1. **Training in Cathodic Protection System Design according to International Standards and Best Practices" (AHEF GE-74)**
2. **"Training and Assistance in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines" (AHEF GE-75)**
3. **"Training and specification of GOGC Personnel in Construction Supervision (Non Destructive Testing-NDT and Pipeline Testing and Commissioning)" (AHEF GE-76)**

Combined AHEF GE74, 75, 76 REPORT

01 October -01 November 2013

Georgia /Greece

INOGATE Technical Secretariat (ITS) and Integrated Programme in support of the Baku Initiative and the Eastern Partnership energy objectives

Contract No 2011/278827

A project within the INOGATE Programme

Implemented by:

Ramboll Denmark A/S (lead partner)

EIR Development Partners Ltd.

The British Standards Institution
LDK Consultants S.A.
MVV decon GmbH
ICF International
Statistics Denmark
Energy Institute Hrvoje Požar

Document title	Training in Cathodic Protection System Design according to International Standards and Best Practices" (AHEF GE-74) Training and Assistance in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines" (AHEF GE-75) Training and specification of GOGC Personnel in Construction Supervision (Non Destructive Testing-NDT and Pipeline Testing and Commissioning)" (AHEF GE-76)
Prepared by	Achilleas Gekas, Rusudan Nonikashvili
Check by	Mark Allington (ICF), Nikos Tsakalidis (KE2), Albert Zweering
Date	September 2014

Contents

List of Figures

ABBREVIATIONS LIST

The following definitions and abbreviations have been used in this document.

3LPE	3 Layer Polyethylene
3LPP	3 Layer Polypropylene
A	Amperes
AC	Alternating Current
AGI	Above Ground Installation
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Material
BPD	Building Proximity Distance
CIP	Close Interval Potential
CP	Cathodic Protection
CPTR	Cathodic Protection Transformers
DC	Direct Current and Decoupling Devices
DCVG	Direct Current Voltage Gradient
DESFA	Hellenic Gas Transmission Operator Company
EN	European Norm
ESD	Emergency Shutdown Device
GIS	Geographical Information System
GOGC	Georgian Oil and Gas Company
GPR	Ground Potential Rise
HDD	Horizontal Directional Drill
HV	High Voltage
IGE	Institute of Gas Engineers
I/J	Insulation Joint
ISG	Isolating Spark Gaps
ISO	International Organisation for Standardization
ITS	Inogate Technical Secretariat
Kg	Kilogram
M	Metre
MFL	Magnetic Flux Leakage
MOP	Maximum Operating Pressure
mV	Millivolts
NG	National Grid
NORM	Naturally Occurring Radioactive Material
NDT	Non Destructive Testing
PC	Partner Countries
PCM	Pipeline Current Mapper
QA/QC	Quality Assurance and Quality Control
QRA	Quantitative Risk Assessment
RLX	Rail Crossing
ROW	**right-of-way** is a right to make a way over a piece of land, for transportation purposes (oil and gas pipelines, etc.)

SAC Signal Attenuation Current
SMYS Specified Minimum Yield Stress
SCP South Caucasus Pipeline (SCP) is a gas pipeline to transport gas from Shah Deniz field from the Caspian Sea to Turkey. It follows the route of the Baku-Tbilisi-Ceyhan (BTC) crude oil pipeline through Azerbaijan and Georgia to Turkey, where it is linked to the Turkish gas distribution system.
SPD Surge Protective Devices
TANAR Trans Anatolian Pipeline is a proposed natural gas pipeline from Azerbaijan through Turkey to Europe. The pipeline will run from Georgian–Turkish border to Turkish European border. TAP Trans Adriatic Pipeline Connecting with the Trans Anatolian Pipeline (TANAP) at the Greek-Turkish border, TAP will cross Northern Greece, Albania and the Adriatic Sea before coming ashore in Southern Italy to connect to the Italian natural gas network.
V Volts

Executive summary

Description of the seminars and the study tour

The Georgian Oil and Gas Corporation (GOGC) with three AHEF applications, requested ITS to train its personnel in European Methods and Standards for the Construction, Supervision and Commissioning of Gas Pipelines, for the Cathodic Protection of Existing and New Pipelines and for the Assessment Methods for Existing 'Non-Piggable'[1] Gas Piping Network.

Georgia plays a significant role in the security of natural gas needs of Europe. Georgia's foreign policy envisages facilitation of new transit projects and restoration and development of gas links with neighboring countries. Considering the growing export potential of gas from Azerbaijan and the strategic cooperation established between the two countries, it is foreseen to deliver natural gas from the Shah Deniz field in Azerbaijan and later possibly from the Central Asian countries to the Balkans and Central Europe via the Southern Gas Corridor, utilising the capacity of the South Caucasus Pipeline and the planned pipelines (TANAR, TAP). Via the same route, delivery to Europe of Turkmen natural gas is planned, when the Trans Caspian pipeline is constructed. Finally another option of delivery of Azerbaijani Gas to the European Markets is the Azerbaijan-Georgia-Romania Interconnector (AGRI LNG). It envisages construction of an LNG terminal at the Georgian Black Sea coast and a new interconnector connecting SCP to the Georgian trunk pipeline system will be used for implementation of AGRI LNG project on the Georgian territory.

Currently the GOGC is implementing an intensive programme to modernise its gas network in order to achieve safe and reliable gas transmission and supply but also in order to achieve compatibility of the local gas transportation infrastructure with the regional infrastructure (main transit pipelines SCP and NSMGP). This process involves large scale rehabilitation/development works usually performed by international contractors in cooperation with local technical teams.

Within the national Georgian Gas pipeline network there are 2 pipeline systems, the original pipeline system installed during the Soviet era and a new pipeline system that is currently being installed by GOGC. The new pipeline system is being installed to new design standards.

In January 2013 Georgia applied for full membership as a Contracting Party to the Energy Community, subsequently all energy organizations will eventually be obliged to work with European norms and

[1] A 'pig' in this context is an active measuring device used inside pipelines to inspect the pipeline integrity. The pig is pushed along the pipeline by the fluid being transferred, between a launch site and a retrieving site, which are oversized pipeline sections. Passive pigs are also used for cleaning pipelines. The original pigs were made from straw wrapped in wire, which squealed as it was pulled along the pipeline. This is one explanation for the name. Another is that it is an acronym for Pipeline Inspection Gauge. A 'non-piggable' pipeline is one in which pigs cannot be used.

standards. Moreover Georgia and the European Union formally signed the Association Agreement (AA) on June 27, 2014.

The overall objective of this assistance was to assist the Georgian Oil and Gas Corporation to develop and rehabilitate the Gas Transmission Pipeline Network in accordance with European Norms and Standards maximizing the Safety and Security Gas Supply and Minimizing the Gas losses to the Environment.

This was aimed to be achieved by increasing the capacity of the organization in designing and constructing the existing and potential projects using international standards.

The four seminars and one study tour provided by this assistance were designed to address the above issues and were implemented as follows:

The first seminar was about the Methodologies, Quality Procedures and Tests that European Pipeline Owners (Transmission System Operators) apply for the Construction Supervision and Commissioning of their pipelines.

The second seminar analyzed the System Design, Construction and Operation of the Cathodic Protection System, in accordance with the International Standards and Practices.

The study tour was related to the subjects of these two seminars and was conducted on the open site of a pipeline under construction.

These three events were organized in collaboration with the Greek Gas Transmission System Operator - DESFA. The Greek Gas Piping Network is new and has been under continuous development since it was initiated in 1990. DESFA managers have long experience in Construction, Commissioning, Protection and Operation of the Transmission network. Two project managers with 20 years of experience were the trainers of the first seminar and for the second seminar the trainer was a PhD expert in the analysis of the Cathodic Protection Methodologies with over fifteen years actual experience in construction and maintenance of these system in all DESFA's network.

The two seminars and the study tour were conducted in October 2013. The seminars took place in the Tbilisi offices of GOGC and the study tour took place to an under construction pipeline of DESFA in Southern Greece.

The main topics discussed in the Construction Supervision and Commissioning Seminar referred to the Principles of the Construction Process; the Environmental and Social Issues during construction and the necessary Health and Safety Management Systems; the Project Management and Communication Procedures and the Applicable Code and Standards Specification; ROW management (Legislation); Material Approval Procedures and Tests for Acceptance the Work of Contractor; Hydro testing and Non Destructive Testing (NDT) procedures; Valve assemblies – Strength/tightness tests; pre-commissioning, commissioning activities and standard forms; final document package. One day of the seminar was spent at an open construction site of GOGC , where trainer and trainees had the opportunity to compare and discuss the construction and testing at present in Georgia and in Europe.

In the seminar on Cathodic and Lightning Protection the following main areas were analysed : The forms of pipeline corrosion and the standard methods of control; the general principles of the Cathodic

Protection; The design criteria for the selection of the proper method of CP and the most suitable power supply; Codes and Standards for design, purchasing equipment, construction and testing; Pre-commissioning and Commissioning procedures; Operation, Records, maintenance and troubleshooting of the installation; General Principles, Specification, Design Parameters and Standards for Lightning; Proximity effects studies and safety distances and Surge Protective Devices (SPD), Isolating Spark Gaps (ISG) and (DC) decoupling devices. Like the first seminar, one day was spent on different sites of pipelines. The group visited old pipelines without any protection, to see the catastrophic effect of the absence of Cathodic Protection and new installations with CP in order to compare with the European Standards.

For the study tour, three Georgian Managers of the Technical Departments visited a construction site of DESFA (Greece). They visited the construction works and the testing laboratories. DESFA had managed, at the time of the visit, for one of the contractors to execute hydro testing, so that the trainees followed all the practical steps of this procedure. The trainees also had the opportunity to meet and discuss with all stakeholders of the pipeline (owner, contractors, consultants, laboratory operators, third party inspectors and pipeline supplier).

The third Seminar focused on Planning, Preparing and Conducting Direct Assessment Techniques for Unpiggable Pipelines. The trainer was Mr. Patrick Lydon of IACS Corrosion Engineering Ltd, who is experienced in Direct Assessment studies in UK and other Countries. Mr. Lydon had participated in a Gas Losses identification Inogate project in Central Asia. The seminar was conducted in October 2013 and the main topics presented were : The collection and evaluation of historical data; Review and Identification of High Risk Areas; Electric methods of Testing; Visual above Ground Survey; Interpret results to highlight potential defect locations; Locate suspected defect; Excavate pipeline and Measure coating damage and Corrosion depth; Analysing information from direct inspection techniques; Reviewing future inspection requirements; Calculate strength of the pipeline.

Upon completion of the theoretical classes, the trainer and trainees visited existing pipelines, which are unpiggable yet needed evaluation of their condition in order to schedule their replacement. The trainer demonstrated the methods that could be used for evaluation and gave practical examples of what can be done in the future. The GOGC monitoring team received from the trainer a small test kit, which is used to make bacterial analyses of the pipeline. Such a test kit had never been used before in Georgia.

The fourth seminar (with examination) was very specialised, focusing on Non Destructive Testing. During construction of pipelines, the contractors are doing radiographic inspection of welds to assure that their quality is in accordance with specification and that no risk of leakage exists. The resultant radiographic images should be reviewed and approved by experienced engineers, who must be certified for this work. Two qualified GOGC engineers have been sent to the accredited Training Centre of Ukrainian Society of Non Destructive Testing (USNDT), which provided the Certifications to the two GOGC participants upon successful completion of the seminar and the related examinations. The GOGC personnel followed the level 2 training, which transferred knowledge of how to check the quality of radiographic images and the authorisation to approve or reject them. The topics that were presented in the seminar included: Defects in welded joints of vessels and high pressure pipelines; types of radiographic inspection; equipment and accessories for radiographic inspection; technology of conducting radiographic inspection; regulatory and technical documentation and standards; Explanation and interpretation of radiographs and evaluation of the quality of welded joints; Safety Rules when working with sources of ionising radiation.

Key Issues and Findings

During the seminars and the study tour the following interesting issues were identified, discussed and analysed. Tasks that are common practice in Europe but were not known in the region were introduced, and the participants learned how to apply the new practice to their future projects:

1. Project Cost Estimation Methods

   Although it was not one of the topics of the seminar, the methodology used by DESFA for cost estimation in the different phases of a Project (conceptual design, feasibility study, basic design etc.) was presented.

   The tools that DESFA have developed (databases, software) for the cost estimation were demonstrated to the trainees, as well as statistics arising from processing real data from DESFA Projects, providing accurate figures.

2. GIS use in construction and operation of the pipelines

   There was a demonstration of the DESFA GIS system, which connects pipeline coordinates with a database containing all data related with the pipeline (welds, landowners, quality data, etc.) and interventions during operations.

3. Pipeline Drying before pre-commissioning.

   This method was not applied to the region in accordance with international standards. The participants requested details of compliance and already have incorporated the method of drying in the new projects.

4. Third Party Inspector

   During the presentation “Material Approval – Material Specifications”, there was a lot of discussion about the Third Party Inspector and his/her role in procurement and construction activities. DESFA trainers explained that the Inspector’s independent role eliminates frictions between supplier, owner, transportation companies and insurance companies for any defective material or equipment.

5. Preservation of pipelines not in use.

   Trainers informed that according to DESFA practice and European standards, pipelines are filled with nitrogen in case they remain without gas. No new Hydro-testing is required before gas-in.

6. Quantitative Risk Assessment Studies.

   GOGC do not currently undertake Risk Assessment Studies before construction of a new pipeline. The DESFA trainer presented a model of a Quantitative Risk Assessment (QRA) Study and also presented the design criteria, the philosophy of these studies and the acceptance criteria that apply to the legislation and regulatory directives in different European countries. Based on this finding ITS organised through a new AHEF, a comprehensive seminar with case studies in September 2014.

7. Independent Telecommunication System

The trainers explained how DESFA and other European System Operators are installing fibre optic networks alongside the Pipeline Network. The installation of a fibre optic network during the construction or renovation of pipelines represents a relatively low cost investment and, as a result, the Gas Transportation Company owns a communication network which is reliable for their critical and remote control operations.

8. Construction Specification and procedures

   The trainers gave GOGC engineers access to DESFA's Project Specification through the DESFA website.

   The GOGC trainees expressed their willingness to codify GOGC quality procedures in accordance with 9000- ISO Certification. Both parties agreed to communicate directly between themselves in future to exchange information and experience.

9. Cathodic Protection and Coating Pipelines.

   The old GOGC pipelines are not coated and they are interfered by the CP system of the new installations at the crossing points. The DESFA trainer suggested an extensive coating restoration to the existing pipelines and coating in the crossing areas with new pipelines.

10. Isolating Joints

    GOGC replaces old, leaking lines with new PE coated ones without intermediate isolating joints, This means that GOGC runs the risk of accelerated corrosion rates on tiny coating defects on the new line. Therefore, trainer Pat Lydon suggested carrying out a thorough coating integrity inspection.

    In some cases GOGC tends to isolate new pipelines from old ones using insulating joints that are not protected with spark gaps. The trainer warned that GOGC must use spark gaps and that they must install them as soon as possible.

11. CP modeling and AC interference studies

    GOGC engineers are not familiar with proximity effects study, as their pipelines were barely coated and so were submitted to minimal AC interference. But, as the trainer explained, this is a study that has to be taken into consideration for the newly constructed pipelines.

12. The CP TR units and high current and voltage output rating.

    The CP TR unit for new pipelines appears to have a high current and voltage output rating. In Europe, the voltage output of a TR unit is limited to less than 50V for safety. The current output capacity for the new TR unit, in GOGC installations, was up to 75A, which is a very high current for a 3LPE coating system and may mean that there may be issues associated with control of the CP system protection to the pipeline. There are also issues associated with AC/DC stray current interference that would need to be considered. This is a significant risk to pipeline systems and would need to be monitored. It is also important that the DC polarity is checked on the TR units when they are first energised. If connected incorrectly, rapid corrosion can occur on the gas pipeline system. The trainer suggested the GOGC only energises TR units with a CP engineer in attendance.

13. Location of lightning attractor pole.

    The lightning attractor pole has in one instance been installed directly above the pipeline in a visited valve station. This would mean that a high voltage gradient would be created above the pipeline during a lightning strike and would be a safety hazard. The pole should be installed remote from the valve station to minimise GPR on the pipeline during a lightning strike. The present design appears to enhance the risk of lightning damage, not reduce it.

14. CP tests facilities

    CP test facilities should be included in valve stations, but none have been installed.

15. Flow measurement.

    Sufficient lengths of straight pipework should be installed after orifice plates to ensure accurate flow measurement. The straight pipe should extend 10 times the pipe diameter upstream and 5 times the pipe diameter on the downstream side of the flow measurement.

16. Casing for pipelines protection

    Pat Lydon clarified that on new pipelines in the UK, heavy wall pipe has replaced casings. Casings used in old lines, either are filled with nitrogen or an alkaline grout is used to control the corrosion risk.

17. Valves Installations

    During the visit of Pat Lydon some valves were found that were not fenced. Some of these valves were leaking gas and no valves were locked off, with valve movement keys readily accessible. Some other valve chambers were fenced but valves not locked, no earthing on the valve fence, plus corrosion risk where pipeline is shielded at the air to soil interface. Participants recorded the trainer's suggestions for immediate rectifications.

18. Pipework specification on valves stations.

    Pat Lydon suggested that low temperature steels should be used on pipework that may experience sharp temperature changes.

Achieved Results and Expected Impact

The assistance provided by ITS within the combined event (the four seminars and the study tour) has achieved significant results and has been highly appreciated by the participants and the management of the GOGC (see appreciation letter in Annex 6.8). The achieved results and the expected impact can be described as follows:

- Increase of the GOGC personnel capacity to supervise: the construction of pipelines; the rehabilitation program (through which part of the existing network is being replaced); and the

maintenance and operation of the Gas Transmission System. This increase in capacity should help GOGC manager to reduce the cost of construction and maintenance and should decrease the fugitive quantities of gas emissions, thereby mitigating climate change and improving environmental performance.

- Through the seminar on Construction Supervision, GOGC gained capacity in testing and inspection techniques. The inspection techniques that GOGC employees have learned, will help GOGC to install high quality pipelines with low risk of fugitive emissions (due to faulty construction) and with long operational periods without maintenance or rehabilitation costs. Already GOGC has applied quite few of the procedures that were transferred during the seminars.
- Through the seminar for cathodic protection (CP), GOGC specialists have been trained to plan and design new cathodic protection systems in accordance with international standards and best practices and to modify existing CP systems to improve their efficiency and effectiveness. A CP system that is properly designed and constructed and corresponds to the local characteristics, will extend the operation life of the pipeline network with less maintenance or rehabilitation cost and will reduce the fugitive gas emissions due to corrosion. The proper sizing of the power supply to the system will decrease the operating cost of the Gas Transportation.
- Through the Study Tour, key personnel of GOGC saw in practice the methodologies and procedures that they been introduced to during the seminars. They discussed with the local construction engineers the problems and difficulties they have to apply these standards and procedures and how these have been solved.
- Through the seminar for the Direct Assessment of Unpiggable Pipelines, GOGC engineers practiced the direct assessment methods on the existing old and deteriorated network to identify accurately the areas that must be rehabilitated immediately, thus reducing the fugitive gas emissions and optimising the rehabilitation cost. Participants gained an understanding of the selection of high risk pipelines, based upon risk analysis and an awareness of the different techniques available to locate defects.
- The Non Destructive Testing (NDT) seminar provided to GOGC enabled two certified QA/QC engineers to review and approve the radiographic images to assess the quality of pipeline welds during the construction of new pipelines. The obtained qualification will allow GOGC to utilise the NDT laboratory, donated by USAID (about $1mln), to comply with the international standards for construction of pipelines and to improve the quality of new pipelines and to increase the safety and reliability of the national gas pipeline network.

1 Introduction

This Report presents the results of the Study tour and the four seminars held to assist the Georgian Oil and Gas Corporation to develop and rehabilitate the Gas Transmission Pipeline Network in accordance with European Norms and Standards, maximising the safety and security of the gas supply and minimising gas losses.

Within the Georgian Gas pipeline network there appear to be 2 pipeline systems, the original pipeline system installed during the communist era and a new pipeline system that is currently being installed by

GOGC. The new pipeline system is being installed to new design standards. The design MOP (Maximum operating pressure) for the original pipeline system was 55 bar and the pipeline now operates at a maximum pressure of about 25 bar.

The original pipeline system is not capable of being intelligently pigged but the new pipeline system is capable of being intelligently pigged. However, it is understood that as yet no intelligent pig runs have been completed.

The new pipeline system is it is understood designed to ASME B31.8 and uses a high quality 3LPE/3LPP coating system and API 5L X60 grade pipe material. The pipeline is buried along its entire length and at roads and railway crossings it is installed in casings.

The seminars increased the capacity of GOGC to design and supervise rehabilitation of existing and construction of new pipelines using international standards.

Participants from other PCs were also invited to join the seminar at their own cost. The ITS team received interest from several PCs, however only two participants from Azerbaijan were able to join the first seminar.

The three seminars were organised in a specific 5 day agenda, which included a field trip. The fourth seminar was conducted in theTraining Center of the Ukrainian Society of Non Destructive Testing (USNDT) in standard two weeks agenda The seminars are described below.

1.1 Training in Construction Supervision and Pipeline Testing and Commissioning (11-14 October, 2013)

The purpose of the Seminar was to present to the Construction Supervision Managers and Engineers of the Georgian Oil and Gas Company, as well as to the two managers from the Transportation Company of Azerbaijan, the Methodology, Quality Control, Tests, Commissioning Procedures and Standards that European Transmission Operators follow during the construction of their networks. This training was delivered by two very experienced project managers of the Greek System Operator DESFA, Mrs Niarchou and Mr Misirlis. They transferred their over 20 years of experience in the construction of Gas Transmission Lines, presented and explained the Methodology and Standards they have used and discussed with the experienced Georgian and Azeri engineers the problems of the various phases of construction and how have been solved. On the third day of the seminar, the group of trainers and trainees visited a construction site of GOGC and discussed in situ the methodologies that were presented in the class. On the fourth day, the trainers commented on the actual work execution and together with the trainees, they determined improvements that can be achieved in the next construction works, along with the international procedures to apply.

1.2 Training in Cathodic Protection System Design according to International Standards and Best Practices (8-11 October, 2013).

In the second seminar, the trainer Dr N. Kioupis, who has a PhD in the analysis of Cathodic Protection methodologies and over fifteen years of experience in installation and maintenance of Cathodic Protection systems, presented the theory and practical application of CP systems for gas pipelines. He developed analytically the catastrophic consequences of the absence of CP in the old, Soviet origin pipelines and the methodologies and standards that all European companies use to preserve pipelines,

extend their life and to assure the safety of their pipeline networks. On the third day, they visited old pipelines, where there was no Cathodic Protection and saw the corrosion effects on the pipelines. They visited also new installations, where already GOGC had installed CP systems. The group of trainer and trainees had the opportunity to discuss the deviations that the systems had from the European standards. Part of the seminar was the development of the lightning protection standards that GOGC should apply to the construction of transmission pipelines.

1.3 Training in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines (29 October – 1st November).

The third seminar had direct application on the organisation of GOGC. GOGC pipeline network is very old and with many defects. Quite often corroded parts break, resulting in the interruption of gas supply. The GOGC engineering department created a group of experienced engineers to manage the assessment of the pipeline network and to conclude a schedule of pipeline replacements. The pipelines of the old system are unpiggable, therefore it is necessary for direct assessment methods to be applied. Mr.Pat Lydon is a qualified engineer working in the field of pipeline assessment and the design of Cathodic Protection systems for the last fifteen years. Additionally to consultancy services, he provides training to system operator organisations in the UK and overseas. In 2009 he had presented a similar subject to an INOGATE workshop in Central Asia. Mr Lydon presented the methodologies of direct assessment of pipelines and the evaluation methods of the findings. On the third day, the group visited locations within the old piping network and, with various toolkits provided by Mr Lydon, the group of GOGC engineers applied the methods that they have learned on the previous two days. On the last (fourth) day, they discussed and evaluated the findings from the site visit.

1.4 Study tour to Greece (DESFA) (17-22 October 2013)

The study tour followed the two seminars on Construction Supervision, Testing and Commissioning and on Cathodic Protection.

The GOGC specialists visited the construction site of a transmission pipeline in Greece, constructed by the Greek operator DESFA. The construction was well advanced and the delegates had the opportunity to see all phases of the construction: testing, hydro-testing, and to visit the related laboratories. DESFA had scheduled hydro tests to take places in completed sections of the pipeline during the days that GOGC visited the construction site.

GOGC engineers visited the construction of the gas station compressor house, which delivers the gas to the adjusted Power Plant, which was also being completed (similar project are in the initial stage of construction in Georgia). DESFA presented in meetings all participants/stakeholders of the project: the Contractor, the third party inspection company, the pipeline supplier and the engineering company. The GOGC specialists discussed in detail the methodologies and practices that European companies apply to the construction, testing and commissioning of pipeline networks.

GOGC also visited the Cathodic Protection installation along the new pipeline and selected information and experience from the DESFA experts regarding the engineering and the methodology of the Cathodic Protection equipment installation.

1.5 Non Destructive Testing (NDT) Seminar/training (Kiev, 12-23 May, 2014)

This seminar took place under the responsibility of the accredited Training Center of the Ukrainian Society of Non Destructive Testing (USNDT), which provided the Certifications to the two GOGC participants upon successful completion of the seminar and the related examinations.

The Certification Center of USNDT initiates, promotes, maintains and administers procedures for certification of NDT personnel according to the requirements of European Standard EN ISO 9712 "Non-destructive Testing – Qualification and certification of NDT personnel – General principles" and fulfils the requirements of EN ISO/IEC 17024 "Conformity assessment – General requirements for bodies operating certification of persons". The Certification Center of Ukrainian Society for Non-destructive Testing (CC of USNDT) was founded in 2002. It is an independent Certification Body of Ukraine for the personnel working in the field of non-destructive testing and technical diagnostics.

The GOGC personnel followed the level 2 training course, which tranferred knowledge on how to check the quality of radiographic images and the authorisation to approve or reject them.

2 Preparation of the seminars/study tour

The preparation of the seminars/study tour consisted of the following tasks:

- Development of the concept note, thematic agenda and selection of the speakers for each seminar
- Preparation of the invitation letters for the participants
- Selection of the construction sites to be visited by GOGC
- Communication with the owners in order to arrange suitable visiting days
- Logistics of flights, conference venue and hotels for participants and ITS speakers and staff
- Preparation of a contract for the engagement of DESFA in the event
- Development of ex-ante and ex-post questionnaires
- Organise the translation of the seminar and study tour material
- Preparation of contracts for engagement of the speaker for the third seminar
- Development and updating of the seminar agenda;
- Development and editing of the materials which would be provided to the participants
- Distribution of ex-ante and ex-post evaluation questionnaires
- Preparation of the evaluation reports and review of the conclusion of the seminar
- Evaluation of accredited organisations for the NDT seminar. Due to the examinations that the participants should have passed, the seminar had to be presented in Russian Language.

The specific objectives of the four seminars and the study tour were to provide the necessary capacity to GOGC in order to:

- Apply international tests on the commissioning of the constructed pipelines improving the construction quality of the work, and increasing the safety and security of gas supply.
- Establish the EU and International Standards for the design, procurement, installation and operation of cathodic protection in existing and new pipelines.
- Identify and plan the replacement of the deteriorated parts of the old "soviet origin" pipeline network

through the modern methods of Direct Assessment of Unpiggable Pipelines.

- To verify on the job the adaptability and effects of the international standards to the construction sites of Georgia. To get the authorisation of reviewing and approving the radiographic images of the welds implemented by contractors.

3 Seminars and study tour

3.1 Combined Event/Study Tour Overview

3.1.1 Training in Construction Supervision and Pipeline Testing and Commissioning

Location: Tbilisi, Georgia 01-04/10/2013

Three days in the office one day visit to the site

The objective of this training was to Increase GOGC Quality Control Unit's capacity in NDT and Pipeline Testing and Commissioning supervision. The trainers had huge experience of working on this task and it was the first time that GOGC's QC unit had an opportunity to exchange information with European peers. Detailed theoretical classes and the site visit increased the GOGC engineers' confidence of what they are doing. GOGC mainly follows the modern standards and methodologies described by trainers. The most important result of this training was that transferred knowledge to increase GOGC's QC effectiveness in specific areas of construction. After the main part of the theoretical classes, trainers and trainees visited the ongoing pipeline construction of the Kutaisi-Abasha DN700 section. Cathodic stations, valve stations, road and railway crossings, river coastal protection and other important parts of the construction have been visited. After the site visit, the trainers gave GOGC delegates feedback and practical advice on what could be improved.

Topics discussed at the seminar included:

- General principles and Construction Process
- The Environmental and Social issues in pipeline projects
- Health and Safety Management system
- Organisation of construction supervision, testing, commissioning and start up
- Project Communication Procedures – Electronic Platforms
- Applicable Codes & Standards / Project Specifications
- Review Procedures – Document Approval Forms (DAF)
- ROW Management (Legislation – Procedures)
- Material Approvals, Material Certification
- Construction procedures
- NDT -Procedures
- NDT- technologies, equipment
- Hydro testing- Procedures
- Hydro testing- Equipment
- Valve assemblies – Strength/tightness tests

- Procedures for Pipeline dewatering, cleaning and drying
- Procedure for pipeline gauging – diameter integrity
- CP pre-commissioning, commissioning activities
- Standard procedures for pre-commissioning and commissioning activities - Equipment
- Standard forms for testing, pre-commissioning and commissioning.
- Final Document Packages (FDPs) – Review and Approvals
- Examples and Practical Problems Solving

3.1.2 Training in Cathodic Protection System Design according to International Standards and Best Practices

Location: Tbilisi, Georgia 08-11/10/2013

Three days in the office one day visit to the site

Cathodic Protection is a field in GOGC company and generally in Georgia, where there is lack of knowledge, experience and even specialists. The training demonstrated to the engineers of the GOGC Engineering department the modern methodologies and best practices of the cathodic protection system design, equipment selection, and efficient energy consumption. This information increased general knowledge about CP and increased awareness how much work in this field should be done. It clarified risks that occur when CP is designed, installed or operated incorrectly. Thus, GOGC is already working to plan new, more detailed trainings in CP and is searching for CP professionals who can assist the company in protecting new pipelines.

After the main part of the theoretical classes, the trainer and trainees visited existing cathodic protection systems. The group of trainer and trainees, visited the very first T/R unit in Georgia and then, the cathodic station which has been recently installed. The trainers observed the progress that GOGC has made during recent years in this field. After the site visit, the trainers gave GOGC feedback and practical advice on how CP installations could be further improved.

Topics discussed included:

- Introduction to Theoretical Principles of Corrosion
- Forms of pipeline corrosion
- General Principles and theory for the cathodic protection
- Control of Corrosion (Coatings, Cathodic Protection, Isolating Joints, Bonds)
- Measurement of CP Circuits (Potential, Resistance, Current)
- CP Potential Measurement and Criteria (Reference Cells, Coupons, ER probes, Survey Methods & Analysis, Criteria for CP)
- Coating Selection for Cathodic Protection
- Design Criteria
- Cathodic Protection of Complex Structures
- Cathodic Protection in ac/dc interference conditions
- Cathodic Protection Modeling in Different Soil Environments.
- Alternative sources of power supply (e.g. solar panels, wind generators) and criteria for selection

- Standards and specifications for the design
- Equipment and materials specification and standards
- Inspection procedures for equipment delivery
- Installation specification and standards
- Testing procedures
- Pre-commissioning and commissioning procedures
- Operation, Records, maintenance and troubleshooting of the installation
- Examples, Experiments and Practical Problem Solving
- General Principles – Design parameters-Standards for lightning
- Equipotential Bonding and Earthing
- Proximity effects studies and safety distances
- Surge Protective Devices (SPD), Isolating Spark Gaps (ISG) and DC decoupling devices

3.1.3 Training in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines

Location: Tbilisi, Georgia 29/10-1/11/ 2013. Three days in the office one day visit to the site

Over 95% of Georgian gas pipelines have been constructed during the Soviet period and are still under operation. None of them are piggable and have been maintained without CP for years. Assessing their condition and evaluating their safety is vital for GOGC. The monitoring group to do these works was formed several months ago and for this group receiving assistance and training from an internationally experienced specialist was vital.

Pat Lydon provided a course covering the Inspection of Non Piggable Pipelines to the Georgian Oil and Gas Company. Mr Lydon is a professional consultant in Direct Assessment methodologies and has huge experience both in EU and outside EU countries. The training course was presented in a coaching manner, in order to be as helpful as possible, spending more time than planned on topics, which were important for the GOGC monitoring team.

After the main part of the theoretical classes, the trainer and trainees visited existing pipelines, which are unpiggable, and which required inspection by the monitoring team. The trainer demonstrated the methods that could be used for evaluation and gave practical examples of what can be done in the future. The monitoring team received from the trainer a small test kit, which is used to make bacterial analyses of the pipeline. Such test kits have never been used before in Georgia.

The class presentations and the practical demonstrations on site transferred the necessary skills and self-confidence to the group to plan future activities.

Topics discussed included:

- Gathering previous history & pipeline data
- Risk Based Analysis
- Review areas of High Risk
- Select areas to be inspected with indirect inspection techniques
- Direct Current Voltage Gradient check (DCVG)
- Alternating Current Voltage Gradient (ACVG)

- Close Interval Potential Survey (CIPS)
- Visual Survey of above ground pipe
- Interpret results to highlight potential defect locations
- Grade defects dependant on likely defect size and level of risk
- Select locations to be investigated
- Lower Pipeline Pressure
- Locate suspected defect
- Excavate pipeline
- Measure coating damage and corrosion depth
- Calculate remaining strength
- Ascertain the root cause of the defect
- Analysing the info from direct inspection techniques
- Reviewing future inspection requirements
- Site visit to an existing old pipeline
- Apply methods discussed during the seminar
- Calculate strength of the pipeline

3.1.4 The INOGATE Study Tour on Gas Pipeline Construction Supervision, Commissioning and Cathodic Protection

Location: Agioi Theodoroi-Megalopoli area of gas transmission pipeline of 150 km (24") n Southern Greece. (17-22 October 2013)

DESFA had provided the experts for the seminars "Cathodic Protection" and "Construction-Hydrotesting-Commissioning" who are currently constructing a gas transmission pipeline of 150 km (24") in Southern Greece (Agioi Theodoroi-Megalopoli). The project was well advanced at the time of the visit, and included operating laboratories for the Quality Control of the work and installation of a cathodic protection system. Three of the GOGC participants of the two relative seminars visited the construction sites together with their trainers (DESFA employees) for two days.

They had the opportunity to observe the operation of all tasks on which they had received training. Representatives of GOGC visited the construction offices of: DESPA(client), Asprofos (third party supervisor) and J&P Avax (contractor). Meetings were held with top-management, engineers and representatives of the technical teams.

During the visit, the GOGC representatives were hosted by DESFA- Panagiotis Milisianos and J&P Avax – George Manis.

The GOGC representatives had visited parts of the pipeline under construction and completed parts of the pipeline in hard geotechnical conditions, similar to the ones in Georgia. They visited the hydro-testing laboratory and received comprehensive information.

Finally they visited, an under construction power plant in Megalopolis and the station for the gas delivery to the turbines. The project manager of the Power Plant construction provided valuable and important information regarding this project.

3.1.5 Seminar and Certification by accredited organisation for Non Destructive Testing.

Location: Kiev, 12-23, May, 2014

This seminar took place under the responsibility of the accredited Training Center of the Ukrainian Society of Non Destructive Testing (USNDT), which provided the Certifications to the two GOGC participants upon successful completion of the seminar and the related exams.

The Certification Center of USNDT initiates, promotes, maintains and administers procedures for certification of NDT personnel according to the requirements of European Standard EN ISO 9712 "Non-destructive Testing – Qualification and certification of NDT personnel – General principles" and fulfils the requirements of EN ISO/IEC 17024 "Conformity assessment – General requirements for bodies operating certification of persons". The Certification Center of Ukrainian Society for Non-destructive Testing (CC of USNDT) was founded in 2002. It is an independent Certification Body of Ukraine for the personnel working in the field of non-destructive testing and technical diagnostics.

The GOGC personnel followed the level 2 training course, which transferred knowledge of how to check the quality of radiographic images and the authorisation to approve or reject them.

The topics that were presented in the seminar included:

- General questions of nondestructive testing.
- Defects in welded joints of vessels and high pressure pipelines
- Physical basis of radiographic inspection
- Types of radiographic inspection.
- Detectors of ionizing radiation
- Radiographic films and screens
- Equipment and accessories for radiographic inspection
- Sources of high-energy facilities
- Technology of conducting radiographic inspection
- Regulatory and technical documentation and standards
- Explanation and interpretation of radiographs and evaluation of the quality of welded joints
- Safety Rules when working with sources of ionizing radiation
- Organization of radiographic inspection within the company and for each project

Finally the participants gave three type of exams:

- General examination
- Special examinations
- Practical tests

The two participants successfully passed the examinations and were certified **according to ISO 9712 with the issuance of certificates of competence and qualification certificates,** valid up to 23-5- 2017.

3.1.6 The participants

A list of the participants attending the Seminars and the study tour may be found in Appendix 6.2.

3.1.7 The results from the four seminars and the study tour

The results achieved from the combined event (the four seminars and the study tour) are:

- The increase of GOGC personnel capacity to supervise: the construction of pipelines; the rehabilitation program to replace part of the existing network; and the maintenance and operation of the Gas Transmission System. This increased capacity will affect directly the cost of construction and maintenance as well reducing the quantity of fugitive gas emissions.
- Through the seminar on Construction Supervision GOGC gained capacity in NDT and testing inspection techniques. The inspection techniques on which GOGC delegates received training will be applied to help GOGC to install high quality pipelines with low risk of fugitive emissions (due to faulty construction) and extended periods of operation without maintenance or rehabilitation costs. Already GOGC has applied procedures that were taught during the seminars.
- Through the seminar on cathodic protection, GOGC specialists have been trained to plan and design cathodic protection systems in accordance with international standards and best practices and to modify the existing CP systems to improve their efficiency and effectiveness. ACP system that is properly designed and constructed and corresponds to the local characteristics will extend the operation life of the pipeline network with less maintenance or rehabilitation costs and lower fugitive gas emissions due to corrosion.
- Through the seminar for the Direct Assessment of Unpiggable Pipelines, GOGC engineers practiced the direct assessment methods on the existing old and deteriorated network to identify accurately the areas that must be rehabilitated immediately, thus reducing fugitive gas emissions and optimising the rehabilitation cost. Participants gained an understanding of the selection of high risk pipelines, based upon risk analysis and an awareness of the different techniques available to locate defects.
- Through the Study Tour the key personnel of GOGC saw in practice the methodologies and procedures that they had learned during the two seminars. They discussed with the local construction engineers the problems and difficulties they have in applying these standards and how have been solved.
- The NDT seminar provided to GOGC two certified QA/QC engineers, capable to review and approve the radiographic images of welds during the construction of new pipelines. USAID had donated to GOGC a fully equipped laboratory for the NDT testing, however only GOGC can now operate the laboratory. The INOGATE project is therefore complementary to the USAID donation, by providing the proper training and the corresponding certifications and qualified personnel to operate the laboratory.

4 Evaluation of the Event

The evaluation of the event and its impact has been assessed using questionnaires (see appendix 6.4), which were completed by the participants before and after the event. The evaluation was aimed at:

- The assessment of the overall organisation of the event (presentations, logistics, hotel, etc.) and the utility & quality of each session.
- A self-assessment on the knowledge gained & an evaluation covering the priority needs of the participants by the contributions delivered in the event.

4.1 Overall organisation evaluation

An evaluation of the overall organisation of the event included the following components:

1) Organisational Aspects
   - Overall organisation
   - Travel and visa support
   - On-site organisation
   - Quality of the hotel
   - Selection of the topics and presentations

2) Quality of Sessions (selection of topics)

3) Achievement of the INOGATE seminar's objectives

The summary of the evaluation results for all above mentioned components is presented in Appendix 6.5

4.2 Overall evaluation of the Training in Construction Supervision,Pipeline Testing and Commissioning

The here below "pies" present the participants' general evaluation to the performance of the three seminars (par. 4.2, 4.3 and 4.4)

It is worth-while to mention the hard preparation work of ITS and the good cooperation with the corresponding department of GOGC, to achieve a high level organization in all seminars; something that it has been acknowledged by all participants giving the good and excellent by 80% to 100% to the three seminars .

For the usefulness & quality of each session the participants in a percentage of 75 to 80% admitted that the sessions were "good" and "excellent" and the same opinion they have also for the achievement of the objectives of the seminars of .

The high score of participants' evaluastion in all three seminars that took place in Tbilisi indicates that the design of the content of each seminar and the selection of the trainers was in accordance with their expectations and their needs.

Figure 1: Overall Organisation

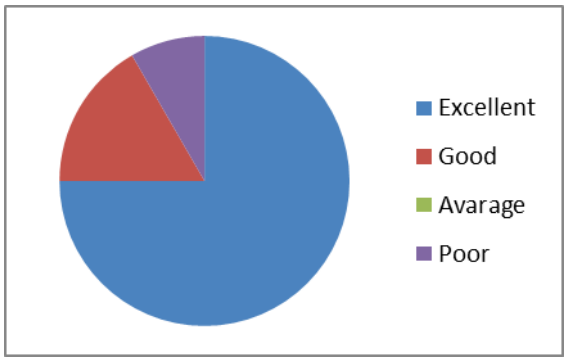


Figure 2: Seminar Sessions

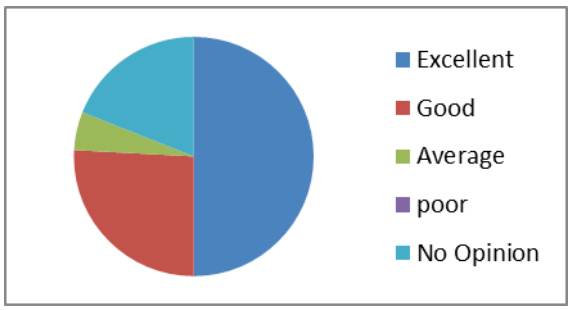
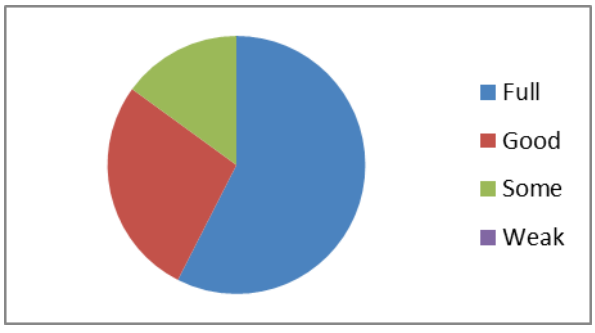


Figure 3: Achievements of Inogate Seminar's Objectives



4.3 Overall evaluation of the Training in Cathodic Protection System Design according to International Standards and Best Practices

Figure 4: Overall Organisation

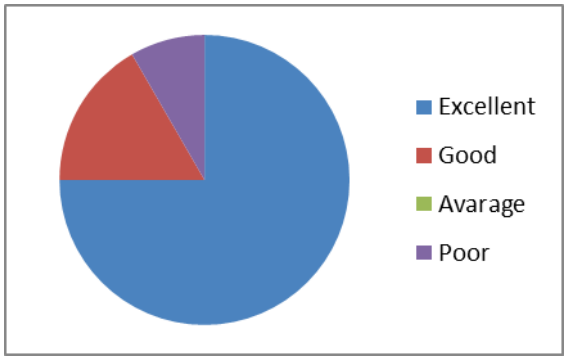


Figure 5: Inogate Seminar Sessions

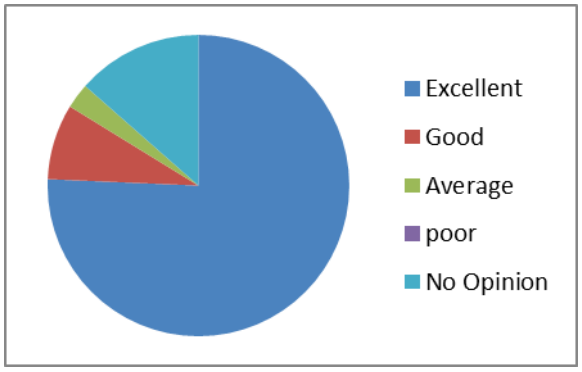
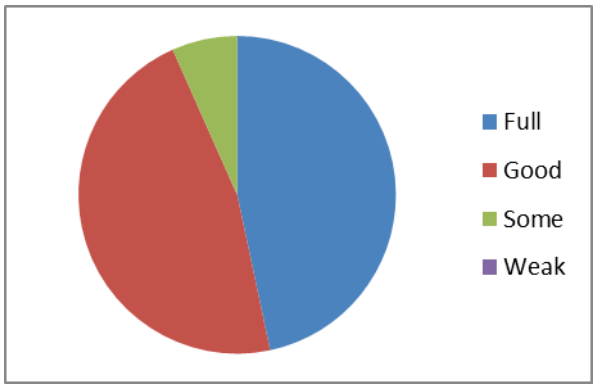


Figure 6: Achievements of Inogate Seminar 's Objectives



4.4 Overall evaluation of the Training in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines

Figure 7: Overall Organisation

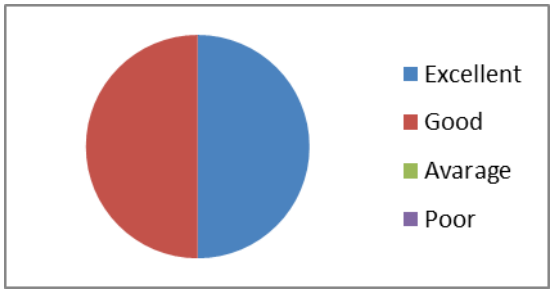


Figure 8: Inogate Seminar Sessions

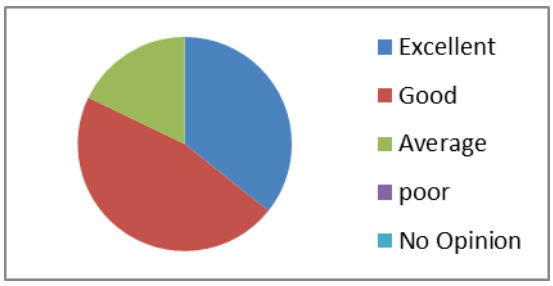
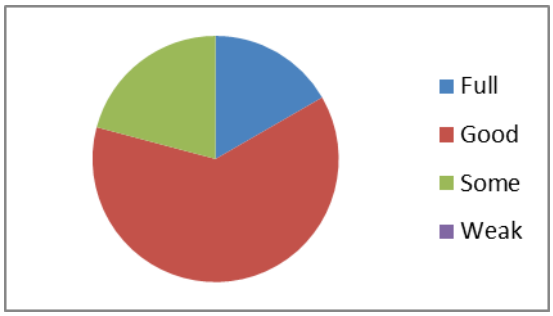


Figure 9:Achievements of INOGATE Seminar's Objectives



4.5 Gained general and specific knowledge and priority needs evaluation.

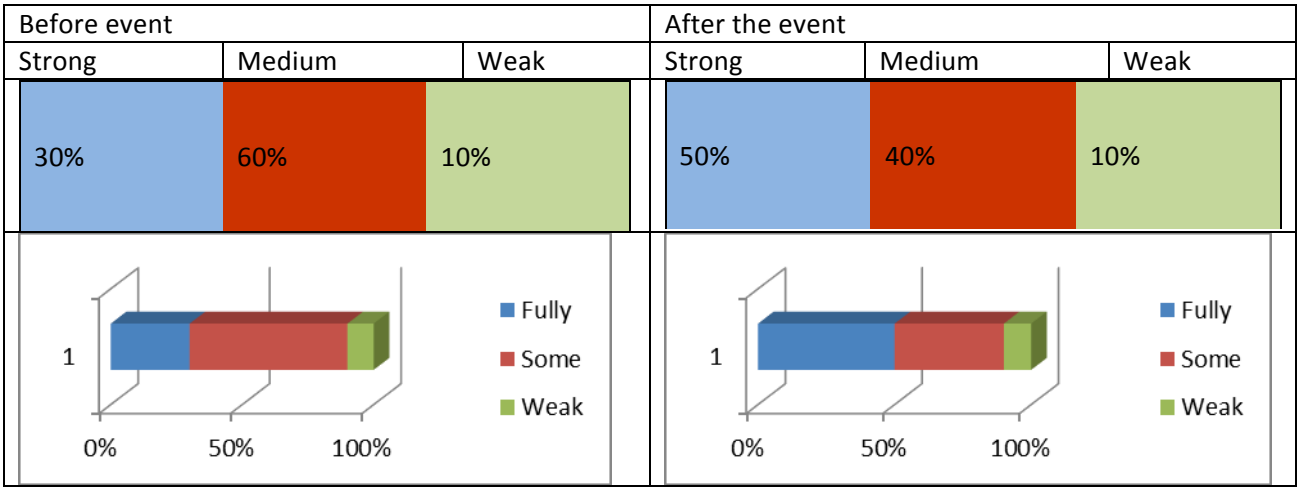
The tables in this section show an example of the difference of the level of understanding of a set of questions, that participants have answered before and after each event. The detailed summary of the evaluation results for all above mentioned components is presented in Appendix 6.5.

4.5.1 Assessment of specific knowledge gained in the Training in Construction Supervision and Pipeline Testing and Commissioning

As it can be seen the strong knowledge on the Construction Supervision and Pipeline Testing and Commissioning before the event was about 30% . **It has increased up to 50% by the end of the event.**

The general procedures and tasks of the construction supervision were known to participants and it is becoming evident with the percentage (70%) of the "weak" and medium knowledge of the subject before the event has been reduced by 20%.

Figure 10: Knowledge acquired in Training in Construction Supervision and Pipeline Testing and Commissioning

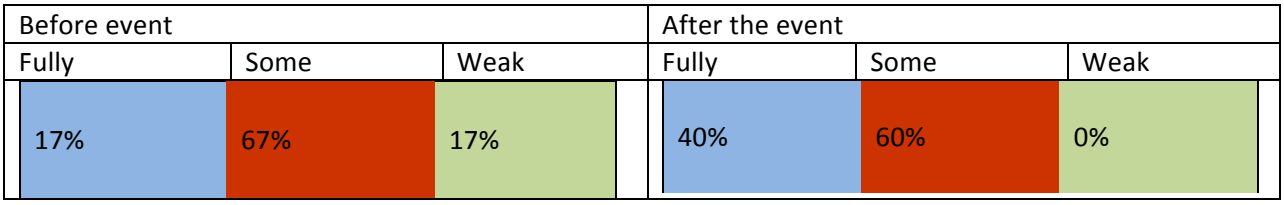


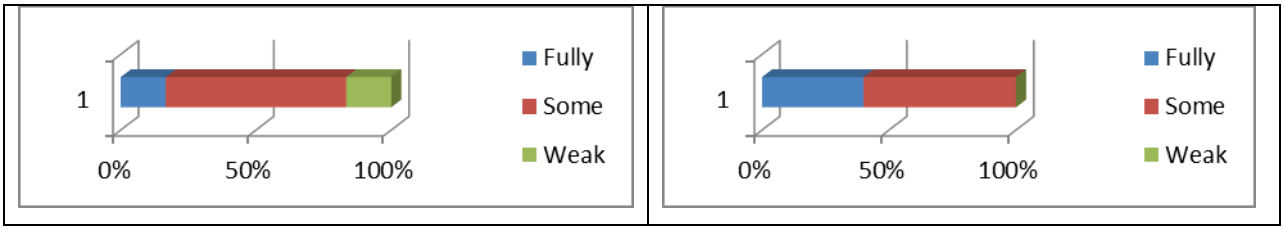
4.5.2 Assessment of specific knowledge gained in the Training in Cathodic Protection System Design according to International Standards and Best Practices.

As it can be seen the strong knowledge and understanding of Cathodic Protection System Design before the event was about 17%. It has increased up to 40% by the end of the event.

Before the seminar the participants were not familiar with the knowledge and understanding of Corrosion Principles and measures of protections . The first session of the seminar providing the basics and the theoretical approach on the subject was proved to be properly selected because everybody after the event felt that knew something on the subject (reduction of 17% of weak to 0%). The specific case studies that trainer developed and the procedures he gave to audience resulted to relatively high degree of "fully understanding" of the procedures and methods applied through the Cathodic protection.

Figure 11: Knowledge acquired in Cathodic Protection System Design according to International Standards and Best Practices



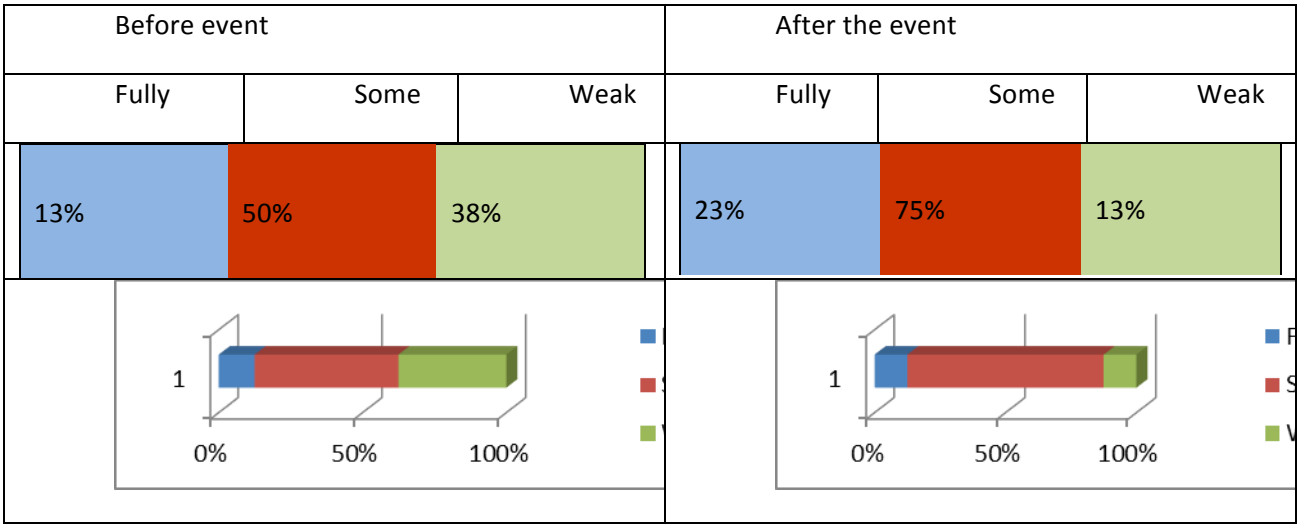


4.5.3 Assessment of specific knowledge gained in the Training in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines

As can be seen the general knowledge in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines before the event was about 63% (strong and some). It has increased up to 88% by the end of the event.

The objective of the third seminar was pretty new for GOGC. Quite recently they have started replacing eroded parts of the gas transportation pipelines and the assessment methods are absolutely necessary for the planning of the replacement work. The unawareness of participants dropped from 38% to 13%, and 75% of participants got the basic principles of the methods applied. The review of the actual of work GOGC on the subject may be will direct to another similar seminar with more practical applications in order the GOGC personnel to obtain full knowledge of the subject.

Figure 12: Knowledge acquired in Planning, Preparing and Conducting Direct Assessment Techniques of unpiggable pipelines



4.6 Specific Comments and Main issues addressed

4.6.1 Issues discussed during the technical seminar for construction supervision, testing, pre-commissioning and commissioning on gas transmission pipelines

Tbilisi, 01/10/2013-05/10/2013

The main issues discussed during the seminar were as follows:

1. Trainees were interested in Project Cost estimation methods.
   Although it was not one of the topics of the seminar, the Methodology used by DESFA for cost estimation in the different phases of a Project (conceptual design, feasibility study, basic design etc.) was presented.
   The tools that DESFA have developed (databases, software) for the cost estimation were demonstrated to the trainees, along with the statistics processing real, operational data from DESFA Projects.

2. Furthermore there was a demonstration of the DESFA GIS system, which connects pipeline coordinates with a database containing all data related with the pipeline (welds, landowners, quality data, etc.) and interventions during operations.

3. After the site visit, there was a lot of discussion about the Valve /Scraper Stations configuration and the use of different types of valves. It showed a different treatment of the subject by every company and advantages and disadvantages were discussed.

4. During the presentation for "Standard Procedures for Pre-commissioning and commissioning activities" details were requested for pipeline drying and the trainees from GGTC explained the way they perform commissioning in their pipeline networks.

5. During the presentation "Material Approval – Material Specifications" there was a lot of discussion about the Third Party Inspector and his role in procurement and construction activities.
   Trainees reported that in GOGC projects there is no Third Party Inspection and no Certificate is issued. For the materials, no special inspection is required.
   They purchase materials by allocation to the lowest tender, and for pipes ordinary suppliers come from Turkey, China and India.
   The Owner (GOGC) buys all the materials of the project, according to the Detailed Design and delivers to Contractor for the installation.

   Trainers informed trainees that usually DESFA buys only pipes and big diameter valves.
   For the other materials the Contractor is responsible to undertake the Detailed Design. DESFA awards Engineering, Procurement and Construction (EPC) Contracts for the big projects. For small projects (system expansions or modifications) DESFA proceed with Detailed Design and Material Supply.

6. After the presentation for "NDT Procedures – Hydro-testing" trainees noted that, in accordance with GOGC procedures, if their pipeline remain for more than 6 months without gas-in, then Hydro-testing should be repeated. The pipeline, when not in use, is filled with air.

The trainers informed that, according to DESFA practice and European standards, pipelines are filled with nitrogen in case that they remain without gas. No new Hydro-testing test is required before gas-in.
GOGC do not use pipes with internal lining.

7. After the presentation for the "Health and Safety Management System", there was a lot of discussion about Quantitative Risk Assessment Studies.
   GOGC do not undertake Risk Assessment Studies before construction of a new pipeline. The DESFA trainer presented a model of a QRA Study.
   There was extensive discussion on the design criteria and the philosophy of these studies and the variety of the acceptance criteria that apply to the legislation and regulatory directives in different European countries.

8. Trainees described the way the pipeline projects are performed in Georgia.
   The Ministry of Finance is the financier.
   The Georgian Oil and Gas Company proceed with the construction of the pipeline including Hydro-testing and Drying.
   The final acceptance of the Project is given from the Ministry of Finance, which transfers the Project to Georgian Gas Transmission Company who is the Operator.
   Commissioning activity is performed by GGTC.
   The trainers indicated that in Greece the Ministry of Environment, Energy and Climate Change is the one who gives "Permit for Installation" for starting the Construction and "Permit for Operation" for gas-in and operation.
   DESFA is the Owner and performs both construction and operation activities for Gas Transmission Pipelines.

9. Thorough discussion took place about the ROW easement and the procedure of Land Acquisition.
   GOGC purchases and owns the ROW construction area, width of 25 meters, along the pipeline – routing.
   No plants or crops are allowed in these areas.

10. GOGC trainees mentioned that no Fibre Optic Cable is laid alongside their Pipelines and that no Telecommunication System and SCADA exist.
    GOGC have problems with the connections of Valve Stations and TR Units for Cathodic protection with the Electricity System.
    The trainers analysed the DESFA practice and criteria for Installing fibre optics along their pipelines. DESFA has developed its own telecommunication system.

11. There was a long discussion regarding the standards that DESFA and other European Operators are using. DESFA informed GOGC that 10 years before they were using ASME B.31.8 for pipeline design and that still some sections are valid.
    Trainees were informed about the philosophy of the ASME Std. for "class location'', safety factors and distances between Valve Stations and Scrapers that are incorporated in DESFA practice. The Greek Regulation for pipelines was also presented to them.

The GOGC trainees were informed that they can have access to DESFA's specifications through DESFA's site (www.desfa.gr).
GOGC still uses Russian Standards for the Design and API 5L for pipes procurement.
They also use ASME B.31.8, but no European Standard.

12. The discussion revealed that there is no legislation on environmental protection matters although for the GOGC project which is now under construction, the donor, USAID is proceeding with the execution of the Environmental Impact Assessment study and will issue it to the Ministry.

13. The GOGC trainees expressed their willingness to codify GOGC procedures even if they don't issue these for ISO 9000 Certification. GOGC requested whether DESFA could support this effort. The DESFA trainers replied that they are available for everything GOGC need. Both parties agreed to communicate directly between themselves in future for exchanging information and experience.

4.6.2 Issues discussed during technical seminar for the Cathodic protection and lightning protection on gas transmission pipelines

Tbilisi, 08/10/2013-11/10/2013

The main issues that attracted the interest of trainees during the seminar were as follows:

1. Cathodic Protection design considerations.

2. Cathodic Protection interference from foreign pipeline CP systems and at crossings with bare pipelines. GOGC generally do not protect or ineffectively protect the old pipelines. As they have a mixture of pipelines (new pipelines PE coated with old barely coated pipelines) they were interested in interference between two systems.

3. On the question of suggesting an effective way of protecting the old bare pipelines the DESFA trainer suggested that anything would not be effective without extensive coating restoration.

4. GOGC tends to install T/R units of high power to protect new PE coated pipelines which should normally require minimal current and voltage. DESFA suggested that it is a rather costly installation that is not at all necessary when the pipeline is well isolated from foreign structures. The strong fence surrounding the T/R unit installation was a good measure against vandalism and theft.

5. CP modeling and AC interference studies. It seems that GOGC engineers are not familiar with proximity effects study as their pipelines were barely coated and so submitted to minimal AC interference. But, as was explained by the trainer, this is a study that has to be taken into consideration for newly constructed pipelines.

6. Corrosion risk of new pipeline section when replacing an old one. As they seem to replace old leaking lines with new PE coated ones without intermediate isolating joints, GOGC run the risk of accelerated corrosion rates on tiny coating defects on the new line, unless they carry out a thorough coating integrity inspection first. The trainer suggested a practical example with pictures of severe fast corrosion on coating breaksof a military PE-coated pipeline which had been used to replace old leaking line sections.

7. Insulating joints and the necessity to be protected with spark gaps gained GOGC interest. GOGC tends to isolate new pipelines from the old ones via insulating joints that are not protected with spark gaps. The trainer warned that they must use spark gaps and they must install them as soon as possible.

8. Upon GOGC request, the trainer provided information for materials suppliers and types of T/R units and anodes implemented in the DESFA system.

9. Text plates of CP test posts and marking of pin brazing connections was discussed.

10. A special question was addressed on how the magnesium anode wiring connection setup is better, in order to test both current and potential as accurately as possible.

11. The GOGC design team was also encouraged to establish long term cooperation with the operation team, in order to get feedback from the operations point of view.

12. GOGC was encouraged to hire a CP specialist who will gradually take over and develop the CP system.

13. GOGC demonstrated a primitive gas pressure monitoring SCADA system operated through GSM technology. It was noteworthy that it had been built with in-house expertise. What was also remarkable is that GGTC remotely followed their patrollers' movement. The patrollers could communicate their findings remotely by pressing a button and sending a coded alarm.

4.6.3 Issues discussed during the technical seminar for planning, preparing and conducting direct assessment techniques for non-piggable pipelines

Tbilisi, 29/10/13-1/11/13

The following issues were discussed during the seminar:

1) Original pipeline system

The information on the original pipeline system was limited. It was understood that the actual pipeline operating pressure is a lot lower than the design pressure.

The trainer demonstrated to participants that in the UK, in accordance with UK regulatory practice and UK pipeline design code requirements, where a pressure system has not seen a pressure within 7 bar of the design pressure in the previous 4 years, then the MOP of the pipeline system would need to be re-confirmed at the maximum pressure seen during the 4 year period and the pipeline could not be operated at its design pressure without a detailed integrity assessment.

There was CP applied to the visited GOGC pipeline system up to 1990. Thereafter the CP system was removed and it is understood that there is no CP applied to this pipeline system at present.

There are inspections carried out on the pipeline system. However, no documentation to confirm the nature of the inspections conducted was presented for review. There was a document showing photographs of the pipeline system and route information.

The limited inspection of the pipeline system conducted by the trainer showed its condition to be far from ideal and serious integrity and operational performance concerns were highlighted.

It is believed that GOGC had plans in place to address these but they were not discussed in detail.

2) New Pipeline System

The new pipeline system was understood to be designed to ASME B31.8 and used a high quality 3LPE/3LPP coating system and API 5L X60 grade pipe material. The pipeline was buried along its entire length and at roads and railway crossings it was installed in casings. No precise details were provided of the pipeline specification but it was understood that the pipeline is capable of having CP applied, but the CP system has not been energised at present.

3) Legislation

During the presentations the trainer explained that the UK gas industry is heavily regulated and any breaches of pipeline safety would incur significant fines and even possible closure of gas pipeline systems.

In the UK, gas pipelines are designed to IGE specifications rather than EN standards. The IGE documents are extremely detailed and have been based upon actual gas industry experience.

4) CP of New Pipelines

The CP TR unit for new pipelines appeared to have a high current and voltage output rating.

In Europe the voltage output of a TR unit is limited to less than 50V for safety. The current output capacity for the new TR unit was up to 75A. This is a very high current output for a 3LPE/3LPE coating system and would mean that there may issues associated with control of the CP system for the pipeline. The CP system may have been over designed.

On 3LPE systems there are also issues associated with AC/DC stray current interference that would need to be considered. These should have been included in the original pipeline and CP system design.

However, it was not clear if the risks of AC/DC interference had been considered and suitable mitigation measures included in the CP system design. GOGC indicated that there is DC stray current from the DC traction systems. This presented a significant risk to pipeline systems and would need to be monitored. The trainer also considered it important that the DC polarity is checked on the TR units when they are first energised. If connected incorrectly, rapid corrosion could occur on the gas pipeline system. The trainer's advice was to only energise TR units with a CP engineer in attendance.

The high TR unit current rating may also mean that carrying out a CIP survey could be problematic.

5) Valve Station Construction

There were a number of issues associated with the construction of the valve stations that were noted during the site survey. These were summarised as follows:

- The hazardous area appeared to extend outside the valve station fence.
- The valve station fences did not appear to be earthed.
- Below ground pipework seems to have been used for above ground pipework. In valve stations PRS pipework should be suitable for low temperature service e.g. ASTM A333 grade but it seems that API 5L grade material has been used.
- The lightning attractor pole had in one instance been installed directly above the pipeline in a visited valve station. This would mean a high voltage gradient would be created above the pipeline during a lightning strike and would be a safety hazard. The pole should be installed remote from the valve station to minimize GPR on pipeline during a lightning strike. The present design appeared to enhance the risk of lightning damage, not reduce it.
- Some sections of the buried pipeline at air to soil interfaces had plastic sheeting installed above pipeline, which would shield the pipeline from CP current. Thus the pipeline at this location may not be protected from corrosion. This indicated poor design. Field welds on the pipework above ground sometimes have not been coated.
- The coating on buried valves should be suitable for direct burial. The gravel should not be installed around pipework at ground exit points, but sand should be placed around the

pipe to mitigate coating damage.

- CP test facilities should be included in valve stations but none had been installed.
- Sufficient lengths of straight pipework should be installed after orifice plates to ensure accurate flow measurement. The straight pipe should extend 10 times the pipe diameter upstream and 5 times the pipe diameter on the downstream side of the flow measurement.
- Only one gas filtering stream had been used but on some PRS's GOGC may consider two to restrict downtime when filters are being replaced.
- Filters were cleaned every 2 weeks when Azerbaijan gas was used, and were not cleaned when Russian gas was used, which indicates possible internal corrosion risk with Azerbaijan gas.

The potential on the pipeline within the valve station was measured at -0.350V vs Cu/CuSO4. This indicates that the pipeline system may be suffering from galvanic corrosion by contact with the local earthen system and thus exposed an enhanced corrosion risk.

4.6.4 NDT seminar in Kiev issues & topics

Kiev, 12-23, May, 2014

The following issues were discussed during the study tour to NDT qualification seminar:

- General questions of nondestructive testing.
- Defects in welded joints of vessels and high pressure pipelines
- Physical basis of radiographic inspection
- Types of radiographic inspection.
- Detectors of ionizing radiation
- Radiographic films and screens
- Equipment and accessories for radiographic inspection
- Sources of high-energy facilities
- Technology of conducting radiographic inspection
- Regulatory and technical documentation and standards
- Explanation and interpretation of radiographs and evaluation of the quality of welded joints
- Safety Rules when working with sources of ionizing radiation
- Organization of radiographic inspection within the company and for each project

4.6.5 Study tour to DESFA, issues and topics

Greece, 17-22 October 2013.

The following issues were discussed during the study tour to DESFA's pipeline construction site:

1) Third Party Inspection

GOGC does not use services from third party inspection companies (TUV, LLOYDS, Bureau Veritas , SGS etc). DESFA explained that these companies are complying to ISO 17020 standard, are not involved in any other activity than inspection and testing and all companies and parties involved in plant design supply and installation (like buyers, sellers, engineering companies, plant owners) have access to their services and due to their independency and objective action their certifications are acceptable from all parties. That saves frictions and delays during construction or purchasing equipment.

2) Timetable of radiographies

The question of GOGC technical manager regarding the usual timetable that DESFA uses to implement radiographies, gave the opportunity for a long discussion on the subject. The main contractor of DESFA ,J&P-AVAX who has the responsibility of implementation explained the procedures that they areusing. The radiography, special in gas pipelines is the most critical test during construction but also the most hazard from the point of view of exposing workers in radioactivity. There are specialized small companies with the special equipment and certificates on equipment and personnel. The Owner has general specification for the precautions should be taken for the operation and the radiographies take place only when there is no other work at site and always with the presence of safety personnel of contractor and operator.

3) Hydro testing procedures

The methods that are using the European companies for the hydro testing has been discusses extensively. DESFA had arranged during the visit of GOGC, to have such test in part of the pipeline which was ready for that. The quality of water used , the repetition in cases of leakages and the "drying" of pipeline upon completion of the test were the main subjects that GOGC, DESFA , J&P-AVAX exchange their experience .

4) Special construction works

Special construction works for the protection of pipeline when crosses, rivers, bridges, roads, railway lines etc, have been shown by the contractor to GOGC engineers. Contractor presented the standards they are using and the practical details for the

methodologies of construction

5) Design Criteria for the allocation of valve and compressor stations

Valve and compressor stations are the main hazardous areas for a pipeline installation. GOGC visited the stations under construction and DESFA explained to the engineers the design criteria they are using to allocate the stations. They should not close to residential areas and should have convenient accessibility for the maintenance. Their design foresees operation without personnel. Through the Scada and Video monitoring systems there is continuous monitoring and control .

6) Identification of piping routes

The identification of the pipeline route is not a technical issue only, as explained by DESFA project manager, usually consumes more time to be decided the route than to be constructed the pipeline. The subject is social , political and economical. When the basic route will be decided from the technical point of view negotiations start with the communities of the area that the pipeline will go through and modifications will be decided in order to avoid objections. Afterwards negotiations start with the specific owners to find out the amount of compensation their requesting .Finally with the owners that there is no agreement the solution comes through the courts. The planning of the gas transmission network expansion should be executed carefully and will take into consideration the time of route identification, otherwise is not realistic.

4.7 Questions raised by the trainees during the seminars and the responses provided

What is the hazard radius in the event of pipeline failure?
This is determined by the pipeline diameter and pressure. The thermal hazard radius guidance given in UK standards was shown.

DCVG surveys: if they need a CP system to be available can they be performed on new pipeline construction before energisation of CP system?
Yes, DCVG surveys on new pipelines can be conducted using a temporary power source. On 3 layer CP systems the current requirement for CP is low so yes DCVG surveys can be conducted without a CP system energised. On the older pipelines DCVG surveys will not be practical due to high current demand.

Is there a test that can be used to evaluate coating integrity on HDDs?
Yes there is and details of the test are described in UK Gas standards. P. Lydon did have a PowerPoint presentation on how to conduct this test and showed photographs of the test being conducted and HDD installation method.

MFL pigging how is this performed in the UK what are indicative costs?

P. Lydon advised some typical costs but advised costs vary dependent upon extent of pigging e.g. need to perform cleaning pig runs, determine if NORM is present, if pipeline can be pigged and caliper and gauging pig runs would be possible.

What is typical cold bending radius for cold bends during new pipelines?
P. Lydon advised that he was not sure but would check, but it is believed to be in the region of 1 degree per meter so maximum 10 degrees.

What over the line surveys can be performed on the existing pipeline?
These are limited the DCVG and CIPS techniques are not practical as no CP is present on GOGC pipeline systems. PCM survey is possible but the small signal spread, limited connections to new pipeline and poor coating quality would mean that survey data would be of limited use.

What integrity management should be considered for the new and existing pipelines?
Need a different system for each pipeline type as there are different risks associated with the new pipelines and the older pipelines.

Are casings used in the UK?
No casings are not used on new pipelines. Heavy wall pipe is used instead. The UK does use casings on older lines and these are either filled with nitrogen or an alkaline grout is used to control the corrosion risk.

Pipeline fatigue: GOGC do not see an issue because of limited pressure variation
Correct that would be the case the limit in pressure cycling would limit the fatigue risk and increase the pipeline fatigue life.

GOGC delegate: we do not believe we have an internal corrosion risk.
You may have an internal corrosion risk as the gas quality is not monitored and you need to check the gas analysis to assess the corrosion risk. There may be a cracking risk dependent upon gas composition.

DC tractions system are present in Georgia do we have a problem?

There was a pipeline explosion in Russia near a rail line.
Yes, most definitely at rail crossings these would be high risk areas. The DC interference problem would actually be more severe on the new pipeline system with the high quality coating. If DC traction interference is present, the diodes that are used in bonds should have system redundancy in terms of spare diodes. GOGC need to look at this risk.

GOGC personnel were not aware of hazardous area requirements and risk
P. Lydon provided a separate presentation to provide an awareness of hazardous areas, electrical equipment specification for hazardous areas and explosion risks

5 Conclusions

5.1 The conclusions of the seminars are:

This AHEF assignment increased the capacity of GOGC personnel to supervise: the construction of pipelines; the rehabilitation program to replace part of the existing network; and the maintenance and operation of the Gas Transmission System. This new capacity will affect directly the cost of construction and maintenance as well as the reduction of the quantity of gas emissions improving environmental performance. Through the seminar for cathodic protection, GOGC specialists were trained to plan and design cathodic protection systems in accordance with international standards and best practices and to modify the existing CP systems to improve their efficiency and effectiveness. Through the seminar for the Direct Assessment of Unpiggable Pipelines, GOGC engineers practiced the new direct assessment methods on the existing old and deteriorated network to identify accurately the areas that must be rehabilitated immediately, thus reducing fugitive gas emissions and optimising the rehabilitation cost. Participants gained an understanding of the selection of high risk pipelines, based upon risk based analysis and an awareness of the different techniques available to locate defects. Through the seminar of Construction Supervision, GOGC gained capacity in NDT and testing inspection techniques and acquired professionals with internationally recognised NDT certificates. Through the Study Tour the key personnel of GOGC saw in practice all methodologies and procedures that they heard in the two seminars. They can now discuss with the local construction engineers the problems and difficulties they had in past and follow the standards.

5.2 Specific outcome from the seminars

As a result of the discussions during the seminars and the study tours following issues were identified as actions that GOGC will undertake:

5.2.1 Seminar for Construction Supervision, Testing and Commissioning and study tour

- GOGC QC units maintain a continuous conversation on ongoing tasks and receive advice from European colleagues.
- Recently, GOGC performed for the first time, a pipeline drying operation. Trainers assisted GOGC experts showing how this procedure should have been done and how many foam pigs are normally used in similar situations. Thus, the operation was performed according to European standards.
- Trainers gave GOGC access to DESFA's specifications in DESFA's site, which can be used for the future projects.

5.2.2 Seminar for Cathodic Protection in Transmission Pipelines

- The GOGC design team received information about more recent solutions for pipeline protection under high voltage power lines and these methods will be used for all future projects.
- As GOGC generally does not protect or ineffectively protect the old pipelines, GOGC received valuable information about how to minimize risks associated with interference between old and new systems.

- GOGC normally uses T/R units of high power to protect new, coated pipelines, which normally require minimal current and voltage. The trainers gave GOGC information that there is no necessity of such a costly installation when the pipeline is well isolated from foreign structures.
- GOGC normally uses insulating joints to separate old and new pipelines. As a result of trainings GOGC received information about necessity to protect them with spark gaps. It has been decided, that spark gaps will be definitely used for the future projects.
- Seminars gave GOGC more acknowledgment and understanding of the importance and significance of cathodic protection and its proper maintenance. As a result, it has been already decided to hire a cathodic protection professional.
- Trainers provided contact information about suppliers of T/R units and anodes implemented in DESFA system.

5.2.3 Seminar for Direct Assessment of Un-Piggable Pipelines

- The integrity management system adopted should be different for the new pipelines than the older pipelines that are in operation.
- The older pipeline system management is in need of urgent review as serious integrity and operational concerns are evident.
- The CP system on the section of new pipeline that has been installed is not operational.
- DC stray current and AC corrosion risks are highly likely on the new pipeline system.
- New pipeline CP TR units should only be energised when CP engineers are present as there is a risk of incorrect polarity connection, which could result in serious damage to the system.
- There are serious safety and integrity issues associated with operation of the original pipeline system.
- There are also risks that have been identified on the new pipeline system and these risks would need to be addressed by GOGC for construction of any new pipelines.
- Application of CP to the existing pipeline would be expensive and may provide limited benefit if the coating system has dis-bonded.
- The trainer of the third seminar P. Lydon prepared and submitted to GOGC participants two tables with his observations and comments regarding the existing and new pipeline systems. These tables are presented in Appendix 6.9

5.2.4 Seminar for NDT and Certification

- GOGC started operation of the NDT laboratory donated by USAID.
- GOGC already started reviewing and approving radiographic images for actual pipeline construction projects.
- Increased safety and security of the gas pipelines transmission network.

- Final acceptance of the construction parts by all involved parties (insurance companies, financial institutions, foreign operators of Cross Border Trading-TAP , etc.).

6 Appendixes

6.1 Agenda

The Agenda of the seminars/study tour can be found at the following link of the INOGATE web portal)

http://www.inogate.org/activities/287?lang=en

6.2 List of participants

The List of Participants of the seminars/study tour can be seen in the following link of the INOGATE web portal

http://www.inogate.org/activities/287?lang=en

6.3 Presentations

The main presentations of the seminars/study tour could be seen in the following link of the INOGATE web portal

http://www.inogate.org/activities/287?lang=en

6.4 Questionnaires

See Attachment 1

6.5 Evaluation results

See Attachment 2

6.6 Photos & media material

http://www.inogate.org/activities/287?lang=en

6.7 Certificates and GOGC reports

See Attachment 3

6.8 Thank you letter

See Attachment 4

6.9 Observation on GOGC Pipelines

During the site visit of the technical Seminar of Planning, Preparing and Conducting Direct Assessment the following integrity issues were identified by the trainer Mr. P. Lydon

6.9.1 Integrity Issues Existing Pipeline System

Item	Integrity Risk	Comment
1.0	Third Party Damage	This risk is high no pipeline route markers were evident or pipeline identification plates, the pipeline is routed above ground for parts of its length. The valves did not appear to be fenced off. Pipeline route is exposed on some sections and the pipeline can be easily damaged A third party organisation had constructed a trench across one operational pipeline in the area inspected. Route inspection is conducted by GOGC however not sure whether this is fully detailed and what procedures are in place
2.0	Corrosion	The risk of pipeline corrosion is high. The coating is damaged in many areas, no CP is applied and the pipeline coating shows evidence of disbondment
3.0	Valves	Valves not fenced, valves leaking gas in some instances, No valves locked off and valve movement keys readily accessible limited evidence of valve maintenance
4.0	Cathodic Protection	No CP is applied.
5.0	Valve Operation	Valves look to be in very poor condition and may not be able to be operated in the event of an emergency
6.0	Casings	Pipelines in casing at road crossings so internal corrosion risk in some cases no vent pipes installed at cased crossed so not possible to conduct gas leakage checks
7.0	Monitoring	Not sure what monitoring is installed to warn of leakage, detect pressure temperature and flow rate in pipeline
8.0	Building proximity issues	Along the pipeline routes buildings have been installed close to the pipeline and these may infringe building proximity distances
9.0	Touch Potential risks	Pipelines installed very close to overhead power lines touch potential risks. AC corrosion risk would be low because of poor coating quality
10.0	Air to soil interface issues	Coating on valves not suitable for direct burial in soil also where pipeline exists ground coating damage
11.0	Pipe supports	Corrosion risk under pipe supports this risk needs to be monitored
12.0	Fatigue	Pipeline age quite old no fatigue checks performed which would be a particular issue at above ground crossings
13.0	Valve leakage	Some valves inspected were leaking gas and these pose a significant risk along the pipeline route risk mitigation measures need to be adopted as an urgent priority.

6.9.2 Integrity Issues New Pipeline System

Item	Integrity Risk	Comment
1.0	Third Party Damage	This risk is high no pipeline route markers were evident or pipeline identification plates, the pipeline is routed above ground for parts of its length. The valves did not appear to be fenced off. Pipeline route is exposed on some sections and the pipeline can be easily damaged A third party organisation had constructed a trench across one operational pipeline in the area inspected. Route inspection is conducted by GOGC however not sure whether this is fully detailed and what procedures are in place
2.0	Corrosion	The risk of pipeline corrosion is high. The coating is damaged in many areas, no CP is applied and the pipeline coating shows evidence of disbandment
3.0	Valves	Valves not fenced, valves leaking gas in some instances, No valves locked off and valve movement keys readily accessible limited evidence of valve maintenance
4.0	Cathodic Protection	No CP is applied.
5.0	Valve Operation	Valves look to be in very poor condition and may not be able to be operated in the event of an emergency
6.0	Casings	Pipelines in casing at road crossings so internal corrosion risk in some cases no vent pipes installed at cased crossed so not possible to conduct gas leakage checks
7.0	Monitoring	Not sure what monitoring is installed to warn of leakage, detect pressure temperature and flow rate in pipeline
8.0	Building proximity issues	Along the pipeline routes buildings have been installed close to the pipeline and these may infringe building proximity distances

9.0	Touch Potential risks	Pipelines installed very close to overhead power lines touch potential risks. AC corrosion risk would be low because of poor coating quality
10.0	Air to soil interface issues	Coating on valves not suitable for direct burial in soil also where pipeline exists ground coating damage
11.0	Pipe supports	Corrosion risk under pipe supports this risk needs to be monitored
12.0	Fatigue	Pipeline age quite old no fatigue checks performed which would be a particular issue at above ground crossings
13.0	Valve leakage	Some valves inspected were leaking gas and these pose a significant risk along the pipeline route risk mitigation measures need to be adopted as an urgent priority.