determining the cost effectiveness of the gas distribution company.

In the future, other committees could use this process to identify best or leading practices.

The study will provide

- A framework for evaluating common operational data
- A framework for implementing and tracking practices
- A review of work management systems that foster improved performance

The Study Group would like to sincerely thank all those associations, companies, authorities and individuals who answered the questionnaire, and thus contributed to the findings of this report.

All conclusions and analysis are solely based on the answers received to the questionnaire, and it is accepted that some people misunderstood some of the questions. Every effort has been made however to present the information in as simple a format as is possible.

2.0 CONCLUSIONS

The Study confirmed that Best Practice Companies had several similar characteristics/ criteria in use:

1) Cost Reductions
2) Maximizing Productivity
3) Increasing Safety of customers, employees and the general public
4) Use of technology & innovative practices
5) Employee training / education

Best Practices definitely exist throughout the industry and are significant in operational areas. These include:

- No-dig technologies
- Remote leakage detection, including portable equipment
- Keyhole excavation process
- GPS technology to improve response time
- Collaborative relationship with industry and government to improve 3d party damage prevention.

While Best Practices exist and have been highlighted in this report, there is no known ongoing international forum available to collect, share and track best practice implementations.

3.0 METHODOLOGY

In the initial phase of the study, the study group developed a questionnaire and a benchmarking methodology, to seek to receive comparable data from participating companies on six particular operational subjects. The information was divided into methodology and performance.

Operational costs were not considered due to the wide range of economic variables in participating countries.

Benchmarking studies were carried out on the following six operational areas, namely

- Main & Service Pipes Construction and Replacement.
- Leakage Survey & Classification.
- Leak Repairs.
- Emergency Response.
- Damage Prevention.
- Pressure Regulator Operation & Maintenance Policies.

A good response was generated by the questionnaire, and a considerable amount of data was initially received. The information was used to make comparisons, draw conclusions and generate some charts.

The second phase of the study involved the selection of the five best companies in each of the above operational areas, based on the methodology we had agreed, and a further questionnaire was sent to each of these companies, made up of two parts, namely a section specific to the particular topic, but also a separate section, seeking answers that were company orientated, and not just topic based.

The study group felt that being the best operator in a particular topic did not just require a particular expertise in the subject area, but also needed to have the sustained support of the company management structure.

The study group tried to analyse the particular innovative approaches that companies employed, that made them the best.

The first questionnaire was sent to 37 Companies from 26 different Countries. 20 Companies responded from 12 different Countries. They were from the following continents, namely:

Asia	1
Europe	13
South America	4
North America	2
Total	20

The above represented a return rate of 54% from the Companies circulated, and 46% from the Countries that were chosen.

It became obvious during the analysis of data, as stated previously, that some questions were misunderstood, and that some companies in particular chose to answer others without the level of detail requested. In any event, best efforts were made to present the data in a fair and representative way.

4.0 DATA ANALYSIS

This section of the report tries to express in a graphical way the answers received from the participating countries to some of the questions they were asked in the questionnaire.

Obviously not all of the questions lent themselves to this form of representation, nor did some of the answers. Some answers to typical questions that were topic specific are contained in the “INNOVATIVE APPROACHES“ section of the report.

Other answers, to company specific questions are detailed in the “BEST PRACTICES“ section of the report.

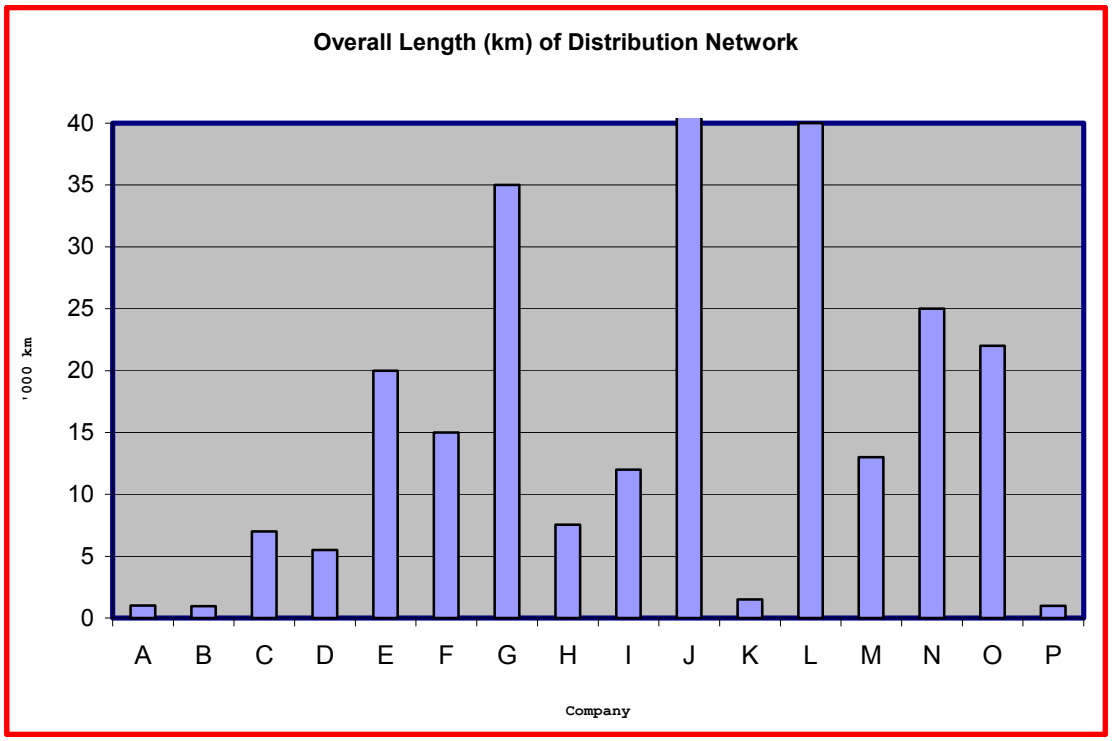
There are 8 graphs in this section and they plot the following specific answers to questions as follows:

- Overall length of distribution network in each company
- % of mains and services scheduled for replacement
- Annual rate of replacement of mains and services.
- Leak repair practices versus number of site visits
- Number of crew members in pinpoint and repair crews.
- Average response and resolution time
- Third party damage incidents
- Pressure regulator productivity

Brief comments are noted on each graph. Other comments and conclusions are possible, and can be made at the reader’s discretion.

Graph No. 1

This graph captures the overall length of distribution pipe work in each of the companies who participated in the questionnaire. Twelve companies filled in the appropriate information to produce the graph seen below.

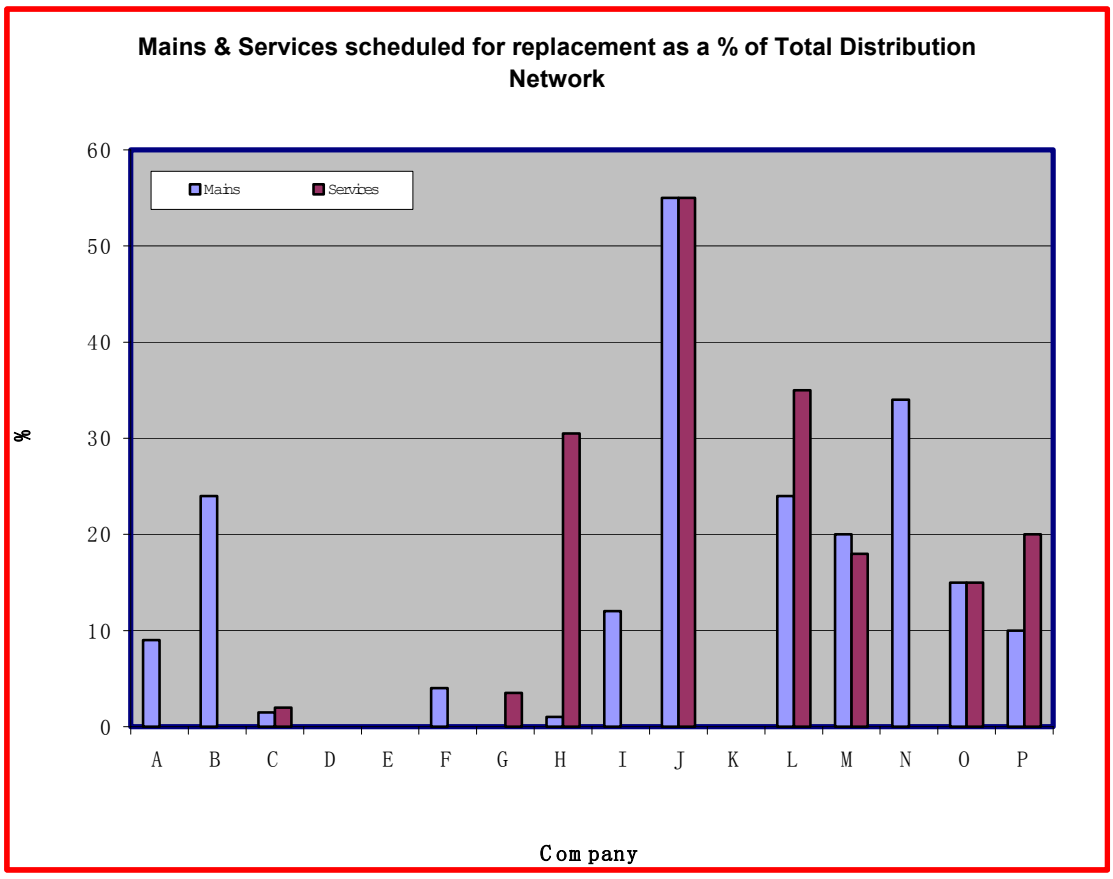


Comments

- Of the twelve respondents, the average length of the distribution network is 38,000km.
- With the exception of company “J “, the average length of the other eleven companies was calculated as 18,300km
- The lengths of network above can be sometimes useful in qualifying the answers that have been given by individual companies to other questions recorded later on in this section of the report, and indeed later sections on innovative approaches.
- Eight of the twelve companies have a distribution network less than 25,000km in length. This was 66% of the companies who responded

Graph No. 2

This graph represents the percentage of mains and services scheduled for replacement in each participating company expressed as a percentage over the total amount of mains and services in the total distribution network.



Comments

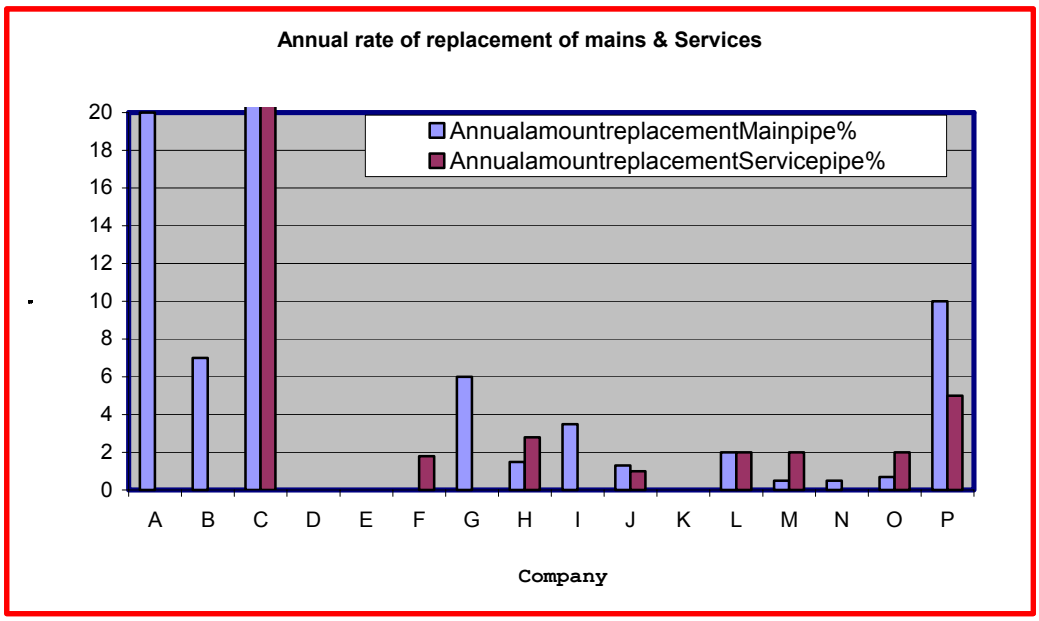
- Eight countries gave adequate information to the above question in relation to the percentage of services that were scheduled for replacement, as a percentage of the overall total of services in their network. The average percentage over the eight countries was recorded as 22.37%.

- If we disregard company “J“ whose individual percentage was 55%, the average of the remaining seven countries was recorded as 17.7%. This may indicate that in the participating companies, almost 80% of their services have already been replaced, or are polyethylene, and not scheduled for replacement.

- The average percentage of the mains networks scheduled for replacement, as a percentage of the total distribution mains network was recorded at 17%. Again, if company “J“ is not included, the average percentage was 14%. This is an interesting finding, as it may indicate that over 85% of networks consist of steel or polyethylene and that metallic mains either have been substantially replaced, or are targeted for replacement.

Graph No. 3

This graph illustrates the annual rate of replacement of mains and services in the thirteen companies who responded to this specific question.



Comments

- Twelve countries responded re the annual rate of replacement of mains. The average rate of replacement was calculated as 9%. If we disregard company "C " in this instance the average rate of mains replacement in the remaining companies calculates at 4.8% per annum. This is quite a high average.

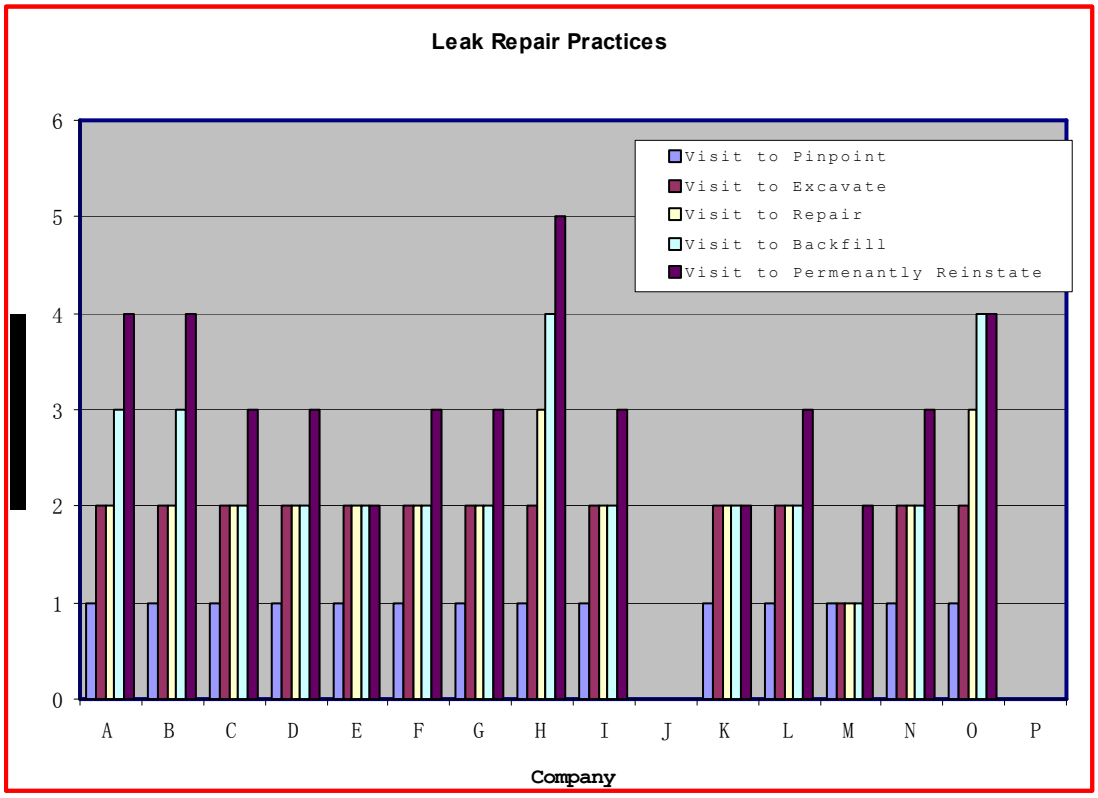
- For service replacement, the average rate of replacement was calculated at 9.3%, and if "C" is again omitted from the calculation, the average in the other companies is calculated at 2.3%.

- An interesting aspect of the above graph, is to cross reference the answers given by the individual companies above, with the information given in Graph No. 1 on network size, so that you can see the relationship between the rate of replacement and the overall network size.

Graph No. 4

This graph illustrates the different approaches taken by individual companies to pinpoint the source of a leak, excavate, repair, backfill and permanently reinstate the ground after completion of the repair. It was very clear from the answers received that there was a large variation in the approach to the above by individual companies.

The question focused on the number of visits to site required to complete the work, combined with the specific tasks that were completed during each site visit. The graph clearly indicates the activity carried out, and on which visit it is completed.



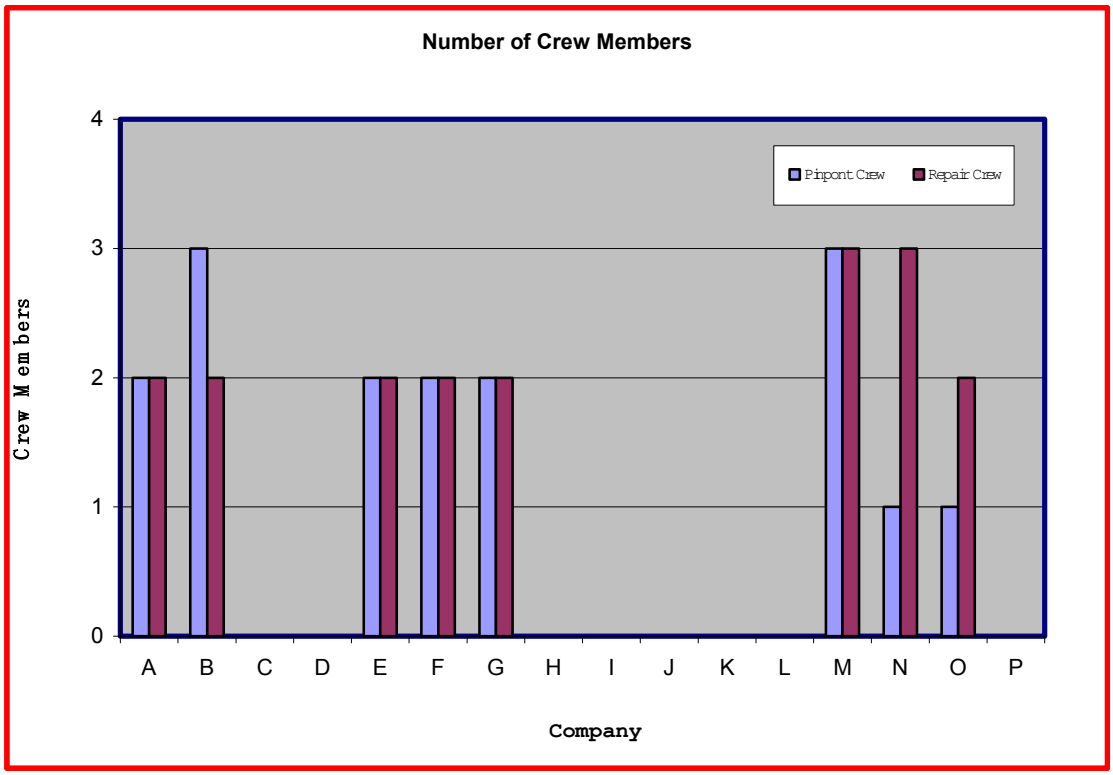
Comments

- Three companies achieve all the activities above mentioned in two visits to site.
- Two of the three use a separate pinpointing crew, with the follow up crew completing the excavation, repair, backfill and permanent reinstatement.
- Thirteen of the fourteen companies use a designated pinpointing crew.
- In eleven companies (78%) permanent reinstatement requires a final visit.
- In 50% of the companies, all of the activities up to and including backfilling are carried out with two visits to site, the last visit being to carry out permanent reinstatement.
- As a general comment it is accepted that the achievement of carrying out all the work activities in the minimum number of visits relies on local factors pertaining in the operational area. If selected backfill is allowed, then excavated materials can be used, but in many operational areas imported materials are required by local authorities, which would usually require a second designated visit to backfill the trench, usually in turn followed with a further visit to permanently reinstate.

- Ten of the fourteen companies (71%) complete all the work in three visits.

Graph No. 5

This chart shows the number of crew members that make up the pinpointing crew, and the repair crew in the companies that responded. Eight companies gave sufficient detail in their responses to produce the graph below.



Comments

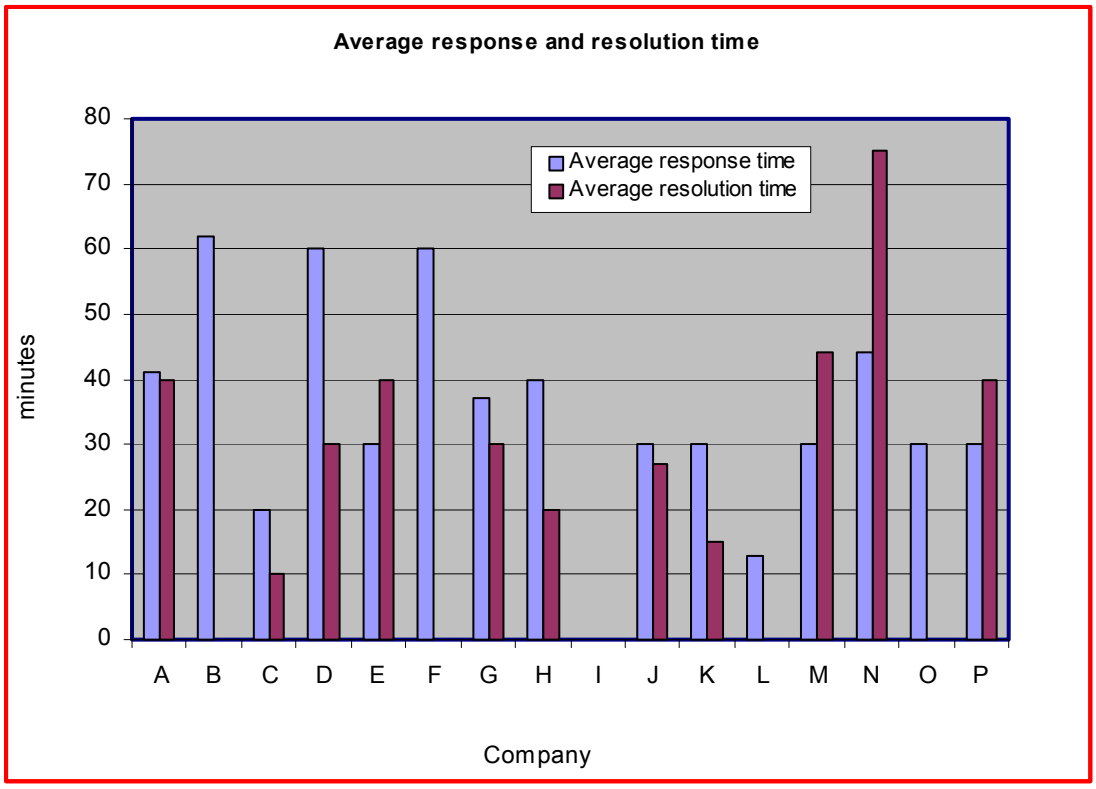
- 25% of pinpoint crews are one man crews, 50% are made up of two man crews, with the remaining 25% being three man crews.

- Six of the eight repair crews (75%) are two man crews, with the remaining 25% being three man crews.

- From other answers received in this specific operational area, it was also recorded that the average number of man hours required to repair a leak was 4.6. ,Obviously this is directly related to the crew numbers in each individual company.

Graph No. 6

This graph was produced from answers received from companies when asked about the average time it took to respond to a Public Reported Escape (PRE), and upon arrival at the location, the average length of time it took to locate the source of the escape. (pinpoint the source).

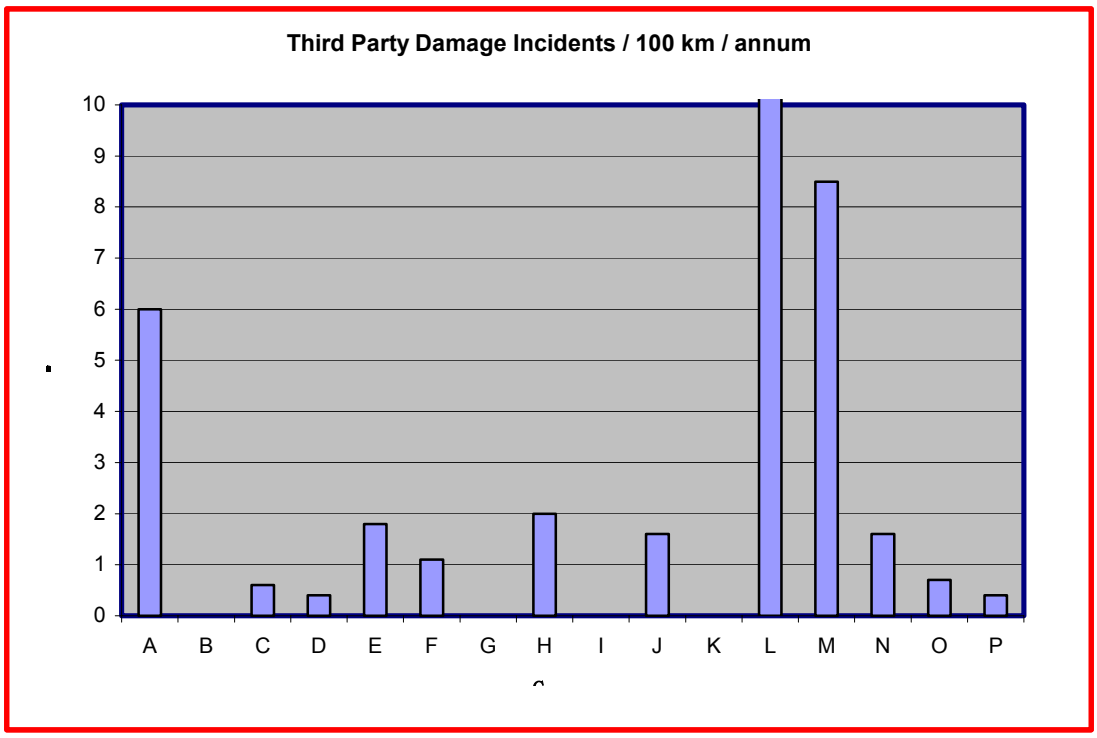


Comments

- Fourteen of the fifteen companies (93%) achieve the response on average inside 60 minutes.
- Eight of fifteen (53%) achieved an average response in 30 minutes or less.
- The average time taken to pinpoint the escape upon arrival on site was noted as 34 minutes.

Graph No. 7

This graph has been created from information received on “Third Party Damage” incidents recorded on the distribution network, per 100km, per annum.

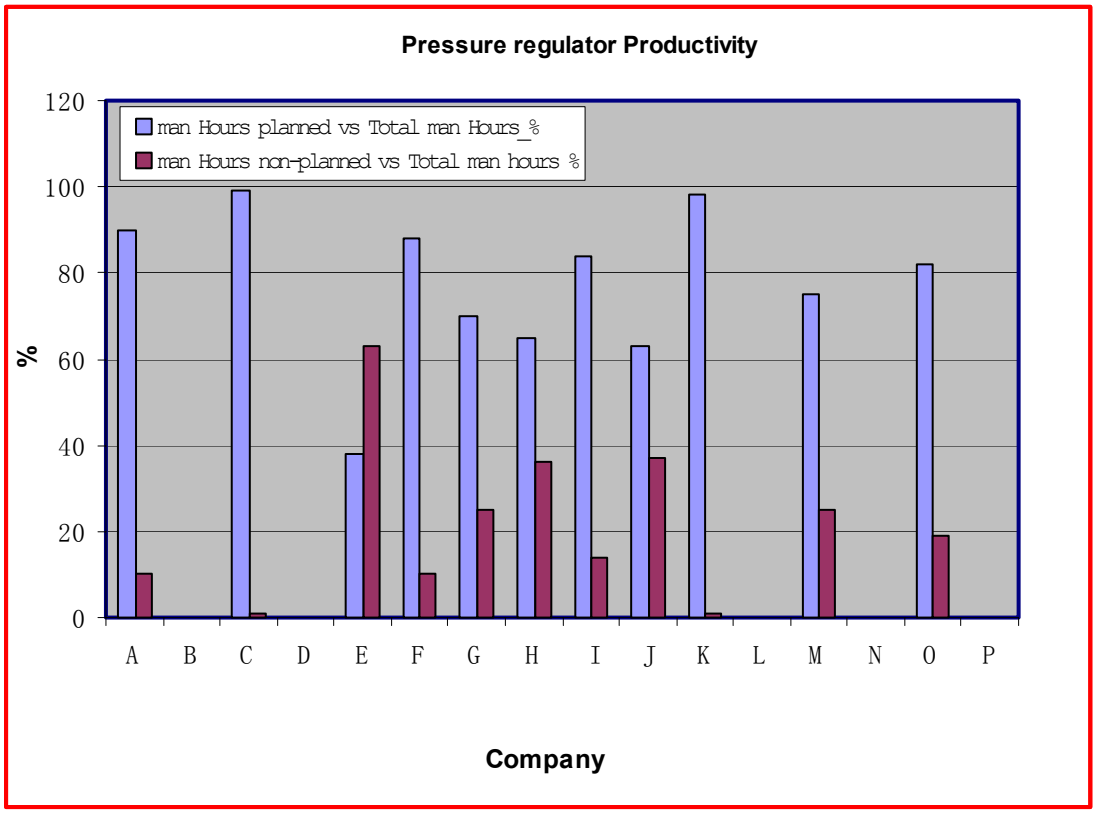


Comments

- The highest recorded incidence of third party damage per 100km was 20.
- The average number of third party damage incidents per 100km per annum, over the twelve companies was 7.22.
- The minimum recorded number of incidents per 100km per annum was 0.4.
- 33% of companies recorded less than one incident, while 83% of companies achieved a performance level better than the recorded 7.22 average.

Graph No. 8

In analysing the information received to our questionnaire on the “Pressure Regulator Operation and Maintenance Policies“ existing in each company, the graph below was created. It seeks to show the comparison at the end of a year between the hours worked on planned or scheduled maintenance, compared to what turned out to be unplanned or unscheduled hours. This gives some indication as to the effectiveness or otherwise of planned maintenance programmes in preventing emergency interventions.



Comments

- On average 77.5% of the planned maintenance programme was achieved, while the remaining 22.5% is unplanned or emergency driven.
- Five companies were successful in achieving greater than 80% of their planned maintenance programme.
- Two companies (18) achieved greater than 90% of their planned programme.

5.0 INNOVATIVE APPROACHES

As described earlier, the working committee was trying wherever possible, to identify innovative approaches taken by companies to manage the operational activities we were studying.

The six operational areas were examined to see if there were any innovative approaches being adopted by companies that were worthy of mention, and that might be of some interest to readers of this report.

The six operational areas were as follows, and some innovations noted are described in this section of the report:

Main & Service Pipes Construction and Replacement
Leakage Survey & Classification
Leak Repairs
Emergency Response
Damage Prevention
Pressure Regulator Operation & Maintenance Policies

5.1 Main & Service Pipes Construction and Replacement

Selection

- Selection is targeted at the decommissioning of iron pipes within 30 metres of buildings. Replacement is prioritised by the use of MRPS (Mains Risk Prioritisation System). Each pipe is surveyed and given a risk value.
- Pipes are replaced in areas of enforced diversions.
- Condition replacement policy, where pipe is not fit for purpose of transporting gas safely.
- Replacement where it is financially more beneficial than repeated maintenance.

Methodology

- No dig technologies as much as possible.
- Open dig when there are lots of services.
- Cured in-place Lining on bridges or areas of high restoration cost.
- Pipe Splitting in areas where upsizing is necessary and there are few services.

5.2 Leakage Survey & Classification

Surveys

- During the winter months (Dec - Feb) all iron pipes are surveyed with a risk value of 190 + (Per the MRPS) and all IP/MP ductile iron pipes within 30 metres of buildings.
- Triggered surveys when forecast temperature is below -4C for 12 continuous hours.
- Trigger survey if temperature rises from below -4C to above 5C in 12 hours.
- Surveys must be completed within 48 hours of The trigger conditions.

Equipment

- Flame ionisation detectors.
- Semiconductor sensors.
- Portable laser equipment.
- GMI Optical Methane Detector (OMD). Allows faster speeds during mobile surveys.
- Heath RMLD (remote methane leakage detector).

5.3 Leakage Repairs

Efficiency measures employed by companies

- Asset Management system gives the priority of Leakage repair.
- Use of Keyhole technology using a combination Vacuum & Coring Truck and above ground small hole tools.
- Using the first visit to detect the **exact location of the leak**, and marking it for the repair crew.
- Trained teams in place to carry out repairs on both steel and plastic pipelines.
- Outsourcing of the repair process.

5.4 Emergency Response

- GPS technology is used to identify the nearest available unit to respond.
- Continuously staffed Freephone National telephone number in place.
- Callers are provided with advice to mitigate the risks until emergency personnel arrive on site.
- Call handling staff are guided by a case based reasoning system, which guides the call handling staff through a series of questions to identify the correct course of action and gives appropriate safety advice in relation to the identified emergency.
- Designated regional emergency response organisations are in place.
- A training programme has been implemented to have “multi-tasking“ workers skilled to operate on the overall distribution system.
- Serious accidents and severe incidents are evaluated by a group of specialists after the event, and sometimes involve members of the emergency services. This can lead to the implementation of measures to prevent the same kind of accident occurring in the future.

5.5 Damage Prevention

Preventative measures

- Free provision of mapping information.
- Free pipeline tracing service available.
- Liaison with Health and Safety Regulator.
- Information campaigns.

- A company has a “damage prevention group” who carry out investigations of 3rd party damage incidents. They track all the damage data with monthly performance indicators showing areas for improvement, and areas requiring attention.

- Reporting to State Agencies offenders who repeatedly break the law.

- Hold meetings with companies who cause the most damage to the network.

- Continuous schooling of third parties, especially excavator drivers.

- Participation in the "Balsibau" programme in Germany. The programme is building up an on-line Internet map of all utility grids (gas, water, electricity etc.) and a schooling programme for third parties.

- One Company trains third parties on how to work in the vicinity of gas mains.

- Participation in Common Ground Alliance (CGA) in the U.S. This is a non-profit alliance dedicated to promotion of shared responsibilities and implementation of ‘best practices” in damage prevention of underground utilities. The program is sponsored by the U.S. Department of Transportation and includes key owners of underground facilities plus related organizations such as one- call systems.

5.6 Pressure Regulator Operation & Maintenance Policies

- Condition testing of pressure regulator systems with a so-called “testing box” developed by our company and Kamstrup. The method leads to a person independent test result

- Maintenance by condition based maintenance. We test the condition first by periodic inspection

- The concept of RCM (Reliability Centered Maintenance) is implemented to define the maintenance plans. This determines the actions to be performed on each type of equipment and the time needed and is defined based on the gravity of failure, including safety, loss of gas and cost of repair

- Principal pressure regulators are on-line surveyed by SCADA. Other gas regulation stations are visited every two weeks. Most are interconnected.

6.0 BEST PRACTICES

Having chosen the five best companies in each individual operational topic, the study group compiled a second questionnaire, that contained a section which queried if there was any particular individual company attribute, practice or approach to their business that facilitated the implementation of best practices. The following is a compilation of some of the individual responses we received to a selection of some of those questions.

While some answers are particular to a certain working environment, they do however demonstrate the various differences in approach that distribution companies employ, in carrying out various aspects of their work on an ongoing basis.

The study group is not recommending any particular view, but feels that some approaches are worthy of mention and strong consideration. Where it has been possible, the identity of the respondent has been kept anonymous.

6.1 Question: What do you do that makes you a best practices company?

- ISO 9001:2000 (Quality Management), ISO 14001 (Environmental), Health and Safety certification
- Use of no-dig technologies with low environmental impact
- High rates of pipe replacement to renew distribution pipeline
- We use an Integrated Emergency Management System provided with GPS and optimized to reduce operating time and to manage data information interchange
- Dedicated standards improvement department
- Telemeter and innovative meters system testing
- Use of palmtops connected to database for reporting and making planned visits
- Geo-radar systems under test to localize underground services
- We use internal employees for external training programs in other companies and or institutions.
- We use a risk-based model to select mains for replacement. It is based on specific programs designed to reduce risk exposure to our customers as well as a computer model which will rank specific segments of main for replacement according to various risk criteria. Our model is a predictive model which weaves leak history with environmental conditions with asset information (size, vintage, and pressure) to create a hazard list; the replacement list is based upon the hazard list, which leads to quantified, proactive main replacement selection. The environmental conditions include building setback, number of underground utilities, demographic area (urban, suburban, rural), and building types (industrial, commercial, or residential)

6.2 Question: What practices and procedures do you use?

- Annual training programme that ensures that workers stay up to date with the latest technologies and emergency procedures
- Continuous benchmarking with other similar companies and keep up to date with the latest technologies

6.3 Question: What are the unique techniques you use in your organization to reduce costs?

- Condition testing of pressure regulator systems with a “testing box” developed by our company and Kamstrup. The test results are non-subjective
- Anticipating pipelines replacing before asphalt covering thus saving costs coming from final reinstatement Bare Steel services are replaced when the main is replaced
- Directional drilling is used whenever possible

- Services are inserted to a great extent
- New technologies are utilized in unique job specific applications (RENU, lining, splitting, pipe pushing, etc.)
- Trench cutting techniques such as saw cut or trench milling
- Tie in techniques to increase productivity, such as three way tees
- Zipper Pavement cutting equipment to reduce pavement breaking and excavation time
- Chain/plowing equipment
- Joint Trench
- Key hole excavating equipment

6.4 Question: How do you maximize productivity?

- Reduction of travel time for our employees by working from home, tele-conferencing,
- Optimized large operational and maintenance territories giving the opportunity to the operational teams to frequently exercise their competences and increase their skills (emergency and maintenance)
- Externalization - Global subcontracted activities (turnkey installed pipeline)
- In order to optimize our activities and the using of resources, we have developed procedures and maintenance criteria with the target of localizing critical situations, defining priorities and intervention techniques. One of our best practices is the definition of an evaluation method for the condition of pipes, using "point-charts": every time we have an intervention on a part of the pipeline, we register the condition of the pipes, as well as the causes of the leakage (if present) and the level of corrosion, providing information to a specific data-base. On these bases, point-charts define the amount of leakage predictable (in terms of flow-rate), together with the "breakdown rate" (in terms of leakages/km/year), these factors are then used in a multiply criterion
- Using specific analysis and algorithms, we can define the "health conditions" of the pipes and (with the contribution of information coming from specific analysis on corrosion run by our internal laboratory service) prepare a ranking to prioritize replacing activities
- Replacement methods (i.e.trenchless technologies, open trench, etc.), together with diameters and materials, are then determined through the analysis of the network developed via a very robust network analysis and simulation model, that enables to focus on the real needs of the network. As an example, we used this technique to define the replacement program of the entire grey cast iron network with lead-yarn joints
- The network analysis and simulation model is another of our best practices, as it is mainly used for the following activities:

  Checking the distribution structure
  Review of network capacity for new connections with flow rate greater than 100 Sm^3/h (in critical areas for new large meters)
  Review of annual network modernization operations;
  Analysis of network operations in emergencies
  Reliability Plans for the Medium Pressure network
  Emergency operational plans when the receiving stations break down
  Graphic display of geographic distribution of leakages
  Location of materials

- Our fleet is provided with GPS
- Our operative sectors are divided territorially and by pipeline type (main or service lines)

6.5 Question: Any unique approach to increasing public and customer safety?

- We have developed a so-called “Pipeline Safety Indicator”. It allows us to compare sections of a network or whole networks in relation to safety. The indicator is just introduced to our fellow network companies and will be used in our country branches. Our detailed renovation and repair program will be based on the combination of the indicator and our risk analysis model.
- We have developed a best practice emergency response and management service, in order to face all safety needs coming from customers and general public, from the small leakage from the gas meter to the large third-party damage on high pressure networks. We do our best from the call-centre (managed and operated by technical skilled and well experienced personnel) to the operators on the field, continuously trained for the different situations. We cooperate and we coordinate with the Fire Department. We develop predictive models to preview the amount of incoming calls, in order to have always the right amount of people available 24/7
- Public advertisement on correct gas use and security standards
- Training for local hydraulic craftsmen on gas related laws and standards
- Joint training programs with AMGA personnel and Authorities (i.e. Firemen)
- External and easily accessible valve insertion onto riser pipes to intercept gas flow to the building
- Setting the density of our gas smell, higher than the value provided by the law
- Installation of Excess Flow Valves on residential services 15, 60, 120 PSI design

6.6 Question: How do you increase employee safety?

- A yearly goal is set with top management linked to staff accidents – monitored by means of a frequency ratio indicator Tf.
- For each staff accident, the event is thoroughly analyzed in order to extract and update good practices.
- To increase employee safety we develop specific training programs together with searching and application of the best Protection Devices, specific for the single activities; moreover we search and adopt the most up-to-date instruments, together with the definition of specific procedures for relevant operations (for example to manage toxic materials, as asbestos, etc.)
- Morning safety huddles each day with all employees
- Tailboard talks before each job to review all aspects of the job, especially safety
- Recognition for outstanding safety performance

6.7 Question: How do you co-ordinate operations with other utilities?

- Meetings are organized at the beginning of the year by municipalities, joining all the utilities. Global business plans for development or replacement are presented by each utility (extension, renewing of networks, re-engineering,) on a scale of 2 or 3 years. A new meeting is organized in June to finalise the planned works for year (n+1). A final meeting takes place

in December to conclude the coordination talks and establish a work plan. There is also a will of trying to share the mapping systems of different utilities

- When we construct a new pipe, we often have an adjustment meeting to coordinate and determine the term of construction works, the pipe burring position (depth, the isolation distance between pipes) and so on, with other related utilities and municipalities concerned. By using this procedure, we can avoid generating repeated excavations

6.8 Question: How do your company standards exceed those of the national regulator?

- In relation to grey cast iron pipeline replacement, we started a scheduled replacement programme years before this was agreed with the Energy Authority; moreover we adopted a set of criteria not defined yet by the Authority and the National Standardisation Body (and that probably will be the guidelines for the next national standards). On the same issue, our replacement rates are higher than the levels defined by the Authority
- The odorant level in our distribution networks exceeds the levels imposed by the standards (almost double)
- For maintenance activities as well (for example on pressure reducing regulators) we do many activities not requested by national standards

6.9 Question: How do you establish your maintenance schedules?

- The concept of RCM (Reliability Centered Maintenance) is implemented for the time being, to define the maintenance plans (action in progress). So the plans (the actions to perform on each equipment and the periodicity) are defined in accordance with the gravity of the failure (for safety, loss of gas and cost of repair) and its probability to exist
- The optimization of this plan will be based on the analysis of the reliability of the system
- We have an arranged database of gas-leak survey history. Based on this database, we evaluate the safety risk (gas leak probability) of each gas pipeline route, according to the material, the size, and the laying environment of gas pipe underground (ex. soil, over crowdedness level of house), and we replace old pipes with new ones based on our priority level.

6.10 Question: How do you continually improve your technical processes?

- We share experiences with other distribution companies both at home and abroad, and we monitor new products and technologies available on the market.
- Normally we work together with our suppliers developing new equipment and tools for improving our daily jobs. Also practical procedures are routinely checked in order to improve and eliminate incorrect actions
- We regularly have an opinion exchange between “the technological development section”, “the pipe construction section”, and “the maintenance section”
- We also have the management cycle of “collecting and evaluating technological needs (or seeds)”, “decision of the theme”, “execution of the development and monitoring”, and “evaluation after the method is installed”
- By monitoring and tracking newly implemented Best Practice
- Monthly Scorecard reviews to measure performance, accountability

- Monthly meetings with Senior Field Supervisors

6.11 Question: Do you use new technologies to improve performances?

- Mobile tools with GPS technology for operation and maintenance (under development)
- CMMS (Computerized Maintenance Management System (or Software)
- Lining of services and mains is done wherever it makes economic sense
- A new service tee (NIST) is used to transfer an existing service from an old main to a new main without interrupting gas service to the customer
- Directional piercing tools are used to bore under roadways where a trench is impractical or not allowed
- RENU, a trenchless technology for renewing low pressure services, is utilized on newly paved streets with street moratoriums and homes with inside meter sets with finished basements
- Pipe splitting and pipe pushing are utilized where size-for-size replacement is required
- Use of advanced plastic materials to advance the use of plastic over metallic materials in new and replacement installations
- Builder sponsored Excavating for new service installations
- CCTV – Internal camera inspection equipment

6.12 Question: Is employee's level of education important?

- We consider that having employees with a high level of education will improve the efficiency of our activity. For this reason we push our employees to complete or start technical studies to improve their knowledge about the gas activity. We support with funding and special leave requirements
- Each training program is individualized. Each year, all employees have the occasion, during their individual meeting with their close management, to discuss and agree on a training session for the next year
- Global feedbacks allow us to adjust the training program in accordance with the requirements.

6.13 Question: Have you registered any patents for the techniques you use?

- Yes, for an automatic-remote controlled domestic gas meter.
- Yes: optical fiber positioning inside working gas main
- About 5-10 patents every year
- For example, new surrounding technologies concerning "gas pipeline trenchless (Non-open cut) construction method", or "a new pipe material (ex. polyethylene piping), or "pipe joint method (ex. Steel gas mechanical joint, Automatic pipe welding machine)", or "new type of gas meter (ex. automatic monitoring function)", "remote surveillance technology (ex. control or acquire gas transportation pressure and flowing quantities)"

6.14 Question: Any innovations in construction?

- In the construction phase, we have a recycling procedure:
  a. for unused PE materials,
  b. for excavated soil materials

- Where 100% soil removal is required, the soil is recycled through a soil screener and reused instead of being sent to a landfill.

- Non-destructive inspection of plastic pipe joints, and the use of coiled piping where possible.

- We are engaging in the recycling of plastic piping materials.

- Electronic Itemized Materials order for project work

- Bundling/direct shipping of required project materials to contractors

23nd World Gas Conference June 5–9, 2006 Amsterdam, NL

Report of Study Group 4.3

"ROLE OF R&D & TECHNOLOGY IN GAS DISTRIBUTION"

Rapport du Groupe d'Étude 4.3

"Rôle d'I&D et de la Technologie dans la Distribution de gaz"

Coordinator/Coordinateur

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“Role of R&D & Technology in Gas Distribution”

Abstract

Over the last few years, the gas industry worldwide has been seeing a downward trend in its investments in research and development. This trend is particularly significant in research projects concerning distribution studies. In parallel with this, the last decade has brought a liberalization drive that has fragmented the value chain in gas industries.

This report seeks to investigate whether these two circumstances are linked as cause-and-effect or whether they are two independent phenomena coming at the same time, and also whether their impact is comparable in all geographic areas or whether it is focused on certain specific areas. The future of research and development in the gas-distribution sector is also analysed, and potential pathways in developing future projects for the new context encountered in the sector are considered.

Extrait

L’industrie gazière mondiale voit diminuer ses investissements en recherche et développement depuis quelques années. L’effet se fait particulièrement sentir en matière de projets de recherche appliqués aux études de distribution. Parallèlement, nous vivons depuis une dizaine d’années un procès de libéralisation qui a fragmenté la chaîne de valeur des industries gazières.

Dans le présent rapport, nous cherchons à déterminer s’il y a un rapport de cause à effet entre ces deux phénomènes, ou bien s’ils sont indépendants et coïncident dans le temps, et si leur impact est le même dans toutes les régions géographiques ou se focalise sur certaines en particulier. De plus, nous analysons l’avenir de la recherche et le développement dans le secteur de la distribution du gaz, en envisageant diverses voies pour mettre au point de futurs projets pour le nouveau contexte du secteur.

Report of Study Group 4.3

"Role of R&D & Technology in Gas Distribution"

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Appendix II- STUDY GROUP MEMBERS

1.0 INTRODUCTION

Energy-market liberalization and deregulation, whether in general or in the gas market in particular, is aimed at giving end users the opportunity to choose their suppliers as they wish and at fostering a more competitive industry, and it is a trend that is spreading all over the world. This liberalization process has a strong influence on every area of distribution activities, on end prices and on company revenues. In this context, regulatory bodies and customers themselves expect distribution companies, which are inherently monopolies, to be more efficient, reactive and more competitive in terms of costs.

In this new scenario, the distribution company no longer owns the gas flowing through the networks and the auxiliary systems, though any gas lost or unaccounted for is its responsibility.

Metering, which has always been a major concern among distribution companies, has now become a critical issue with a direct bearing on the company's bottom line, and new tasks are appearing in connection with this aspect. These tasks include the need to draw up gas balance sheets regularly in order to demarcate the economic and technical relations between the various operators of the system (brokers in distribution, brokers in transmission, transportation companies, storage companies and so on) and the need to make it possible to bill each customer only for the gas actually used.

Replacing the traditional emphasis on promoting the use of gas and providing value-added services for the product's end users, the industry is now focusing on cost-cutting and process efficiency as the driving forces behind the strategies of gas distribution companies. Moreover, managerial, financial and results-oriented issues are taking over as the top priorities for action, to the detriment of technological requirements, which seem to have lost their former role as the driving forces for R&D in gas distribution.

In view of this outlook, the WOC-4 Study Group 3 of the IGU has examined the current R&D situation in the gas distribution sector and its future evolution, as it can be foreseen by gas operators. Specifically, the aim was to consider what role gas distribution companies should be playing as regards R&D; whether margins and critical mass are sufficient for investment in R&D; and who is to finance the R&D and how.

All data in the report refer to year 2004, with some exceptions that refer to the year 2003.

2.0 CONCLUSIONS

The deregulation and liberalization processes running in the Gas Industry throughout the world are effecting the business of the Industry itself and in particular have changed the approach of the players towards activities that have been traditionally developed until recent past.

Nowadays Distribution Companies are facing new tasks, while their role in the Gas Business has changed. The business focus is now orientated on short-term results, together with cost-cutting targets.

This situation has brought a new approach to their activities and to Research and Development in particular, analyzing the need to maintain the R&D level of development, to look for different financial resources, and to propose new approaches to develop R&D projects.

The outcomes of the study developed by SG 4.3 show that:

1. From a "financial" point of view R&D shouldn't be developed anymore, as Distribution is operated through a mature technology, with no need for further economic efforts on developing it; on the other hand from a "technical" point of view operators feel clearly that R&D must be still developed, but with a great capability to focus and address the most relevant issues that Distribution Companies are now facing: R&D must become one of the main keys for companies' competitiveness in the new industry scenario.

2. Actual approach is not homogeneous around the world, as it is possible to identify three different areas:
    a. Asia, where there are still significant investments on R&D both through the availability of adequate budgets and the direct involvement of companies' employees
    b. Europe, where (with differences due to variety in size of the players) budgets permit to maintain some activity on R&D, and R&D programs are developed mainly through the outsourcing of the activities
    c. USA & Australia, where budgets for R&D are small (although in USA are rising in the near future) and the activities are completely outsourced

3. Liberalization processes generate new needs for R&D in distribution (e.g. related to balancing and metering activities), that must be approached together with the need to reduce companies' costs

4. Costs of R&D should be recovered in tariff system: this means that Distribution Companies must show the benefits to the Consumers coming from their R&D activities (e.g.: increase of safety, increase of reliability, reduction of the environmental impacts, etc.)

5. The approach to R&D must be through what can be defined "Collaborative Research": this is clearly seen as the only future approach for R&D for the Distribution Sector, as "free-riders" will not be anymore an alternative.

The experts of SG 4.3 consider that main recommendations coming from the study are:

- it is necessary to keep a balance between financial restrains and technology needs, in order to enable long-term benefits for the companies, as well as short term results;
- R&D activities must be focused clearly on highest priority topics, targeting cost reduction and effective benefits for the customers, without abandoning the efforts to maintain the actual safety and reliability levels of the networks; among them improving information technology in distribution systems.
- The approach must be the "Collaborative Research" one;

Authorities must give the right importance to R&D processes also in Gas Distribution, to guarantee the safety and integrity of the gas sector in the future and allow the cost of R&D to be included in gas rates.

3.0 OVERVIEW OF THE GAS DISTRIBUTION SECTOR

3.1 Data Sources

The IGU WOC 4 SG 4.3 group compiled its information on gas distribution and associated Research and Development (R&D) work through a questionnaire sent to the members of IGU WOC 4. The information below is based on the 25 replies obtained from companies and associations in 18 countries, broken down by regions as follows:

Table 1: Breakdown of the replies received

Continent	Number of countries	Number of Companies
Europe	12	15
Asia	1	3
America	4	5+ 1 Association
Oceania	1	1

The questionnaire asked for information on the R&D work pursued and also for statistics on the company or country concerned, in order to be able to establish correlations among the data.

3.2 Data Representativeness

The respondent companies supply gas to over 172 million natural gas customers, which amounts to approximately 75% of the total world customers of this energy source. The companies represented in the report have distribution networks totaling more than 2 500 000 km.

The replies show a panorama featuring various degrees of liberalization, reflecting the situation of the gas industry the world over. It is therefore concluded that this set of replies is valid and allows work to be done objectively and fruitfully.

3.3 The Regulatory Scheme

The regulatory environment in the gas sector has changed a great deal over recent years, and will probably go on changing. The first substantial change is the liberalization of the natural gas market and its opening up to competition. See Figure 3.1 for a summary of Deregulation levels by regions.

The data in this Report come mainly from countries and companies in which the market has already been opened up to competition. The situation at the start of 2004 was as follows:

- Fully deregulated sector: 58%
- Partially deregulated sector: 25%
- Non-deregulated sector: 17%

NOTE: one of the non liberalized markets was liberalized at the end of 2004

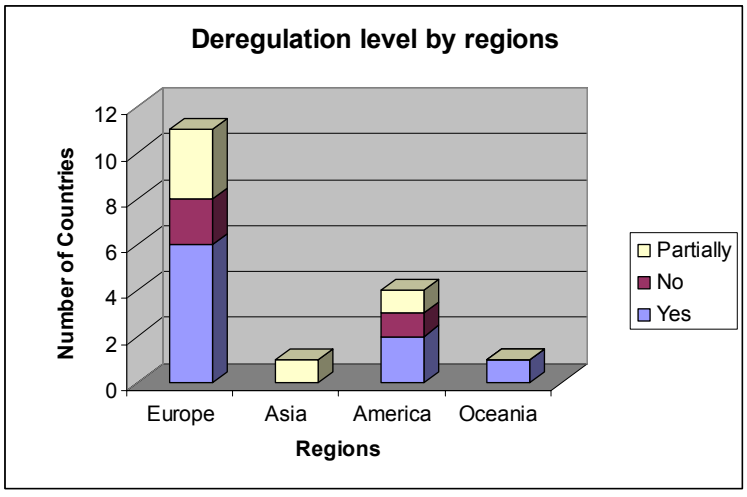


Fig. 3-1: Deregulation level by regions

In general, in deregulated environments, distribution companies are responsible for the metering, for producing gas balance sheets and for dealing with domestic emergencies, all without any additional remuneration. There are only two instances of countries (UK and NL) in which special companies have been set up to take charge of the various metering-related aspects of the business.

The characteristics of the gas sector in the respondent countries can be summarized as follows:

- The number of gas distribution companies operating in the country varies from one (Slovakia, United Kingdom) to 1,400 (USA)

  - In some countries, a large number of local distribution companies still exist. This is the case in Germany (some 700 companies), Italy (561 companies), Japan (233 companies) and the USA (1,400 companies).
  - A second block of countries features a moderate number of companies: Brazil (21), Canada (10 majors, and around 20 of smaller size), Colombia (26), France (approximately 10), the Netherlands (14), Serbia and Montenegro (30) and Spain (around 25).
  - The other countries have fewer than 10 gas distribution companies.

- The number of shippers using the networks of the respondent companies can sometimes be as high as in Ontario in Canada where there are around 120, or the United Kingdom with an average of 70 operators. The usual arrangement, however, is for each distribution company to have no more than about twenty clients (i.e. shippers using their networks to transport gas).

3.4 Distribution Systems

Summarized below are the technical data on the current situation of distribution systems:

- The materials most commonly used in networks with maximum operating pressures around 5 bar ("low pressure" and "medium pressure" networks) are polyethylene, followed by steel, though ductile cast iron still has a strong presence in Asia, and gray cast iron still accounts for a significant share in Europe, America and Oceania. For systems withstanding higher pressure values, steel enjoys a pre-eminent position.

- In Europe (fig. 3-2) there is complete predominance of polyethylene (PE), given that it accounts for somewhat more than half the existing network. The remainder is divided up mainly between steel and gray cast iron (each with virtually the same share), and ductile cast iron has a small presence.

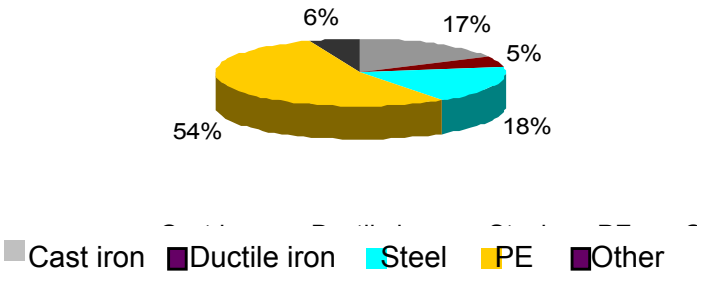


Figure 3-2: Europe

- In America and Oceania (figs. 3-3 and 3-4 below), the two most widely used materials are (PE) and steel. As in Europe, virtually half the networks use PE, although steel networks account for a significant two-fifths. Grey cast iron also has a small presence, and ductile cast iron is even smaller. Thus we are dealing with systems featuring very low maintenance requirements, except in the case of the gray cast iron systems.

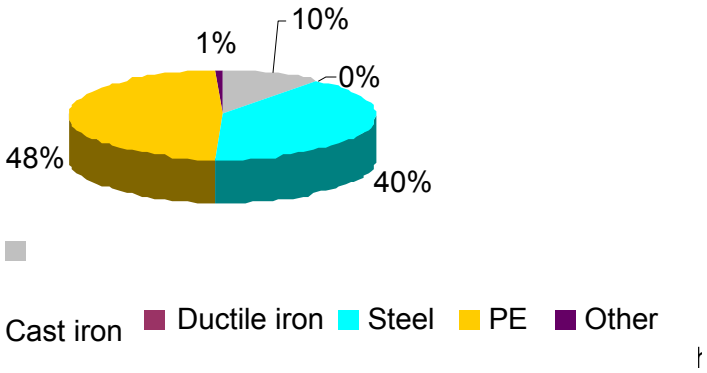


Figure 3-3: America

NOTE: Includes data from just two USA companies

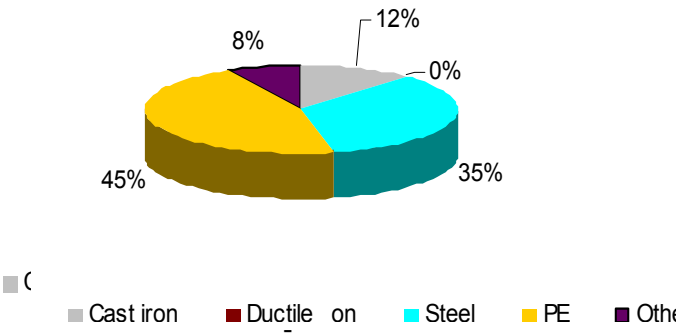


Figure 3-4: Oceania

In Asia (Fig. 3-5), however, the materials that predominate are steel, which accounts for nearly half the networks, and ductile cast iron, with nearly a third. Polyethylene accounts for only a fifth, which is in clear contrast to the other continents, where polyethylene is predominant.

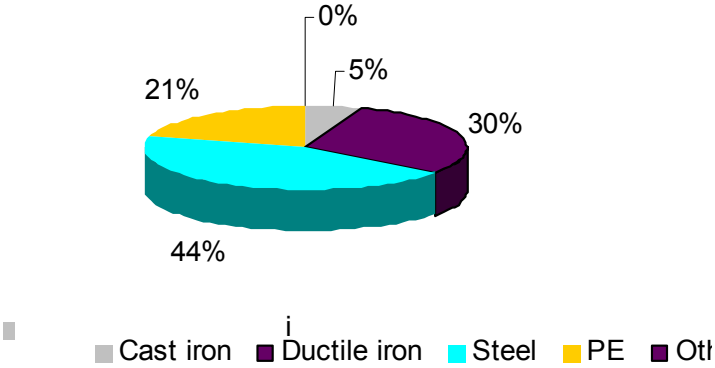


Figure 3-5: Asia

In absolute terms, over 168,000 km of gray cast iron pipe still remains, 101,000 km of which are in Europe and 67,000 km are in the USA.

3.5 The Age Of The Systems

As distribution systems age, maintenance and rehabilitation work takes on increasing significance in the distribution company's work as a whole. The average period over which gas distribution systems have been in service is around 26 years

(see Fig. 3.6), wherefore in general they may be regarded as very young infrastructure systems.

By continents, the oldest pipe systems are in America, where the systems have been in service for some 5 years longer than the world average.

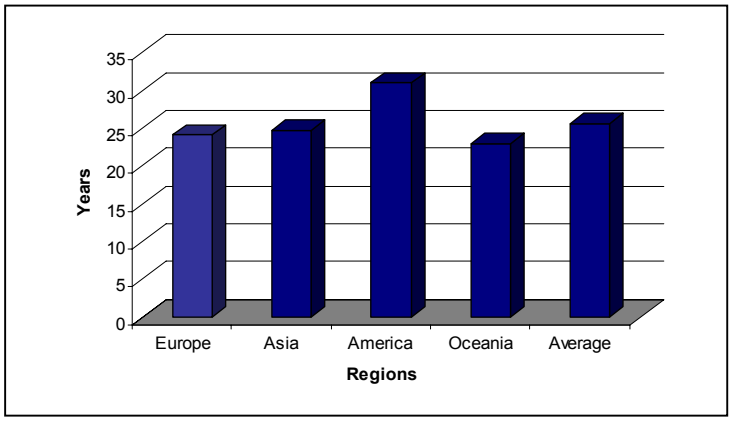


Fig. 3.6: Average age of gas distribution systems

65% of the companies have plans to replace their gray cast iron pipes, with 57% intending to replace it with steel pipes. Similarly, 74% of the companies have projects in place to cut back on the costs associated with the maintenance of their systems.

3.6 Investment Activities

Generally speaking, there is little sign of activity in building new distribution networks. The average ratio between the length of new piping added every year and the length of the pre-existing piping network is about 4%, wherefore it can be said that the gas distribution sector has reached maturity (except for specific areas where distribution networks are now developing, e.g. South-America).

This is corroborated by the fact that two regions (Asia and Oceania) have an annual network-growth factor equal to or less than 2%, as shown in Figure 3.7:

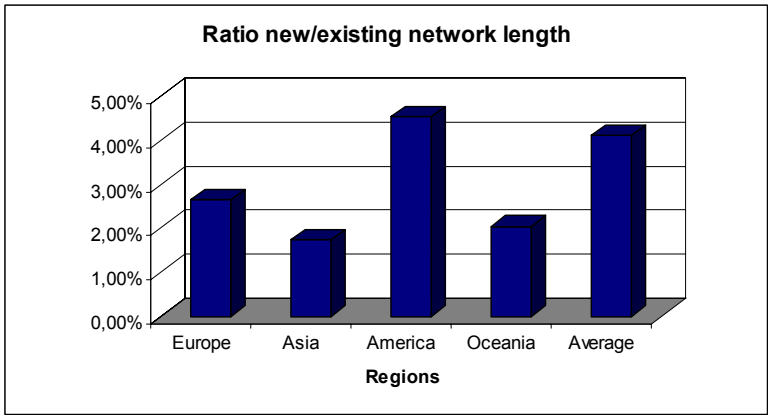


Fig. 3.7: Network growth factor

3.7 System Saturation

The volume of gas piped by companies every year is shown in Figure 3.8. Most of the companies pipe over 1000 $Mm^3(n)$/year and nearly half reach almost 10,000. There are two companies that go well beyond this figure (30,000), with one almost reaching the 70,000 mark.

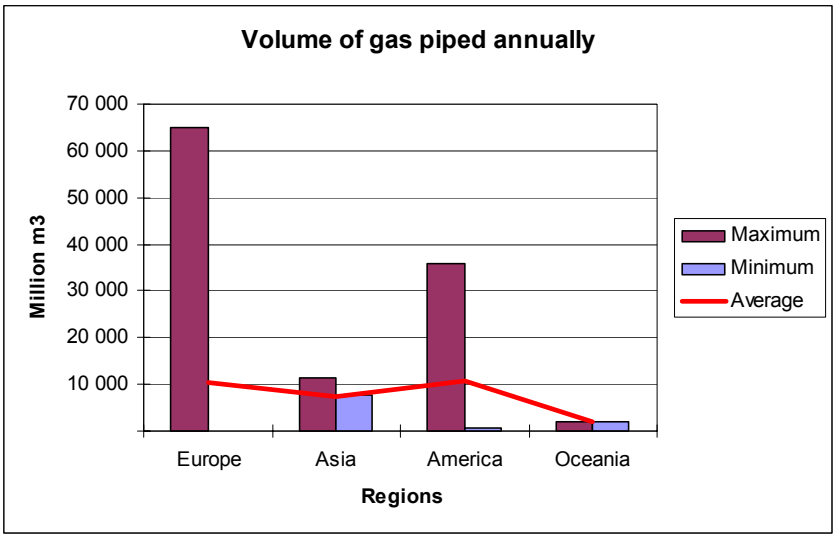


Fig. 3.8: Volume of gas piped annually

However, the results are rather more evenly matched if the comparison is based on the amount of gas piped every year per km of network (see Fig. 3.9), since for most companies the amount of gas piped per km of network lies somewhere between 0.15 and 0.4 $Mm^3(n)$/km, the average being 0.3. Indeed, there are only two companies attaining much higher values: one with almost 0.8 $Mm^3(n)$/km and the other with over 1.2 $Mm^3(n)$/km.

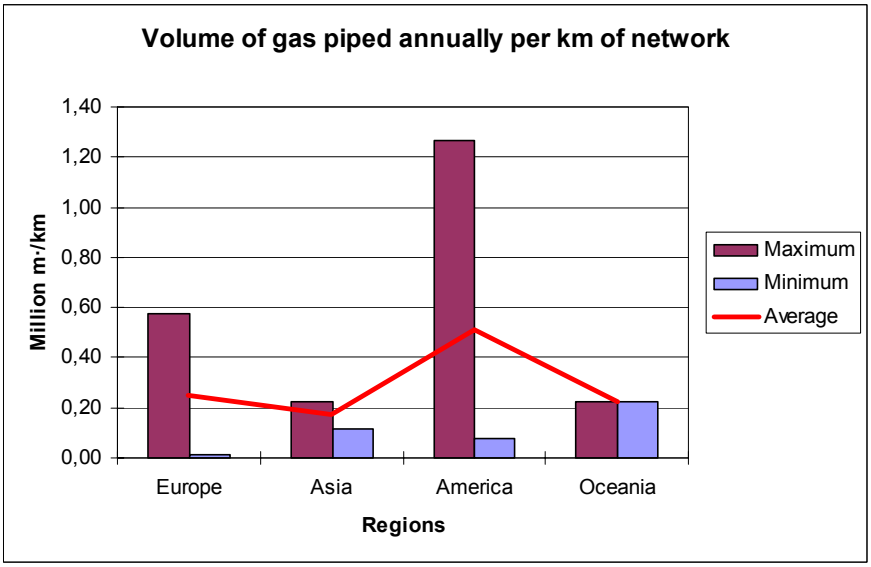


Fig. 3.9: Volume of gas piped annually per km of network

3.8 THE WORKFORCE SITUATION IN DISTRIBUTION COMPANIES

The number of employees engaged in distribution varies widely depending on the size of the company. However, if the comparison is based on the number of employees working in distribution for each 1000 km of pipe network, the result is fairly uniform (see Fig.3.10). Two thirds of the companies have between 20 and 50 distribution employees per 1000 km, a fifth have 50 to 100, and just two companies go well beyond those values, having around 200 and 250 employees respectively.

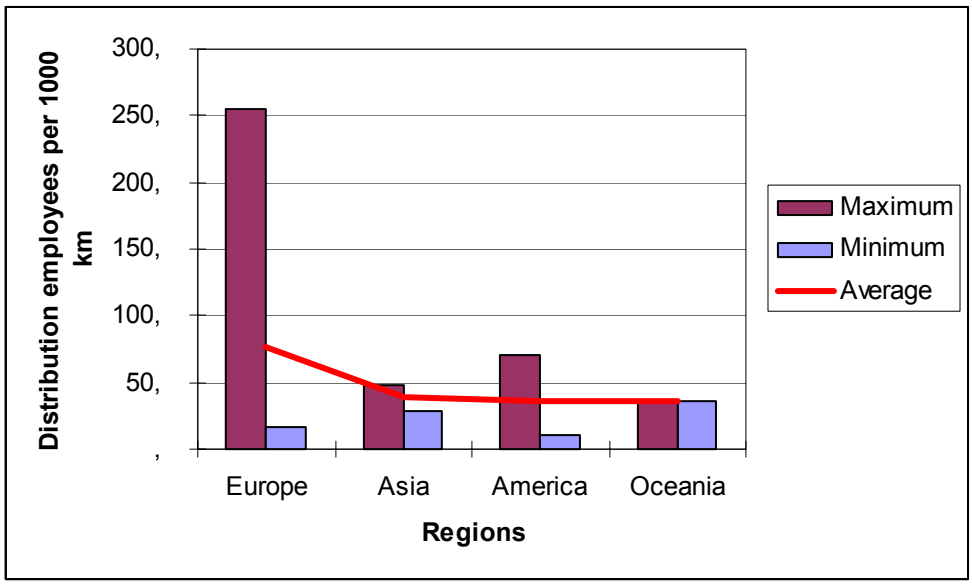


Figure 3.10: Number of distribution employees per 1000 km

The number of employees engaged in R&D, when there are any, ranges from 1 to 600 (see Fig. 3.11), though in R&D work on Distribution the range is 1 to 100. This figure indicates that companies that remain committed to R&D nonetheless do not regard the distribution field as a high priority for research and development.

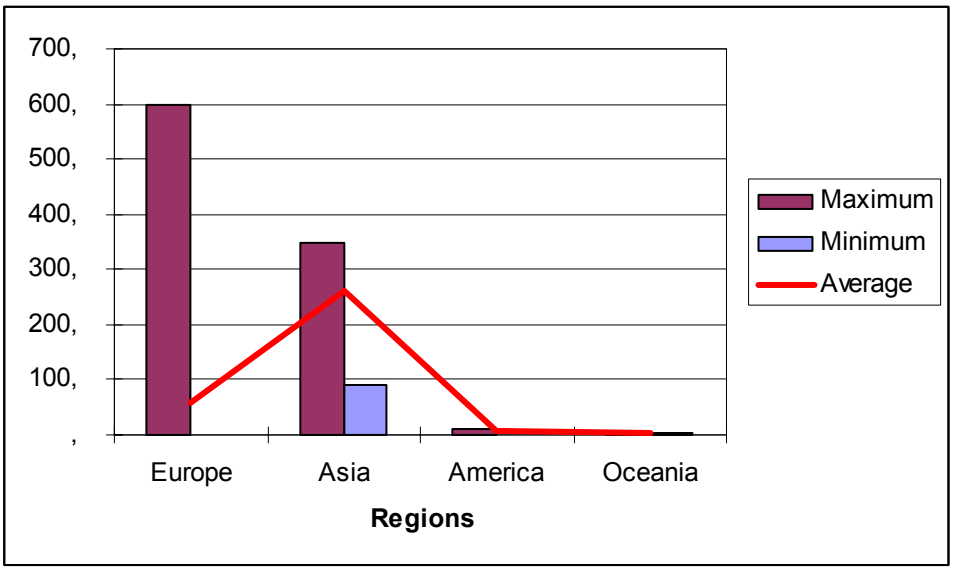


Fig. 3.11: Number of employees engaged in R&D per Company

The distribution of employees engaged in R&D by continents is revealing: in Europe and Asia, distribution companies still devote significant resources (57 and 261 R&D employees per company respectively), while in Oceania and America almost none are engaged (2 and 7 employees in R&D per company respectively).

If we look at the concentration of R&D employees for a given length of distribution network, it becomes clear that most of the companies – over three fifths of them – have no more than 0.5 employees in R&D per 1000 km of pipe, though there is still a group, amounting to 20% of the companies, that continues to commit to considerable R&D work, with more than 4 R&D employees per 1000 km. See Figure 3.12.

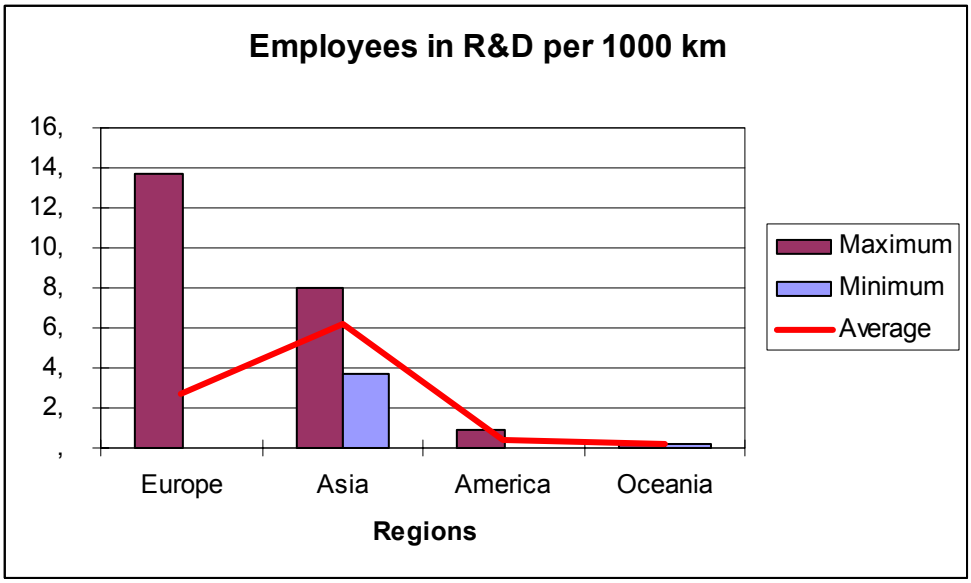


Fig. 3.12: Employees in R&D per 1000 Km

Comparing the numbers of distribution staff engaged in R&D with the numbers engaged in distribution as a whole results in an average value of just 3%, though with great dispersion from company to company.

Even though most companies have their own staff directing the projects, R&D outsourcing is common practice for most of the respondent companies. Outsourced R&D is thus becoming a new model for new times, and it is just as valid as the traditional model.

It can be deduced from the analyzed data that:

- There is a direct relationship between the maturity of liberalization processes and the reduction of R&D work.

- R&D is thus shifting away from the core group of activities in gas companies and is moving towards specialized technology companies and manufacturers.

4.0 THE FUTURE ROLE OF R&D

Study Group 4.3 endeavored to investigate whether R&D could help to meet company needs in areas such as cost cutting, operational safety, reliability, deliverability, control over the gas, supply balance, and environmental aspects.

Table 2 summarizes the R&D activities where distribution companies devote their efforts, and they are referenced to related areas stated above.

Table 2- R& D Activity Areas

	Related area						
R&D activity	Deli-verabi-lity	Supply balance	Opera-tional safety	Control over the gas	Cost cutting	Envi-ron-mental aspects	Relia-bility
Computerized network analysis/management	X	X					
Aspects relating to leak and deterioration points detection and/or repair			X	X	X	X	
Optimization of pipe material design					X	X	
Work on the safety of receiving facilities	X		X	X	X		X
Cartography optimization and computerization work			X		X		X
Computerized workforce management			X		X		
Optimization of construction designs for receiving facilities			X		X		X
Developing new rehabilitation techniques for old pipes			X	X	X	X	X
New pipe-laying and supply-point building techniques					X	X	X
Work connected with gas metering		X		X		X	
CRM (Customer Relationship Management)	X	X					
Pipeline Contaminants (i.e.: PCBs)			X			X	
Maintenance car for mobile workforce (including mobile technologies)			X		X		
Odorization (Sulphur free)			X	X			
Gas stop (self closing tapping tee)			X	X			
Polyethylene pipes					X		X
Network remote control systems	X		X				
Risk Management, Network Safety and Network Efficiency	X		X				X
Trenchless Technologies					X	X	
Keyhole repair technologies					X	X	
Underground utilities location			X				
Direct assessment							X

It can be clearly seen that efforts are devoted mostly to operational safety and cost cutting.

4.1 On What Criteria R&D Projects Are Based?

As it can be seen from the data in Table 2, the distribution areas where most R&D projects are developed are operational safety and cost-cutting, though work on reliability and environmental aspects is also important.

- Most of the companies (64%) believe that R&D "is essential for distribution companies in order to remain competitive," while 56% of the respondents believe that "R&D in the area of distribution only makes sense when it is geared towards cutting costs."

- Companies take the view that R&D is a necessary tool for developing and improving their technology. Sixty-four percent of the respondents disagree with the notion that "distribution companies do not need R&D since the technology they use is solid enough already".

In other words, most believe that there is still room for improving distribution technologies.

By regions, views on this aspect are not so clear: this position is embraced in full in Asia and Oceania (100%), but the degree of support diminishes in Europe (60%) and in America, where support amounts to only 40%. See Figure 4.1.

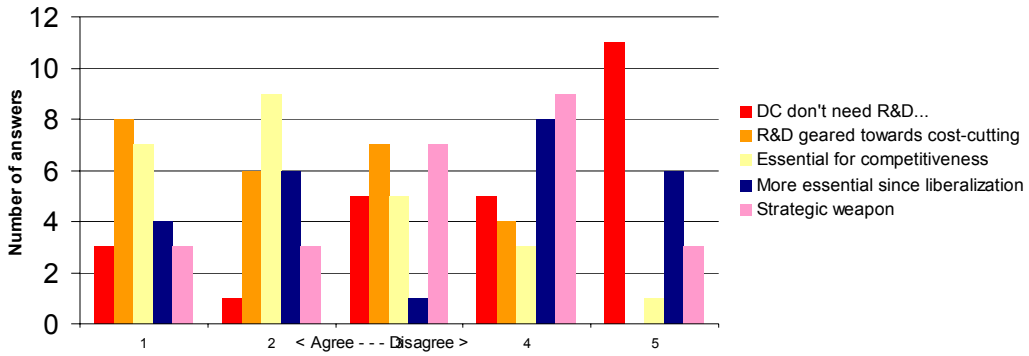


Fig. 4.1: Why do companies commit to R&D?

- The survey results show a clear divide in opinions on whether "R&D has become more essential since market liberalization in order to enable distribution companies to offer the best service to the shippers."

- And lastly, it is clear that for most gas distribution companies, "R&D is not being considered by management as a strategic weapon for consolidating the company's position."

4.2 What Should The Priorities Be For The Future?

The highest priority, according to the opinions gathered, should be **improving distribution systems** (increasing safety and reducing operational and construction costs).

Even though strictly speaking it cannot be regarded as a distribution activity, **electricity generation** (cogeneration/fuel cells) using natural gas is one of the next activities in order of preference, as is **improving information-technology systems (IT)** such as through systems integration, etc.

Other priorities include the following:

- Odorization (sulphur free).
- Developing new technologies for maintaining pipe integrity.
- Bringing in new materials for piping.
- Coordinating IT support between the municipal authority and the distribution company.

4.3 How Should Future Projects Be Implemented?

In the short-term future, cooperation and joint funding between companies for pursuing R&D projects in distribution are still the preferred option. Hardly any of the respondents see arranging projects independently as a viable alternative.

Total R&D budgets are highly dispersed, since most of the companies that sent in data (60% of the respondents) have very low budgets – less than $5M/year – which is logical in view of their stance as outlined above.

If R&D budgets are analyzed in terms of network length, the results are revealing: Asian and European companies whose markets have not yet been deregulated still maintain R&D budgets above $2000/km-year (see Fig. 4.2), while American companies and the rest of the European ones do not exceed $100/Km-year.

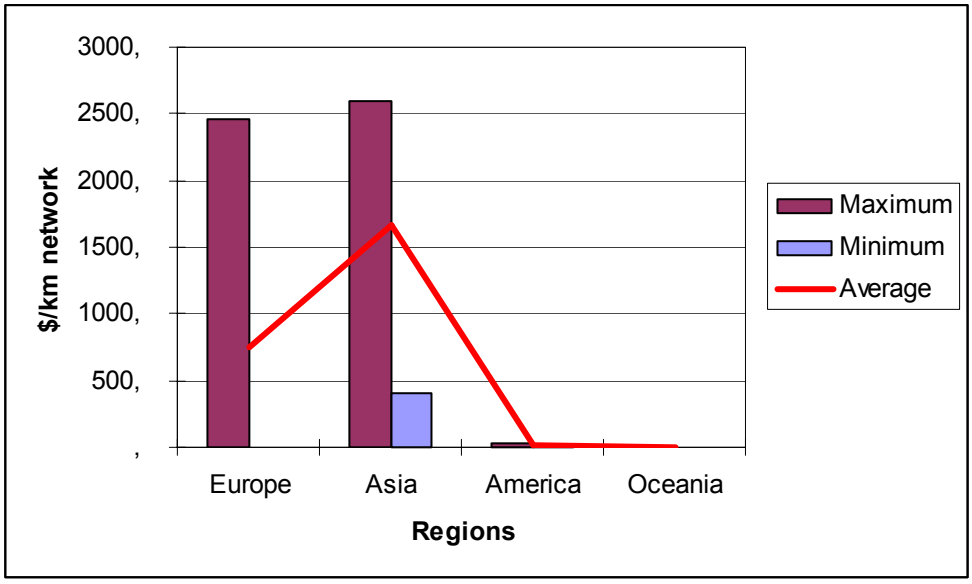


Fig. 4.2: R&D budget in terms of network length

When correlated with number of customers, the R&D budgets of most companies are more uniform: nearly half the respondent companies have budgets that are below $9000/year per 100,000 customers, while the other half have budgets that are between $140,000 and $412,000/year. See Figure 4.3.

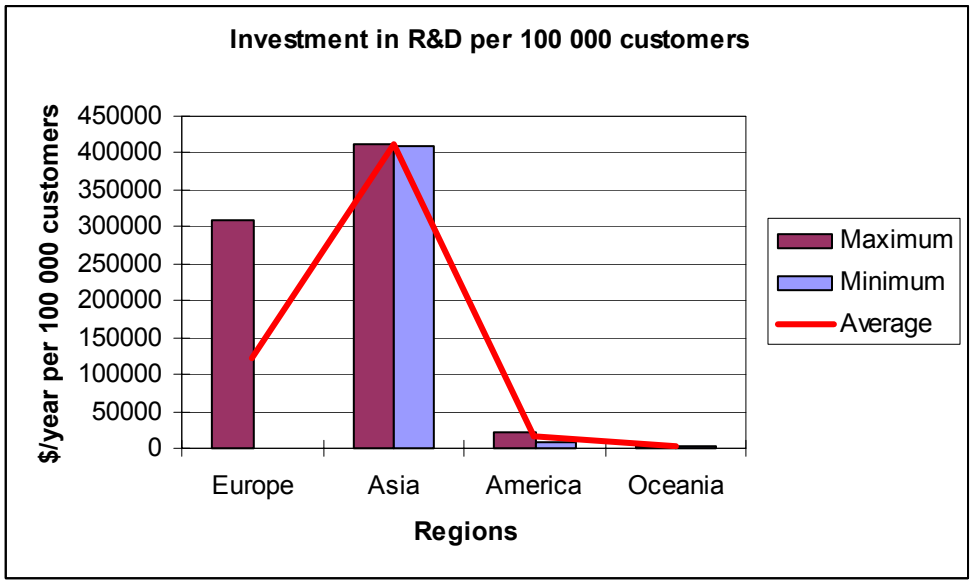


Figure 4.3: R&D investment per 100,000 customers

Correlating the respondent companies' R&D budgets with the total volumes of natural gas delivered in the country as a whole gives a ratio for most of the companies of between $500 and $4000/$Mm^3$(n), with an average of $1840/$Mm^3$(n). See figure 4.4.

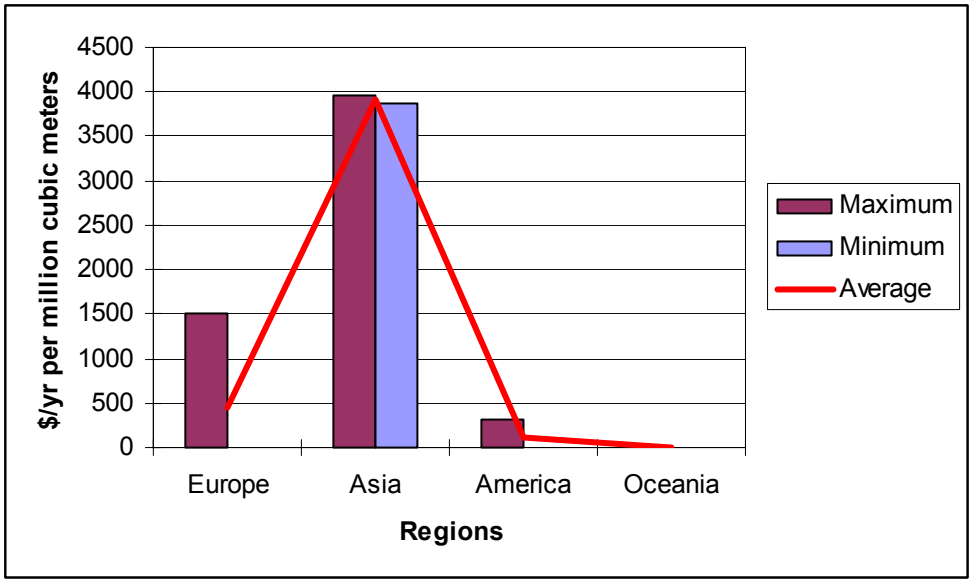


Fig. 4.4: R&D budget according to the total volume of gas delivered

4.4 Where Do The Funds For R&D Come From?

First and foremost, it must be stressed that, generally speaking, public funds are very scarce for R&D in distribution.

- The majority of the companies in different areas get tax breaks to help to finance their R&D.

- In Australia, Canada and some States in U.S.A. – companies manage to recoup 100% of their expenditure through what they charge their customers, although there is another company – in Bosnia Herzegovina – that manages to recoup 87%.

- Japanese and two European companies obtain funds for covering their R&D expenditures from national or local entities.

Consequently, most of the funds come from the shareholders – either completely (7 companies) or almost completely (90 to 96%, three companies).

4.5 R&D And The Liberalization Process

If the way in which companies approach R&D over the various phases of liberalization is analyzed, the effects of the liberalization process on the strategic approach to R&D in companies can be traced. In particular, if the responses of fully deregulated markets are analyzed in comparison with the responses of markets that are not yet deregulated, the following main differences can be discerned:

- In deregulated markets, R&D is perceived as essential for competitiveness, and it is geared towards cost cutting, while this is not the case in not-liberalized markets.

- In deregulated markets, R&D resources come from the funds of distribution companies, thereby directly reducing profits, while in not liberalized markets the funds are recouped through the base rates.

This is contradictory in the sense that it would appear that R&D should be an instrument for improving the efficiency of newly deregulated markets, and yet activity levels have fallen drastically since there are no formulas for financing the activity.

4.6 Are Companies Happy With The Present Situation?

The companies think that investment in R&D should be encouraged to enable them to maintain a solid technological base; however, financing this through the shareholders is rated as the worst option. This could be due to the sensitivity of the current scheme to the changes stemming from liberalization and the underlying need to cut costs. Contrary to the current scenario, most companies think that it should be possible to recoup R&D expenditures by passing it on through the base rates.

Alternatively, companies would be willing to arrange for R&D work to be carried out through associations of gas-sector experts, for example, using funds collected by the gas sector as a whole.

4.7 How Do Companies Handle Their R&D Projects?

R&D work is prompted mainly by the internal needs of a distribution company. However, and despite competition, agreements are very often made with other companies to share the costs and benefits of R&D work. These other companies may be from the same country and/or from abroad. Examples of projects pursued by the gas sector as a whole in a particular country can be found Australia, Canada, Denmark, Germany, Netherlands, Poland, Slovakia, Sweden and the USA.

Participation in international projects, however, is less extensive, although there are a few organizations engaged in promoting such projects. One such organization is the European Gas Research Group (GERG).

More information about these organizations and different examples of approach to R&D in gas distribution is provided in the Appendix.

APPENDIX I

APPROACHES AND BEST PRACTICES FOR R&D DEVELOPMENT IN GAS DISTRIBUTION

Operations Technology Development

Operations Technology Development (OTD) is a 501c(6) not-for profit corporation that develops, tests, and implements new technology, providing solutions to a wide range of issues relating to the operation and maintenance of natural gas infrastructure. It is designed to provide new tools, equipment, software, processes, or procedures that will enhance safety, increase operating efficiency, reduce operating costs, and help maintain system reliability and integrity.

OTD currently has 15 member companies, all of which are local distribution companies (LDC's) serving North America. Each member company votes with their funds when selecting projects of interest. OTD focuses its technology development efforts on distribution and transmission activities identified by the members. The RD&D program includes a mix of short-term (less than 3 years) quick-response research, engineering, or testing activities; and mid- to longer-term research projects (3-7 years to implementation). The current OTD projects are divided into the following six project categories:

- Pipe and Leak Location
- Pipe Materials, Repair and Rehabilitation
- Excavation and Site Restoration
- Pipeline Integrity Management and Automation
- Operations Infrastructure Support
- Environmental Science and Forensic Chemistry

OTD retains the assets of the Partnership. This includes the cash assets of the technology development budget and any intellectual property.

OTD does not have any employees. The Gas Technology Institute (GTI) has contracted with OTD as the Administrator to perform and complete projects; manage projects external to GTI; and work with the appropriate commercialization partner to introduce the product into the marketplace. GTI also utilizes its staff and resources to provide support in contract administration, financial accounting, and management of the new technology program.

Each OTD member company has a seat on the Board of Directors and the Technical Project Committee (TPC). The Board establishes the policy and procedures that governs the operation and conduct of the partnership, provides strategic guidance on program priorities, and sets long-term goals and objectives. The TPC identifies the overall operational issues to be addressed in the program, and the specific topics that will be the focus of individual research projects.

Annual membership dues are approximately $6.2 million comprised of individual dues that range from $250,000 to $750,000 per company. OTD leverages its resources by seeking co-funding of individual projects with state and federal governmental agencies that have common interests and goals as the OTD members.

For more information on OTD, please contact the OTD Program Administrator, Ron Snedic at 847-768-0572 or ron.snedic@gastechnology.org.

GERG

GERG (Groupe Européen de Recherches Gazières) is an organism composed of European companies or associations operating in the gas sector and carrying out research activities.

Objective

GERG was founded in 1961 in order to strengthen the gas industry within the European Community.

Its objective is to promote research and technological innovation in all aspects of the gas chain: exploration, production, transmission, distribution and utilization.

This objective is pursued through both the exchange of information among members and the carrying out of research projects.

Members

Presently the GERG members are: Association Royale des Gaziers Belges / Koninklijke Vereniging van Belgische Gasvaklieden (ARGB/KVGB) (B), Advantica (GB), BP (GB), Dansk Gasteknisk Center (DGC) (DK), Enagás (E), Gas Natural (E), Gassco (N), Gastec (NL), Gasunie (NL), Gaz de France (F), Italgas (I), Polish Oil and Gas Company (POGC) (PL), Ruhrgas (D), Snam Rete Gas (I), and Statoil (N).

The GERG structure is as follows:

The President represents GERG and chairs the Board and the Plenary Assembly. He is elected by the Board among all GERG members and remains in charge for two years. In the period 2005-2006 President is Mr. Eric Van Ingelghem of ARGB/KVGB.

The Board is chaired by the President of GERG and is responsible both for the management of GERG activities and for the efficient and effective gas R&D within GERG. It meets twice a year.

The Plenary Assembly is chaired by the President of GERG and comprises a representative from each GERG member. It has a specific decision-making responsibility with regard to the overall functioning of GERG. It meets twice a year.

The Programme Committees (PC) are made up of R&D staff from member organizations and are responsible for the technical work. Currently four PCs are active:

- PC General Studies
- PC Transmission and Storage
- PC Distribution
- PC Utilization

The Secretariat is responsible not only for the routine management of GERG affairs and activities, but also for the liaison with Marcogaz, Eurogas and other external organizations, in particular those of the European Union.

Activities

As stated before, GERG activities are carried out by the Secretariat and by the Programme Committees.

The Secretariat conducts strategic and political actions, maintaining strong links with the European Union and contributing to the discussion of policies on activities concerning natural gas in Europe.

On the other hand, it is up to the PCs to perform the most specifically technical work. It is inside the PCs that ideas are exchanged and common R&D projects are initiated and carried out.

When, inside a PC, some R&D topic turns out to be of interest for at least three members, a collaborative project is established on such a topic. A project may include non GERG members.

Some projects are self-financed by participants. Presently many GERG projects are proposed for funding to the European Commission within the relevant Framework Programmes.

Normally any exchange of information is on a non-confidential basis, but, in the event there is a need, a specific confidentiality agreement is set up.

GERG R&D Programme

The aims of the research projects promoted by GERG are:

- Maintain and improve safety in gas industry
- Reduce the environmental impacts of gas technologies
- Contribute to energy saving
- Reduce costs for gas utilities and general public
- Improve efficiency in gas utilization
- Find out new applications for gas (also through integration with renewable energy systems)
- Contribute to standards and technical procedures
- Maintain strong links with university research
- Support and improve the image of the gas industry.

In the following table, the value of GERG R&D programme is shown (in euro) at some fixed dates for the most recent years. The total value of the projects that are self-financed by members (self-funded) and of the projects that receive funds from the European Commission (EC-funded) is given.

	April 2002	*October 2002*	*March 2003*	*October 2003*	*March 2004*
Self-funded	13,258,000	14,911,000	15,136,000	13,316,000	20,847,000
EC-funded	9,609,000	11,109,000	10,694,000	9,413,000	17,100,000

As can be seen, the proportion of EC-funded projects is high and still increasing.

The R&D priority topics of GERG are:

- New methodologies for operation & maintenance of transmission pipelines
- Pipeline integrity management for transmission & distribution systems
- New LNG technologies
- Gas quality and thermodynamics
- Volume gas measurement, energy measurement and flow metering
- Interoperability aspects of gas networks
- Hydrogen & fuel cells
- New methodologies for operation & maintenance of gas distribution networks
- Natural gas vehicles
- Telemetering
- High efficiency/low emission processes
- Environmental improvement/sustainability
- No-dig techniques for construction & in-service inspection of distribution systems.

Address

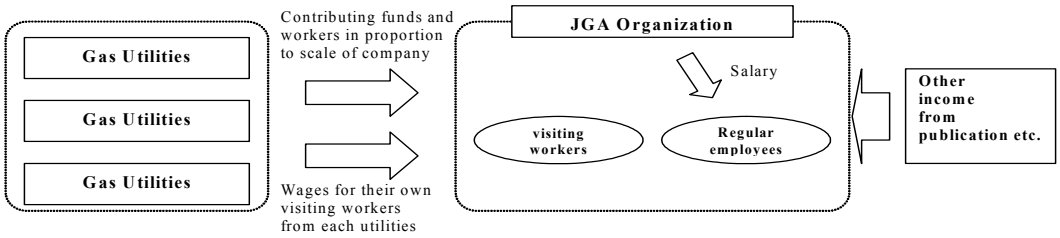
The GERG General Secretariat is located at:
Avenue Palmerston, 4
1000 Bruxelles, Belgium
Phone: 0032.2.2308017 - Fax: 0032.2.2306788
e-mail: gerg@arcadis.be - Web site: www.gerg.info

The R&D activities promoted by the JGA

Outline of the JGA

JGA (Japan Gas Association) is an organization composed of 215 Japanese gas utilities and some affiliated companies.

The activities of the JGA are extremely wide-ranging and it is an organization that combines the functions of the AGA and the GTI of the United States, making it an extremely rare organization in gas industries around the world. Its specific activities include aggressively contributing to the revision of laws concerning the deregulations, funding and implementing technological development that will improve security and expand the use of natural gas, leading efforts to revise various technological standards, helping overcome management challenges faced by small gas utilities, and handling negotiations with administrations concerning the provision of subsidies to projects that spread the use of existing technologies and that promote the improvement of safety. The following figure shows the feature of supporting the constitution of the JGA.



The system to keep JGA Organization

National R&D Projects implemented by the JGA

The main R&D activities of JGA consist of National R&D Projects which are fully funded by national budget. A big difference between the JGA and other industrial organizations is that in addition to negotiating administrative bodies, it aggressively promotes research and development and is closely involved in implementing this research and development and popularizing its results.

The reason why Japanese government contributes national budget to such objectives is related to its policy of expanding the use of natural gas and environment conservation. And generally, the amount of budget for this kind of R&D project is more than $5 million and the term of a project is less than 6 years.

Example of National Projects promoted by JGA

The following table shows specific examples of national projects conducted by the JGA. Projects related to gas distribution industry are mainly items shown in “Strengthening the foundations of the city gas industry”.

The list of National Projects promoted by JGA

(Including final themes)

Categories (Basic goals)	Project Name		Project period '02	'03	'04	'05	'06	'07	'08	'09
Advancing distributed energy technologies	Developing technologies related to Polymer Electrolyte Fuel Cells (PEFC)	Provision of the foundations for the spread of fixed type PEFC (Millennium Project)	→	→	→					
		Development of technologies for effective use of PEFC output	→							
		Development of hydrogen making technology based on the new PSA method	→	→	→					
		Development of hydrogen separation type reforming technology	→	→	→					
		Corroborative trial of a fixed type fuel cell	←	→	→					
		Project to Provide Common Foundations for the Construction of Hydrogen Companies: Fixed Type Fuel Cell System Foundation Provision (newly enacted)				↔	↔	↔	↔	→
	Development of a triple effect high performance absorption type hot and chilled water machine		→	→	→					
	Development of high efficiency compact natural gas cogeneration technology			↔	↔	↔				
	Hydrogen Supply System Safety Technology Survey Project (newly enacted)					↔	↔	↔		
Protecting the environment and conserving energy	Development of practical high efficiency super low polluting natural gas automobiles		→	→						
	Next Generation Low Polluting Automobile Development Promotion Project: Development and trial manufacture of super low polluting large trucks		←	→	→					
	Survey of supercritical methane technology		→	→						
Strengthening the foundations of the city gas industry	Development of gas pipeline leak countermeasure technology		→	→						
	City Gas Safety Information Publicizing Project		→	→	→	→	→	→		
	Survey of Bedrock Storage Technology		→	→						
	Development of next generation natural gas high pressure storage technology (ANGAS)				↔	↔	↔	↔	↔	
	Project to Develop Countermeasure and Renewal Technologies for Aging Pipelines on Customer's Property		→	→	→	→				
	Survey of the provision of safety standards for natural gas pipelines		↔							
	Super High Pressure Gas Pipeline Bursting Safety Survey Project				↔	↔				
	High Efficiency Natural Gas Supply System Safety Technology Survey Project (newly enacted)					↔	↔	↔		

* Plans after 2005 are predicted at this tim

For further information on the activities of the JGA, please refer to the paper **"The Outlook for Present Challenges Facing the Japanese Gas Industry and R&D Solution Methods Undertaken by the JGA"** or contact the IGU WOC4 Study Group 4.3 member ,Seita Shimizu, seita@tokyo-gas.co.jp

APPENDIX II

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