APPRAISAL REPORT

CAO Appraisal for Audit of IFC

CAO Compliance

C-I-R7-Y06-F075
February 2007

Georgia
Baku-Tbilisi-Ceyhan (BTC) Pipeline

Case of Villagers of Krtsanisi

Summary

This appraisal report responds to a complaint about the Baku-Tbilisi-Ceyhan (BTC) Pipeline (the Project), an IFC investment. The complaint was filed by villagers in Krtsanisi, Georgia. The CAO Ombudsman concluded that the parties were not willing to engage in a facilitated solution. The case was therefore transferred to CAO Compliance for an appraisal to determine whether the complaint fulfilled the criteria for the next step in the CAO's investigative process, an audit of IFC. The complaint raised concerns about dust and disruptions to water supply generated during construction, pipeline safety, stakeholder interaction, and relocation/compensation.

Office of the Compliance Advisor/Ombudsman (CAO)
of the
International Finance Corporation (IFC) and
Multilateral Investment Guarantee Agency (MIGA)
Members of the World Bank Group

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About the CAO

The CAO's mission is to serve as a fair, trusted, and effective independent recourse mechanism and to improve the environmental and social accountability of IFC and MIGA.

The CAO (Office of the Compliance Advisor/Ombudsman) is an independent post that reports directly to the President of the World Bank Group. The CAO reviews complaints from communities affected by development projects undertaken by the two private sector lending arms of the World Bank Group: the International Finance Corporation (IFC) and the Multilateral Investment Guarantee Fund (MIGA).

For more information about the CAO, please visit www.cao-ombudsman.org

1. Overview of the CAO Compliance Appraisal Process

When the CAO receives a complaint about an IFC or MIGA project, it first refers it to the CAO Ombudsman, which works to respond quickly and effectively to complaints through facilitated settlements, if appropriate. If the CAO Ombudsman concludes that the parties are not willing to reach a facilitated solution, the CAO Vice President has the discretion to request the compliance arm of CAO, CAO Compliance, to appraise the concerns raised in the complaint for a compliance audit of IFC or MIGA. Alternatively, a compliance audit can be initiated by request from the President of the World Bank Group or the senior management of IFC or MIGA.

A CAO Compliance appraisal is a preliminary investigation to determine whether the CAO should proceed to a compliance audit of IFC or MIGA. Through CAO Compliance appraisals, the CAO ensures that compliance audits of IFC or MIGA are initiated only for those cases with substantial concerns regarding social or environmental outcomes.

A compliance audit is concerned with assessing the application of relevant policy provisions and related guidelines and procedures to determine whether IFC and MIGA are in compliance. The primary focus of compliance auditing is on IFC and MIGA, but the role of the sponsor may also be considered.

A compliance audit appraisal, and any audit that ensues, must remain within scope of the original complaint or request. It cannot go beyond the confines of the complaint or request to address other issues. In such cases, the complainant or requestor should consider a new complaint or request.

CAO compliance appraisal will consider how IFC/MIGA assured itself/themselves of compliance with national law, reflecting international legal commitments, along with other audit criteria. The CAO has no authority with respect to judicial processes. The CAO is not an appeals court or a legal enforcement mechanism, nor is the CAO a substitute for international courts systems or court systems in host countries.

The appraisal criteria are set forth in CAO's Operational Guidelines**.** The criteria are framed as a series of questions to test the value of undertaking a compliance audit of IFC or MIGA. The criteria are as follows:

- Is there evidence (or perceived risk) of adverse social and environmental outcomes that indicates that policy provisions (or other audit criteria) may not have been adhered to?
- Is there evidence of risk of significant adverse social and environmental outcomes that indicates that policy provisions, standards, guidelines, etc., whether or not complied with, have failed to provide an adequate level of protection?

- Is there evidence (or perceived risk) of significant adverse social and environmental outcomes where policy provisions, standards (or other audit criteria) were not thought to be applicable but perhaps should have been applied?
- Is there evidence that the application of some aspect of a policy, standard, guideline or procedure resulted in adverse social and environmental outcomes?
- Can the cause of adverse social and environmental outcomes not be readily identified and corrected through the intervention of the project team without a detailed investigation of the underlying causes or circumstances?
- Could a compliance audit yield information or findings that might better inform the application of policies (or other audit criteria) to future projects?

During appraisal, CAO Compliance holds discussions with the IFC or MIGA project team and other relevant parties to understand the validity of the concerns and to explore whether an audit would be warranted.

After a compliance appraisal has been completed, the CAO can choose only one of two options: to close the case, or to initiate a compliance audit of IFC or MIGA.

The CAO will report and disclose the findings and decision of the CAO compliance appraisal in an appraisal report in order to inform the President of the World Bank Group, the Boards of the World Bank Group, senior management of IFC or MIGA, and the public in writing about its decision.

If the CAO decides to initiate a compliance audit, as a result of the compliance appraisal, the CAO will draw up a terms of reference for the audit in accordance with CAO's operational guidelines.

2. Background and Concerns that Led to the Appraisal

1. The 1,760 km Baku–Tbilisi–Ceyhan (BTC) Pipeline, an IFC investment, starts in Azerbaijan at the Sangachal Terminal near Baku, passes through Georgia, and ends in Turkey at a new marine terminal at Ceyhan on the Mediterranean coast.

2. Residents of the villages of Krtsanisi, Georgia filed a complaint with the CAO concerning consequences for the villages as a result of the BTC pipeline project. The main issues concern: generation of dust during construction, shortage of water supply during construction, pipeline safety, the functioning of the project-specific grievance mechanism, and as a result of the above, issues of compensation and relocation.

3. Construction was finished and the pipeline corridor near Krtsanisi was re-vegetated by the summer of 2006.

2005	
December 12	Residents of the village of Krtsanisi, George file a complaint with the CAO.
2006	
June 15	The CAO Ombudsman finds that the stakeholders are unwilling to engage further in a process of facilitated dispute resolution.
June 15	CAO Compliance receives the case from CAO's Vice President for appraisal.
October 29	CAO Compliance receives the last clarification from the involved parties.

3. Scope of the Appraisal for an Audit of IFC

4. The complainants have raised specific issues in their complaint regarding:

a. *Generation of dust during construction*. The complaint states that truck traffic during construction generated so much dust that living conditions and farming conditions became intolerable.

b. *Shortage of water during construction*. The complaint states that many fruit trees were lost because the complainants were derived of water for one year.

c. *Pipeline safety*. The complaint specifies the following conditions, which it claims have led to danger/unacceptable risk for the population:

- Pipes had to be repaired/welded/redone in eight places close to their village.
- The pipeline in this area has no automatic close-down system in case of failure. The nearby pipeline has "no automatically closing sash safety valve" and does “not have accidental automatic closing hatches.”
- The foundation for the pipeline in this area is unsatisfactory. "Pipelines were laid in the ground without concrete bearings" and "pipes on special concrete holdfasts should have been installed.” This, in combination with heavy truck traffic on and across the pipeline corridor has increased the danger and risk to the population, according the complainants.

d. *Stakeholders interaction*. The complaint states that “the company” (the Project) could not receive claims from the village because the promised/stated working group was never established. The complainants state that they "tried to settle the question, but we could not manage to overcome bureaucratic barriers."

e. *Relocation/compensation*. The complaint states that the complainants were informed that they lived too close to the pipeline to be safe. The complaint further states that the complainants have not been relocated and/or received the compensation they should have.

5. The complainants seek compensation for all of the above, and relocation and compensation because of safety issues.

4. Policy Provisions Identified as Relevant

6. CAO Compliance identified the following policy provisions as the basis for evaluating the issues raised:

a. *Generation of dust during construction*. Requirements for control and mitigation of dust as a construction activity consequence are outlined in BTC Project Contractor Control Plan-Pollution Prevention–Georgia, May 2003, and in BTC Project Environmental and Social Impact Assessment (ESIA) Executive Summary–Georgia, November 2002.

b. *Shortage of water during construction*. Requirements for securing water supply during construction are outlined in BTC Project Contractor Control Plan–Reinstatement, May 2003, and in BTC Project ESIA Executive Summary–Georgia, November 2002.

c. *Pipeline safety*. Design requirements used for the pipeline are American Society of Mechanical Engineers (ASME) B31.4, “Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids.”

d. *Stakeholders interaction*. Requirements for project-based grievance mechanisms are spelled out in the BTC Project Contractor Control Plan-Community Liaison–Georgia, May 2003, as well as in the Public Consultation and Disclosure Plan (PCDP)–Georgia, June 2003.

e. *Relocation/compensation.* Requirements and provisions are outlined in BTC Project–Resettlement Action Plan–Georgia, December 2002.

5. CAO Findings

7. The appraisal team found the following:

a. *Generation of dust during construction*. None of the complaints (verbal or written) registered during construction concerned the issue of dust generation. CAO sees no indications that the BTC Project Contractor Control Plan-Pollution Prevention–Georgia, May 2003, or the BTC Project Environmental and Social Impact Assessment (ESIA) Executive Summary–Georgia, November 2002 failed in providing provisions in this case, or that IFC failed in assuring itself that the provisions were followed.

b. *Shortage of water during construction*. There are registered occasions when the potable water distribution system was damaged by construction. The Project could on those occasions readily document that they responded swiftly. There are no indications that the Project caused additional damage to the existing irrigation water system. The CAO sees no indications that the BTC Project Contractor Control Plan–Reinstatement, May 2003, or the BTC Project ESIA Executive Summary–Georgia, November 2002 failed in providing provisions in this case, or that IFC failed in assuring itself that the provisions were followed.

c. *Pipeline safety*. The CAO sees no indications that the design standard had not been adhered to. In order to assess the comprehensive technical documentation the Project handed over to the appraisal team, and to assure the villagers of Krtsanisi of their safety, the CAO, as part of the appraisal, engaged an independent engineer to assess how IFC and the Project assured themselves that the design requirements were met. The independent engineer concluded that complaints relating to pipeline safety could not be substantiated. The complete technical assessment report is attached to this appraisal report as an appendix.

d. *Stakeholders interaction*. IFC and the Project could readily document for CAO the presence of a Community Liason Officer (CLO) in the area during construction, as outlined in the requirements. Because the CLO encountered hostilities on occasion from local residents, the Project suspended visits to the area for security reasons for certain periods. Documentation of the CLO's verbal interaction with the villagers during construction, as well as filed written complaints submitted by the villagers and documentation of communication between the Project and residents, does however indicate that a grievance mechanism was in place during construction. The CAO does not address the effectiveness of the grievance mechanism in cases not related to this complaint. The CAO sees no indications that the BTC Project Contractor Control Plan-Community Liaison–Georgia, May 2003, or the Public Consultation and Disclosure Plan (PCDP)–Georgia, June 2003, failed in providing provisions in this case, or that IFC failed in assuring itself that the provisions were followed.

e. *Relocation/compensation*. The CAO sees no indications that the BTC Project–Resettlement Action Plan–Georgia, December 2002, failed in providing provisions in this case, or that IFC failed in assuring itself that the provisions were followed.

6. The CAO Decision

8. The CAO concludes that this case does not fulfill the criteria for further investigation in the form of an audit of how IFC assured itself that it adhered to its social and environmental policy provisions. The CAO closes the case.

Appendix. Technical Assessment Report

The text of the report on safety issues follows. The report was prepared by an independent engineer contracted by the CAO during the appraisal.

COMPLIANCE ADVISOR OMBUDSMAN

BTC PIPELINE – GEORGIA
Assessment of Pipeline Safety
Complaint from
Krtsanisi Village Residents

DOCUMENT NO: 125-R-03

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REVIEW AND APPROVAL RECORD

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0	22/12/06	Issued	PBV	HL	
A	28/11/06	Issued for Client Review	PBV	HL	

Disclaimer

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1. SUMMARY

This report presents an independent review of the safety of the Baku-Tbilisi-Ceyhan (BTC) oil transmission pipeline and the South Caucasus Pipeline (SCP) constructed in the vicinity of the village of Krtsanisi, Gardabani Region, Georgia.

The report was commissioned by the Compliance Advisor Ombudsman (CAO), to provide advice that could be used in assessing complaints raised by residents of Krtsanisi in relation to the safety or pipelines passing close to the village.

The report was prepared by Venton and Associates Pty Ltd, (Venton) using information provided by BTC, and referencing information gathered by Venton during visits to the site during 2004 to consider and advise on a number of similar complaints received by CAO. Venton and Associates have had no other involvement with either the BTC or the SCP projects.

The report addresses the technical issues associated with the design and construction of the pipeline and comments on safety issues associated with the operation of the pipeline. This is done by comparing the design of the pipelines as presented in the documented provided by the project, together with public information downloaded from the project web site and provided by BTC as part of work undertaken for the CAO during 2004.

The report concludes that:

- The design of each pipeline is consistent with the requirements of the international Standard to which each was designed.
- Each pipeline was constructed with an appropriate level of construction quality management. This management process identified potential flaws in the pipeline and implemented appropriate rectification processes to realise a safe pipeline.
- The pipeline operator has implemented an appropriate safety and operating plan, including specific procedures to identify and manage potential threats to the pipeline at a high and detailed level.

Based on information available to the author, this report concludes that complaints relating to pipeline safety cannot be substantiated.

2. ABBREVIATIONS

The following abbreviations are used in this report:

API	American Petroleum Institute (a body responsible for preparing and issuing standards that are internationally accepted and used)
ASME	American Society of Mechanical Engineers (a body responsible for preparing and issuing standards that are internationally accepted and used)
ATMOS PIPE	Pipeline Integrity Monitoring System (installed on SCP)
B31.4	ASME Standard B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids
B31.8	ASME Standard B31.8 Gas Transmission and Distribution Piping Systems
BTC	Baku Tblisi Ceyhan pipeline (and pipeline company)
CAO	Compliance Advisor / Ombudsman
DCVG	Direct current voltage gradient (a test method to detect damaged coating on buried pipelines)
HV	Vickers hardness (a test method for determining hardness of a material)
IFC	International Finance Corporation
kP	Kilometre post (location along the pipeline from the start measurement point)
MPa	MegaPascal (A unit of pressure. 1 MPa = 10 Bar = 145 psi)
SCP	South Caucasus Pipeline
SMYS	Specified minimum yield strength (a property of pipe steel)
SPPD	Strategic Pipeline Protection Department (part of BTC)
WREP	An existing pipeline passing through Georgia

3. NATURE OF COMPLAINT

The Compliance Advisor / Ombudsman (CAO) received a complaint from residents of the Village Krtsanisi, Gardabani Region, Georgia, in relation to issues with the design and construction of the Baku-Tbilisi-Ceyhan (BTC) crude oil pipeline and the South Caucasus Pipeline (SCP) natural gas pipeline.

These pipelines pass close to the village.

One aspect of the complaint relates to pipeline safety. Specifically:

1. The pipelines are installed in ground without “concrete bearing” (which was understood to be the basis proposed in initial public documents). There is a concern that this will caused the pipeline to become unstable and break, potentially causing harm to the residents.
2. This concern is heightened by the residents being aware that the pipelines “burst” in eight places after laying, causing the pipeline construction contractor to return to the installed pipelines and undertake repairs.

The pipelines are constructed and are now in operation.

4. SCOPE OF THIS REPORT

This report is limited to the technical aspects of the pipeline design, construction, and operation of the pipeline as they influence the safety of the pipeline with respect to the people and the environment within the zone of influence of the pipeline.

The International Finance Corporation (IFC) contributed funds to the realisation of the BTC pipeline, and it is through the social and environmental obligations that are tied to this funding that the residents of the village Krtsanisi have lodged this complaint.

The IFC did not contribute funds to the realisation of the SCP, and as such there is no obligation for them to accept a complaint in relation to the safety of the SCP. However it must be recognised that since both pipelines are constructed in the same corridor, and service the same hydrocarbon source, it may be reasonable to expect that the residents are unable to fully comprehend the subtlety of the funding arrangements when assessing potential impacts on their safety. Consequently this report considers the safety issues connected to both pipelines.

The safety assessment is made against comparison of the design and construction of the pipelines against:

- The standards (Codes) to which the pipelines were designed and constructed.
- Good engineering and operating practices for high pressure hydrocarbon transmission pipelines.

Documents considered in preparing this report are summarised in Appendix 1 of this report.

5. PIPELINES ROUTE AT KRTSANISI

5.1 GENERAL

The location of the pipelines in the vicinity of Krtsanisi is illustrated in **Figure 5-1** and **Figure 5-2**.

The land traversed by the pipeline is rural / agricultural. At Krtsanisi the pipelines route passes to the north of the village, turns left, and passes to the south side of a road, and proceeds through agricultural land to the west of the village. There are a number of dwellings on either side of the pipeline route between kP 39.2 and 39.8 (approx).

There are many constraints to the pipeline route at this location, both physical (dams roads and agricultural areas) and residential areas. The pipeline location between the two residential areas is not ideal; inspection of the land in the vicinity suggests that the location was chosen as the one that minimised the number of dwellings close to the pipelines.

If the pipeline route was moved south, it would run close to the area identified as Zoovetinst Dasakhleba, while if it was moved to the north it would potentially affect other residential and industrial areas, and increase the pipeline length and cost.

Because of its proximity to the residential areas, the design of each pipeline is modified in this location to increase safety in accordance with the requirements of the design standards for such areas, and in accordance with international design practice.

Pipeline designers usually prefer to install the pipeline away from residential areas, but in this location it is apparent that the design choice to route the pipeline between the two residential areas with additional safety provisions was substantially lower cost than the cost of the increased length to route the pipelines where they avoided the villages. This approach is reasonable, and consistent with international pipeline design practice.

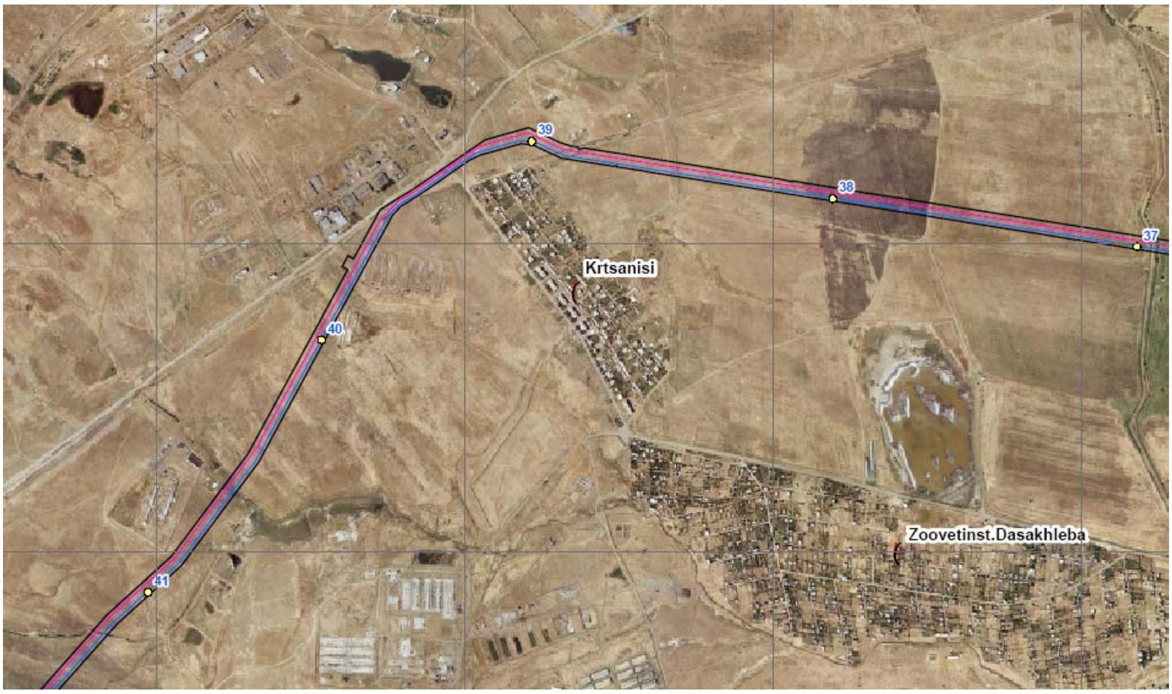

Figure 5-1 Pipeline Location in Vicinity of Krtsanisi

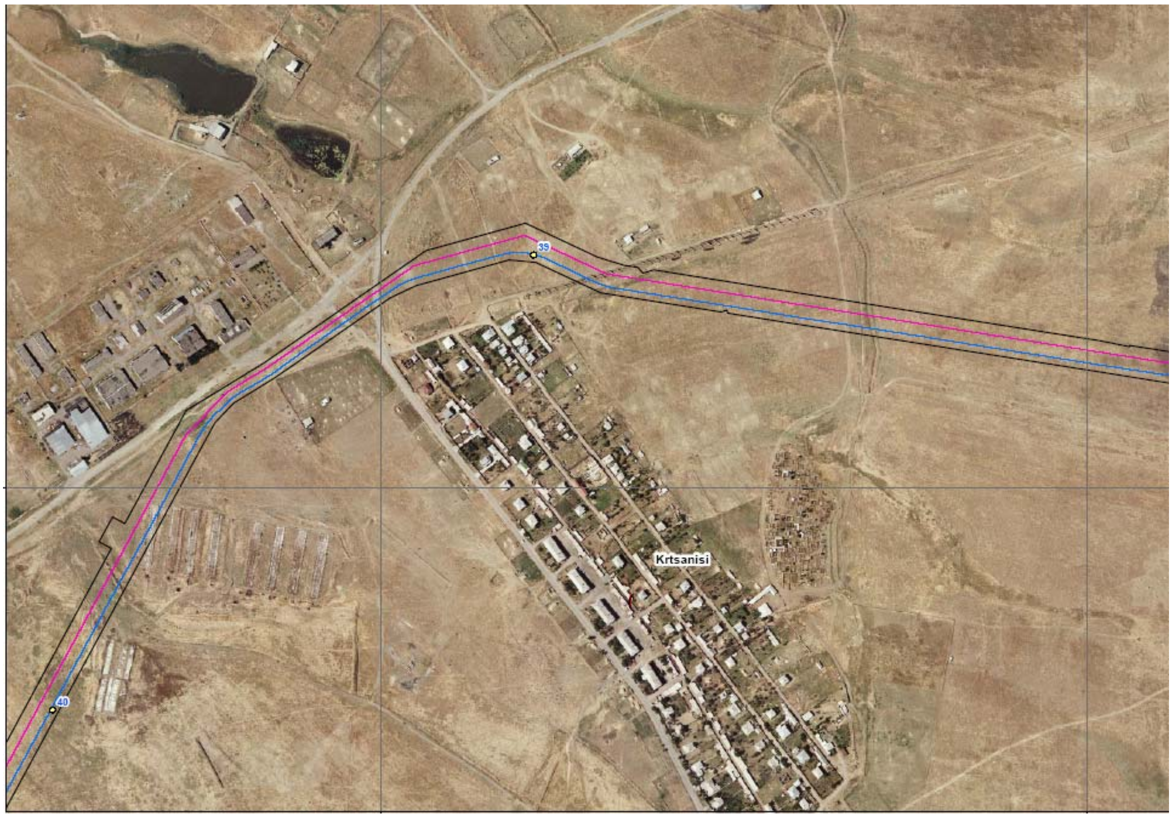

Figure 5-2 Location of Pipelines at Krtsanisi

5.2 LOCATION CLASS

The concept of "Location Class" applies only to gas pipelines. The concept is to broadly classify the route into areas where the threats to the pipeline and the consequences from pipeline failure (in terms of human population) are roughly equal.

The concept is based on the population density in a location 0.25 mile wide and 1 mile long along the pipeline route.

Location Class 1: applies to any location where there are ≤ 10 buildings intended for human occupancy.

Location Class 2: applies to any location where there are >10 and < 46 buildings intended for human occupancy.

Location Class 3: applies to any location where there are ≥ 46 buildings intended for human occupancy

Location Class 4: applies to any location where multistorey buildings predominate, where traffic is heavy or dense, and where there may be numerous other utilities underground.

Between kP 21.199 and kP 42.349, the SCP has classified the route as Location Class 3, recognising that there are a number of residential areas along the route, and that the location is designated for development.

The difference between gas and liquid pipelines is that because the gas is compressed and it is highly flammable, the energy release rate and the likelihood of gas ignition following a pipeline leak is very high. Furthermore the release will continue for a considerable time whether or not isolation valves are installed and operated. An oil pipeline leak on the other hand can be quickly identified by the pipeline control system, and the pipeline can be quickly depressurised, minimising the leak. Furthermore, the oil product is considerably more difficult to ignite.

The Location Class of a gas pipeline is used to require more conservative designs in locations where, because of the population density and activities associated with the population centres there may be increased the frequency of pipeline damage, and if there is a leak, where the consequence in terms of human and property impact is higher.

6. DESIGN STANDARDS

The BTC pipeline transports stabilised crude oil. It is designed in accordance with the requirements of ASME B31.4 "Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids". ASME B31.4 is used internationally for design of high pressure pipelines transporting petroleum liquids.

This document states:

Clause 400(b) "*The requirements of this Code are adequate for safety under conditions normally encountered in the operation of liquid pipeline systems. Requirements for abnormal or unusual conditions are not specifically provided for, nor are all details of engineering and construction prescribed. All work performed within the Scope of this Code shall comply with the safety standards, expressed or implied".*

Clause 400(c) "*The primary purpose of this Code is to establish requirements for safe design, construction, inspection, testing, operation, and maintenance of liquid pipeline systems for protection of the general public and operating company personnel, as well as reasonable protection of the piping system against vandalism and accidental damage by others, and reasonable protection of the environment".*

Clause 400(e) "*The Code does not do away with the need for the engineer or competent engineering judgement. The specific design requirements of the Code usually revolve around a simplified engineering approach to a subject. It is intended that a designer capable of applying more complete and rigorous analysis to a special of unusual problems shall have the latitude in the development of such designs and the evaluation of complex or combine stresses. In such cases the designer is responsible for demonstrating the validity of his approach*".

The SCP pipeline is designed in accordance with the requirements of ASME B31.8 "Gas Transmission and Distribution Piping Systems". ASME B31.8 is used internationally for design of high pressure pipelines transporting natural gas.

Clause 802.2 (Intent) mirrors the principles nominated in ASME B31.4.

These basic principles provide an assurance to the public that a pipeline designed, constructed, operated and maintained in accordance with the Standard satisfies at least the minimum requirements for safety, and importantly that there is an obligation to investigate and provide for "*abnormal or unusual conditions".*

Each Standard requires that "*work undertaken on pipeline design, construction or operation should be undertaken using supervisory personnel having the experience or knowledge to make adequate provision for such unusual conditions and specific engineering and construction details"* (ASME B31.8 words, but the principle of *competence* applies equally to the requirements for liquids pipelines).

Consequently, if it can be demonstrated that the design, construction, testing and operation of the pipeline is consistent with the principles of the Standard, then by definition, the pipeline is "safe". Such demonstration requires not only compliance with the written work for the Standard, but more importantly that the organisation responsible for the pipeline undertake sufficient work to be able to demonstrate that the pipeline complies with the principles.

While there may be specific *threats* to a pipeline that are not identified during its design and construction which have the potential to impact on the integrity of the pipeline through its operating life, rigorous application of the design principles through the design, construction testing and operating phases of the pipeline can be counted on to reduce the likelihood of threats that pose a significant risk to the pipeline integrity to a level where the risk from these threats is lower than the level usually accepted by the community.

7. PIPELINE DESIGN AT KRTSANISI

7.1 BTC OIL PIPELINE

The design parameters for the BTC pipeline in the vicinity of Krtsanisi are:

Design Standard	ANSI B31.4
Diameter	1168.4 mm (46”) outside diameter
Design Pressure	120Bar (MPa) (1740 psi)
Pipe Specification	API 5L
Steel Grade	X70 (70,000 psi specified minimum yield strength (SMYS))
Wall Thickness for Pressure Containment	20.2 mm
Hoop Stress	72% of SMYS
Wall thickness installed	20.6 mm
Hoop Stress	72% of SMYS
Minimum depth of cover	1.2 m
Typical depth of cover in Krtsanisi area	> 1.5 m

The BTC pipeline diameter is 1067 mm outside diameter (DN 1050) (42”) for most of its length. Because of the elevation change through Georgia, the pipeline diameter is increased downstream of the pump station in the eastern part of Georgia to DN 1150 (46”), and the pump station discharge pressure increased, compared with the design typically used for the DN 1050 (42”) pipeline. This design change enabled BTC to eliminate a pump station that was originally planned to be installed in the mountainous and environmentally sensitive area.

The design standard (ASME B31.4) requires the pipeline wall thickness to be designed using 72% of the specified minimum yield strength of the pipe steel, subject to the strength of the pipe being demonstrated by hydrostatic pressure testing at a pressure that is at least 1.25 times the internal design pressure.

The line pipe is Grade X70 and was manufactured to API 5L by Sumitomo Corporation in Japan. Specific properties of the pipe supplied to the project are:

- Yield strength is typically 590 MPa.
- Tensile strength is typically 650 MPa.
- Elongation is typically around 25%.
- Yield to tensile ratio is typically around 90.8%.
- Toughness Charpy values are typically between 200 and 300 Joules at -30 deg C.

These properties are consistent with the requirements for high quality line pipe. It should be noted that the “typical” yield stress of 590 MPa is more than 20% higher than the specified minimum value for API 5L Grade X70 pipe.

7.2 SCP GAS PIPELINE

The design parameters for the SCP pipeline in the vicinity of Krtsanisi are:

Design Standard	ANSI B31.8
Diameter	1067 mm (42”) outside diameter
Design Pressure	95Bar (9,500MPa) (1,378psi)
Pipe Specification	API 5L
Steel Grade	X70 (70,000 psi specified minimum yield strength – (SMYS))
Wall Thickness for Pressure Containment	14.6 mm (14.7 mm used)
Hoop Stress	72% of SMYS
Wall thickness Specified	21.2 mm
Hoop Stress	50% of SMYS
Minimum depth of cover	1.2 m
Typical depth of cover in Krtsanisi area	> 1.5 m

The design standard (ASME B 31.8) permits the pipeline wall thickness to be designed using 72% of the specified minimum yield strength of the pipe steel, subject to the strength of the pipe being demonstrated by hydrostatic pressure testing at a pressure that is at least 1.25 times the internal design pressure. The design standard also permits the pipeline to be designed at a higher design factor when it is installed in a remote location.

ASME B31.8 mandates that the design stress level is reduced in locations where the pipeline passes close to areas of increased population density. Thus:

- In broad rural areas, the pipeline is permitted to operate at a hoop stress of 72% of SMYS (0.72 design factor)
- In semi-rural areas, the hoop stress is required to be limited to 60% of SMYS (0.60 design factor).
- In residential areas, the hoop stress is required to be limited to 50% of SMYS (0.50 design factor).

The lower design factor effectively requires the pipe wall thickness to be increased.

In the vicinity of Krtsanisi, the pipe is all designed on the basis of 50% of SMYS.

The line pipe is Grade X70 and was manufactured to API 5L by Sumitomo Corporation in Japan. Specific properties of the pipe supplied to the project are:

- Yield strength is typically 570 MPa.
- Tensile strength is typically 650 MPa.
- Elongation is typically around 24%.
- Yield to tensile ratio is typically around 87.7%.
- Charpy values are typically between 200 and 300 Joules at -30 deg C.

These properties are consistent with the requirements for high quality line pipe. It should be noted that the “typical” yield stress of 570 MPa is approximately 18% higher than the specified minimum value for API 5L Grade X70 pipe.

The high level of fracture toughness appears adequate for control of fast tearing fracture in a pipeline of this size and pressure, although work undertaken in preparing this report has not included an analysis of fast tearing fracture.

7.3 Specific Construction Information

7.3.1 Weld Metal Properties

The main line welding process was automatic welding, manual welding was carried out at special sections and tie-ins.

Weld metal properties used for joining pipes are important in assessing the integrity of pipe welds. BTC provided the following information on weld metal properties:

- Tensile testing values were in accordance with API 1104.
- Charpy V-notch impact testing acceptance criteria for weld procedures on both SCP and BTC Pipelines (API 5L X70 line pipe) were a minimum of 50 Joules average and a minimum of 40 Joules for any individual specimen.
- Maximum individual hardness values (HV10) for the weld metal or the heat affected zone on SCP was 325.
- For BTC this was 325 for cellulosic electrodes and 350 for the low hydrogen welding process.
- Overmatching of actual properties was carried out for active fault crossings only. There are no active fault crossings in the Krtsanisi area.
- Welding consumables have been tested in the as-welded condition to ensure they have a tensile strength at least equal to the minimum specified for the parent pipe.

The pipeline design required that the weld metal strength exceeded the strength of the actual pipes in locations where the pipe was installed in areas of known ground faults to ensure that in the event of severe ground movement, strains would be distributed over the whole of the pipe, and not concentrated in lower strength weld metal. In areas where there was no identified risk of ground displacement, specific testing was not applied.

7.3.2 Weld Quality Acceptance

BTC advised that non-destructive testing of each pipeline weld was assessed using the requirements of API 1104. The acceptance criteria for welds are in accordance with API 1104, Section 9, with the following amendments:

- Amendments for SCP: The acceptance criteria for undercut (as defined in clause 9.3.11 of API Standard 1104) shall be Table 4 of API Standard 1104.
- Amendments for SCP: Cracks, including star cracks and crater cracks as described in clause 9.3.10 of API Standard 1104, are unacceptable regardless of size.
- Amendments for BTC: For pipe diameters over 700mm the maximum root penetration at any point shall not exceed 4mm.
- Amendments for BTC: Welds found with cracks shall be cut out (excluding crater cracks with a length of 4mm, or less).
- Amendments for BTC: No arc strikes are permitted outside the weld groove.

- There was no repair methodology for transverse welding indications. All welds containing any transverse defects were cut out.

7.3.3 Weld Defects in the Vicinity of Krtsanisi

On BTC there were 26 transverse welding defects found during internal ultrasonic testing of all manual main line welds between KP29 to KP52. During the ultrasonic testing process an additional 22 cuts were made into the pipeline to ensure safe access for people working inside the pipe to undertake repairs to the weld.

The welding problem was only applicable to the manual welding process used on the BTC Pipeline during the early phase of pipeline construction with the first onset of winter when the ambient temperatures dropped. When the transverse welding indications were discovered the welding procedure was changed to low hydrogen to prevent reoccurrence and all manual welds carried out using the cellulose procedure were subject to 100% U/T from inside the pipe.

In sections, where external access was available the welds were also subject to additional X-radiography using a more sensitive film (Agfa D4) instead of the industry standard D7 to ensure any transverse indications were identified.

The welding problem was resolved prior to construction of SCP and there were no cut outs in this section.

7.3.4 Coating Defects on Installed Pipe

While every care is taken during pipeline construction, it is good practice to undertake a coating integrity inspection after the pipeline has been installed to identify any location where protective coating has been damaged during the installation process, and to repair identified damage locations. The technique usually adopted is the direct current voltage gradient (DCVG) method.

BTC advised that 2 dig-ups were undertaken in the vicinity of Krtsanisi (between KP35 to KP52) to investigate and repair coating damage identified in the DCVG survey.

BTC advised that here were no DCVG indications and subsequent dig-ups on SCP.

7.3.5 Pipeline Construction Dents

Good pipeline construction practice includes an inspection of the pipeline using an in-line inspection tool to measure the internal shape of the pipeline. This tool identifies the presence of ovality or dents formed by the construction process that could indicate a condition which may affect the pipeline integrity.

BTC advised that there were no caliper features requiring dig-ups on either the BTC or the SCP in this section around Krtsanisi.

7.3.6 Hydrostatic Test Procedure

BTC advised that the hydrostatic test for the pipelines in the vicinity of Krtsanisi was undertaken as part of Test Section 2. This was Test Section 2 for BTC and Test Section 6 for SCP.

The minimum hold period for the strength test was 24 hours and the test pressure details for this area are as follows:

- BTC Reference Point KP 39+250. Test Pressure at this point: 149.75 barg. Maximum Allowable Operating Pressure (MAOP): 119.80 barg (TP/1.25). Maximum Operating Pressure (MOP): 111.20 barg (TP/1.35).

- SCP Reference Point KP 39+100. Test Pressure at this point: 161.38 barg. MAOP: 115.27 barg (TP/1.4). MOP: 90.00 barg (TP/1.72).

Each of these test pressures at Krtsanisi exceed the minimum strength test pressure factor required for each pipeline by the design Standard, and demonstrates the structural integrity of the pipeline.

Test pressure values and therefore MAOP and MOP vary according to elevation, however for SCP (gas pipeline) the MOP will remain at 90 barg regardless of elevation.

8. PIPELINE SAFETY

8.1 WHAT CONSTITUTES PIPELINE SAFETY

It must be stated and accepted that while a hydrocarbon pipeline will pose a risk to the public and the environment, this risk is zero, so long as the transported fluid does not escape from the pipe which contains it.

Consequently any assessment of risk to the public must commence with an analysis of the parameters incorporated in the design, construction and operation of the pipeline to establish and maintain pipeline integrity. Such an analysis can demonstrate that the design, construction and operation of the pipeline is sufficient to reduce the likelihood of an integrity loss, and the magnitude of any fluid release to levels where the risk of harm to people or the environment is very low.

This section considers whether the design of each pipeline recognises the requirements of its design Standard, and whether the designs employed are consistent with the usual industry practices for protection of the pipeline.

8.2 GENERAL

In considering the complaints raised by the Krtsanisi residents it is useful to consider the components of the design of each pipeline that contributes to its safety at that location.

Given that the BTC and the SCP pipelines carry hydrocarbon fluids at high pressure, failure of either of them could result in the release of large quantities of fluid which in the case of either fluid, if it ignites, has the potential to cause harm and possible death to people and property in the vicinity of the pipeline, and in the case of the oil pipeline, has the potential to cause a great deal of environmental impact.

For this reason, a major component of the pipeline design and operation relates to ensuring the pipeline is and remains "safe" by design to prevent fluid leaks.

In addition to protecting the public and the environment, a pipeline operator requires that the pipeline remains safe so that it achieves the operating reliability that is required, and importantly for a major pipeline, that the operator is not exposed to the cost and international embarrassment that would result from any safety incident.

It is usual that pipeline safety is achieved and maintained by a combination of multiple and independent controls of identified threats to the pipeline, that are provided by a combination of *physical* and *procedural* protection measures.

There are many millions of kilometres of high pressure oil and gas pipelines operating throughout the world. The *physical* and *procedural* protection measures used by the pipeline industry have been developed and their effectiveness demonstrated over many years of operation. In addition, specific measures are developed and applied to each pipeline to address specific threats that apply to the pipeline.

8.3 SAFE PRESSURE CONTAINMENT

The minimum thickness of a pipeline is that required to safely contain the internal pressure of the fluid transported in the pipeline.

It has been customary pipeline design Standards to adopt a factor of 0.72 as the basis for calculating the minimum wall thickness for pressure containment, provided the strength of the pipeline is demonstrated by a subsequent hydrostatic test at a pressure at least 1.25 times the maximum allowable operating pressure of the pipeline. This design approach means that the minimum pressure at the high point of any hydrostatic test section equivalent to 90% of SMYS, and it allows a margin between the pressure at the high point of the test section, and the low point, to allow for the additional pressure generated by the elevation difference.

More recently Standards have allowed the design factor to be increased to 0.8, providing that the 1.25 test pressure factor is retained.

The key to safe pressure containment is the 1.25 test pressure factor.

Research has shown that when the hydrostatic test pressure is applied to a pipeline and held at that pressure for a period of 4 hours, flaws in the pipe that have a potential to grow to failure during the operating life of the pipeline will grow and will fail.

This means that after a pipeline has satisfactorily completed its hydrostatic strength test it will remain safe for operation at its design pressure for its useful life (assuming that there is no degradation of the pipe steel).

8.4 SAFETY FROM EXTERNAL INTERFERENCE – GENERAL AREAS

Failure statistics show that a major cause of pipeline failure is external interference.

External interference can come from any source – but for buried pipelines, the main source of external interference comes from the operation of construction or maintenance equipment over a pipeline.

A tenet of pipeline safety is that to protect the public from the pipeline, the pipeline must be protected from the public.

Where the pipeline is installed in open areas there is usually no reason for such equipment to be in the vicinity of the pipeline. Where there are services, or in populated areas, there is an increased likelihood that construction or maintenance activities require excavation over the pipeline.

Research has shown that pipes with a thickness greater than approximately 12 mm are extremely difficult to penetrate by large excavators (30-40 tonne operating mass) fitted with sharp digging teeth.

The pipe thickness used on both the BTC and the SCP pipelines in the vicinity of Krtsanisi is in excess of 20 mm. At this thickness it is not credible that an excavator typically engaged to construct or maintain buried services in the village of Krtsanisi could puncture either pipe.

8.5 SAFETY FROM EXTERNAL INTERFERENCE – AREAS WHERE A RISK IS IDENTIFIED

Pipeline designers recognise that there are locations where there is increased likelihood of external interference. These include:

- Locations where the pipeline crosses or runs parallel to another service
- Locations where the pipeline crosses a corridor that is likely to be used to carry buried services (eg road and rail corridors)
- Locations where increased loads are applied to the pipeline (eg road and rail crossings)
- Stream and river crossings

Because a long distance pipeline will cross many of these locations, the pipeline designer usually prepares "typical" drawings that describe the design of the pipeline at each location.

Usually these provide increased protection to the pipeline by a combination of design measures including:

- Increasing the depth of cover so that the pipeline is buried at a depth that is greater than the depth at which the services are typically installed.
- Installing a barrier between the service and the pipeline. Usually the barrier is made using slabs of reinforced concrete installed between the pipeline and the "threat" (the service).
- Installing additional markers to warn of the location of the service. Additional marking is provided using brightly coloured plastic tape installed over the service and the pipeline, printed with an appropriate warning. In addition, above ground marker posts are usually installed at more frequent intervals.
- Use of increased thickness pipe.
- Installing the pipe straight and horizontal for a nominated distance

Each of these control measures are applied in the vicinity of Krtsanisi. In particular:

- In the locations closest to the dwellings, the pipeline depth of cover is increased to nominally 2 metres, placing the pipelines nominally 500 mm below each service that the pipeline crosses.
- At each service crossing, multiple concrete protection slabs are installed to protect the pipeline from possible impact damage during maintenance of the service.
- The thickness of each pipeline is in excess of 20 mm. This, combined with the steel grade, will ensure that either pipeline is not capable of being punctured by "typical" construction machinery that is reasonably expected to be used in the maintenance and construction of facilities in the vicinity of the village.
- Additional above ground and buried marker tape is installed.

8.6 SAFETY USING "PROCEDURAL" PROTECTION

Pipeline wall thickness, depth of burial and barriers provide "physical" protection of the pipeline, irrespective of whether the pipeline operator is paying attention to the pipeline or not.

The pipeline operator will undertake a range of "procedural" protection measures that are designed to warn of the presence of the pipeline, and to detect activities in the vicinity of the pipeline that have the potential to damage it.

These procedures are identified in documents describing the operating and maintenance procedures planned to be implemented on the pipelines, prepared as part of the information package made available for the Environmental and Social Impact Assessment, early in the project.

The procedures generally follow the requirements of the design standards, but include unique procedures including daily inspection including daily horse patrols along the pipeline easement in populated areas.

Furthermore, the operating procedures include a commitment to periodically undertake metal loss inspections using an in-line inspection tool. This tool is designed to measure the entire circumference of the pipeline as it passes through the pipeline, and identify locations where there is a wall thickness anomaly, potentially indicating corrosion. Data from this tool is used to identify locations where corrosion of the pipe wall is occurring so that the pipeline operator can implement specific coating repair and corrosion management processes.

Procedural protection installed on each pipeline includes:

- An effective pipeline patrol strategy in place which addresses the potential for both accidental and intentional damage to the pipeline.
- Pipeline Marker Posts installed at every kilometre point, IP's greater than 12 degrees, line of sight and potentially vulnerable locations such as crossings of road, tracks, railways, canals, streams and rivers.
- Aerial Markers installed at every kilometre and IP's greater than 12 degrees.
- There is ongoing liaison, through the Community Liaison Officers and the Land Team, to educate villagers and land users regarding permitted land use activities in the vicinity of the pipelines, provide BP contact details, and address any issues or concerns coming from the public. Discussions with villagers during external audits have demonstrated a high level of awareness regarding permitted activities and land use on the Right of Way.
- The pipeline is patrolled twice daily by operations horseback patrols to monitor land use restrictions and any unauthorised activities in the vicinity of the pipelines including evidence of disturbed ground.
- The pipeline Right of Way (ROW) and facilities are inspected daily by operations technical patrols to monitor pipeline integrity such as ROW erosion, evidence of disturbed ground, inspection of block valve and check valve facilities and supervision of authorised third party work in the vicinity of the pipelines.
- The pipeline is also patrolled 24/7 by the Strategic Pipeline Protection Department (SPDD) which is a department of the Ministry of the Interior. The SPPD also monitor any unauthorised activities, particularly ground disturbance, in the vicinity of the pipelines and have the power to arrest third parties who refuse to comply with the restrictions.

8.7 PIPELINE ISOLATION (NUMBER AND LOCATION OF VALVES)

8.7.1 General

The design standard for each pipeline requires the installation of isolation valves at locations. The requirements for isolation valves are different for pipelines transporting oil and pipelines transporting gas.

The requirements are different because of the nature of the fluid, the pipeline characteristics, and the purpose for which the valve is installed.

There is no automatic isolation on either BTC or SCP. Isolation valves installed on each pipeline are equipped with actuators that are controlled by the pipeline control system from the pipeline control centre. While automatic close actuators are available, experience with them is that in order to prevent then closing in response to pressure or flow changes in normal operation of the pipeline they need to be set at such low sensitivity levels that they do not provide an effective safety shutdown.

The design approach on each pipeline is to provide continuous monitoring systems with suitable instrumentation and communications. The supervisory control and data acquisition (SCADA) system is capable of detecting abnormal operating conditions which if they occur, requires the duty operator to analyse the alarm and implement an appropriate response. These monitoring systems include competent leak detections systems for each pipeline capable of providing the pipeline operator with an early alarm in the event of any malfunction.

The emergency response for each pipeline is managed from the pipeline control system, which considers the safe operation of the pipeline system.

8.7.2 BTC

BTC is an oil pipeline.

Because the oil is relatively incompressible, the hydraulic characteristics the pipeline allows instrumentation (flow and pressure) to rapidly detect leakage. If the emergency response procedure requires that the pipeline pumps are stopped, the pipeline rapidly depressurises. Even without isolation valves, removal of the operating pressure makes a dramatic reduction in the flow from any leak.

In designing the isolation on an oil pipeline, primary consideration is given to the consequence of a leak. In the case of a crude oil pipeline (which is relatively difficult to ignite), the consequence is usually to the environment that results from a spill of crude oil.

The design Standard requires that:

Clause 434.15.2(a) *"Mainline block valves shall be installed on the upstream side of major river crossings and public water supply reservoirs. Either a block or check valve shall be installed on the downstream side of each major river or public water supply reservoir."*

Clause 434.15.2(b) *"A mainline block valve shall be installed at mainline pump stations, and a block or check valve (where applicable to minimise backflow) shall be installed at other locations appropriate to the terrain features. In industrial, commercial and residential areas where construction activities pose a particular risk of external damage to the pipeline provision shall be made for appropriate spacing and location of mainline valves consistent with the type of liquids being transported."*

Clause 434.15.2(c) *"A remotely operated mainline block valve shall be provided at remotely controlled facilities to isolate segments of the pipeline."*

The location of isolation valves along the pipeline was established from:

- The Quantified Risk Assessment Study
- The Block Valve Spacing Study

In the vicinity of Krtsanisi (kP 39) isolation valves are installed at:

- kP 27.52 (approx) (11.5 km upstream), on the eastern side of the Mtkarvi river. (BTC GB 03)
- kP 34.9 (approx) (BTC GC04), a check valve installed on the western side of the Mtkarvi river.
- kP 52.6 (approx) (13.6 km to the west of Krtsanisi). (BTC GB05

The BTC pipeline complies with the requirements of the design Standard in that there is an isolation valve on the upstream side of the Mtkarvi river, and a check valve installed on the downstream side of the river. The check valve is selected to control backflow in the event of pipeline failure in the vicinity of the river, and is required because of the high static head from the mountain range crossing, in the western region of Georgia.

Each of the ball valves (GB03 and GB05) is equipped with actuators that are controlled remotely from the pipeline control centre.

The check valve operates automatically.

The location of valve GB05 (13.6 km west of Krtsanisi) is considered appropriate, having regard to the design of the pipeline and the land use (now and in the future) between Rustavi and kP 52.6.

The BTC pipeline incorporates a leak detection system complying with API 1130 (Computational Pipeline Modelling for Liquid Pipelines) and API 1155 (Evaluation Methodology for Software Based Leak Detection Systems).

The system is designed to detect and locate a leak in excess of 1% of the pipeline flow within 60 minutes. Larger leaks are detected in a shorter time, with a leak from a pipeline rupture being detected almost instantaneously.

The Oil Spill Response Plan prepared and published as part of the Environment and Social Impact Assessment documents presents a detailed analysis of the nature of any oil spill from the pipeline, the estimated volume that would spill from the pipeline following three possible failure modes, and the response to the spill that would be implemented by the pipeline operator.

The following extract from the oil spill response plan predicts that if a leak occurred in the vicinity of Krtsanisi (kP 39):

- Approximately 466 m^3 would spill from a 5 mm hole
- Approximately 4,228 m^3 would spill from a 50 mm hole
- Approximately 8,685 m^3 would spill if the pipeline ruptured

The spill volumes were calculated from analysis of the topography along the pipeline route and an assessment of the response of the control system to detect a leak from the pipeline, and initiate a response to the leakage.

Venton was not provided with an updated copy of this assessment, and it is possible that more recent documents prepared as part of the pipeline safety and operating plan may have a more recent assessment.

Importantly the oil spill response plan identifies that:

- The volatile components in the oil will vaporise rapid, reducing the risk of ignition. The loss of the volatile components will also increase the viscosity of the fluid, and this will reduce the area covered by the spill.
- The crude oil is *"waxy"*. This means that if a spill occurs in winter, the wax components in the oil will crystallise, resulting in its solidification (or near solidification. This large increase in viscosity will further reduce the size of the area covered by any spill, and will aid collection of the spilt material using conventional earthmoving equipment.

The Oil Spill Response Plan assessment provides confidence that careful thought and specific planning work was undertaken during the project planning phase, to consider the likelihood of a spill, the consequence of a spill, and the methods to be employed to clean up and restore the environment in the unlikely event that the BTC pipeline develops a leak.

While it is most unlikely that the BTC pipeline could develop a leak in the vicinity of Krtsanisi, this document shows that in the planning phase at least, BTC undertook a detailed analysis of the frequency, consequence and management of the risk from any threats the resulted in a breach of the structural integrity of the pipeline.

8.7.3 SCP

The design Standard requires that:

Clause 846.11(a) "*Except for offshore installations, sectionalising block valves shall be installed in new transmission pipelines at the time of construction. When determining the sectionalising valve spacing, primary consideration shall be given to locations that provide continuous accessibility to the valves. Other factors involve the conservation of gas, time to blow down the isolated section, continuity of gas service, necessary operating flexibility, expected future development within the valve spacing development, and significant natural conditions that may adversely affect the operation an security of the line.*"

Clause 846.11(a) "*Notwithstanding the considerations in (a) above, the spacing between valves on a new transmission line shall not exceed the following:*

1. *20 miles (32km) in areas of predominantly Location Class 1 (Rural)*
2. *15 miles (24 km) in areas of predominantly Location Class 2(Semi Rural)*
3. *10 miles (16 km) in areas of predominantly Location Class 3 (Residential)*
4. *5 miles (8 km) in areas of predominantly Location Class 4 (High Rise)*

The primary purposes of an isolation valve in a gas pipeline are:

1. Limit the duration of gas release, if the pipeline should develop a leak.
2. Facilitate maintenance of the pipeline.

Except for limiting the duration of a gas release, isolation valves in gas pipelines do not contribute to pipeline safety. This is because the gas is compressed. Closure of sectionalising valves prevents gas flowing into or out of a section of pipe containing a leak – however once the valves are closed, the gas in the isolated section remains compressed at essentially the same pressure as existed in the pipeline prior to the valve closure. This gas will continue to flow from the leak until such time as all gas is vented from the pipe section.

Furthermore, if the leaking gas is ignited, the effect of the radiation from the fire on the surrounding people and property is immediate, and even though sectionalising valves are closed, the effect will continue until all gas is vented from the pipeline.

The reason that the design Standard imposes maximum intervals between isolation valves in different locations is to limit the maximum exposure to the community.

The location of isolation valves for the SCP was based on design studies including:

- The Quantitative Risk Assessment study of along the length of the pipeline
- The Pipeline System Isolation Study
- The Block Valve Spacing Study

In the vicinity of Krtsanisi, remotely operated isolation valves are installed at the same locations as those installed on the BTC pipeline.

- kP 27.52 (approx) (11.5 km upstream), on the eastern side of the Mtkarvi river (BVR0).
- kP 52.6 (approx) (13.6 km to the west of Krtsanisi) (BVR1).

The isolation section length is approximately 25 km. This is consistent with a design requirement for a predominantly semi-rural location class (Location Class 2), but inconsistent with the requirements of Location Class 3 (the region between kP 21.199 and kP 42.349).

ASME B31.8 does not mandate that each location class must constitute an isolation section. The Location Class changes from Class 3 to Class 2 at kP 42.6, and consequently the valve spacing adopted is a compromise between the requirements of Class 2 and Class 3. While the Standard nominates mandatory limits to the valve spacing in each location class, it is usual to interpret this to permit a small tolerance on the limit to permit the valves to be located where there is ready access to the valve.

At the point where the Location Class is changed from Class 3 to Class 1 (kP 42.6), the pipeline wall thickness is changed from 21.2 mm to 14.7 mm.

The SCP incorporates a Pipeline Integrity Monitoring System based on a real time pipeline model (ATMOS PIPE) that incorporates leak detection and location capabilities for both dynamic and static conditions in the pipeline.

8.8 IDENTIFICATION AND MANAGEMENT OF THREATS TO THE PIPELINE

BTC advised that the design studies and operational experience to date has not identified any specific threats to either pipeline in the vicinity of Krtsanisi.

BTC advised that both BTC and the Government of Georgia regularly carry out regional and country threat assessments to identify potential threats in the area of the pipeline operations.

During development of the BTC project, experience with illegal intervention with an existing pipeline (WREP) caused a change in the application of the mitigation of this risk.

During construction and continuing to the date of this report, BTC advise that there has been no illegal intervention with either the BTC or the SCP in the area.

BTC has established the Strategic Pipeline Protection Department (SPPD) to provide continuous (24 hours /day x 7 days per week) scrutiny of the entire pipeline. This is a whole of pipeline monitoring system, including:

- At a high level, detailed inspection of the pipeline route by aerial patrol
- At a detailed level, daily horse and foot patrols of the pipeline by operations personnel
- Investigating every “ground disturbance” of agricultural activities in the vicinity of the pipeline

- Setting up surveillance posts on a random basis.

In addition, the Company undertakes regular meetings with the Ministry of Internal Affairs and the Deputy Minister, who is responsible for deployment of all state security personnel on pipelines and the main assets in Georgia.

BP security meets regularly with the Commanding Officer of the SPPD and their training and support teams. BP's pipeline security systems provide for all security systems to be managed appropriately in the event of changes to threats to increase the levels of vigilance, depending on the nature of the threat.

9. ASSESSMENT OF SPECIFIC COMPLAINTS

9.1 SAFETY COMPLAINT 1

The pipelines are installed in ground without "concrete bearing" (which was understood to be the basis proposed in initial public documents). There is a concern that this will caused the pipeline to become unstable and break, potentially causing harm to the residents.

Venton is unsure of the source of design information that would give rise to this complaint.

The ESIA documents and other investigations undertaken as part of the design of the pipeline identified locations where the ground is unstable, including areas of landslip and areas subject to erosion.

Venton has been unable to locate any document identifying the Krtsanisi area as either a landslip area, or an area subject to erosion.

In the absence of any specific load that requires special support to a pipeline, experience has shown that properly "bedding" the pipe in suitable fine material is the most suitable method of providing support because:

a) The whole of the pipe circumference is supported, effectively eliminating locations where supporting stresses are concentrated on a small area of the pipe (such as a pipe resting on a concrete sleeper).

b) The whole of the pipe circumference is embedded in an electrolyte made from the bedding material that conducts cathodic protection current, provided to prevent corrosion from occurring at any location where the is a flaw in the coating – either at the time of the pipe installation, or formed during the operating life of the pipeline.

Furthermore, there is no evidence of soil instability or erosion in the Krtsanisi area on aerial photographs of the region.

As a result, Venton concludes that conventional pipe installation and pipe support methods are appropriate for the Krtsanisi area.

9.2 SAFETY COMPLAINT 2

This concern is heightened by the residents being aware that the pipelines "burst" in eight places after laying, causing the pipeline construction contractor to return to the installed pipelines and undertake repairs.

Venton's opinion is that the Standards to which the pipelines are constructed require the integrity of the pipeline to be demonstrated through a number of quality assurance measures.

Provided that these measures are implemented throughout the project, the pipeline integrity at the time it is commissioned is sufficient for its "safety" to be assured.

Most important amongst these quality control procedures are:

a) Non-destructive inspection of the field welds made to join the individual pipes into a pipeline, and repair of any weld that contains flaws that exceed the acceptance limits of the Standard.

b) A pre-commissioning hydrostatic test at a pressure 25% higher than the maximum allowable operating pressure to demonstrate that the pipeline has the strength to safely contain the pressure. This is usually followed by a leak test, undertaken at a lower pressure, but retained for a sufficient period to demonstrate that the pipeline is free from leaks.

BTC has advised that:

a) In the vicinity of Krtsanisi, some welds on the BTC were made using a manual metal arc technique, rather than by automatic welding as generally used on the pipeline. Inspection by radiography and subsequent ultrasonic inspection identified flaws in the welds that exceeded the acceptance limits set by the welding Standard (API 1104). These defects were transverse flaws (cracks). Because crack type defects are not considered reparable, each identified defect was removed by cutting the weld from the pipe, and welding a replacement pipe section into the pipeline using a welding procedure that enabled repair without cracking.

   This confirms the residents observations that weld defects were found in the Krtsanisi area.

   A special investigation was undertaken, engineering solutions to remove the welds were established and proven, and the welds were replaced in accordance with revised the procedures.

   BTC advised that because repairs required in this location indicated that there was a systematic rather than a random quality problem, BTC undertook additional weld non destructive testing beyond the area of concern to confirm that the problem did not extend beyond the area initially identified.

   While to people unfamiliar with the multiple quality control procedures that a are employed on a high pressure transmission pipeline, repairs to a weld may appear to indicate a fault, or a possible lack of integrity in the pipeline, the fact that the weld faults were identified and the repairs were made, is a demonstration that effective quality control processes were in place during the construction of the BTC pipeline.

b) The pipeline completed a strength test in accordance with the requirements of ASME B31.4. Having completed this test, the pipeline is considered safe for pressure containment.

Venton considers that BTC undertook the appropriate review of all welds potentially affected by crack type defects using different and more sensitive non destructive testing techniques, and has identified and rectified all potentially defective welds. Having done this, there is no increased likelihood of subsequent failure of the pipeline as a result of this process failure.

10. CONCLUSION

Venton concludes that based on the information provided, both the BTC and the SCP satisfy the requirements of both the Standard to which it the pipeline was designed and constructed, and that its design, construction and operation comply with good engineering and operating practices for high pressure hydrocarbon transmission pipelines.

The decision made to locate the pipeline in the corridor was based on a sound analysis of the pipeline route.

In recognition of the land use in the vicinity of Krtsanisi, specific design measures were incorporated into the design to provide additional physical protection of the pipeline against potential loads and damage threats, and specific operating procedures have been developed to identify and control threats to the pipeline.

It is clear that the standard of design and construction of the pipelines comply with international standards for safe pipelines. Similarly, the procedures for operation of the pipeline comply with internationally accepted practices, including development and implementation of procedural protection measures designed to specifically address the conditions.

Provided pipeline operating procedures through the operating life of both pipelines are conducted with the level necessary to identify and repair any condition that results in deterioration of the pipeline, and where necessary, implements additional measures to control additional threats, the safety of the residents of Krtsanisi is assured. Achieving this includes an obligation on the residents to appreciate and comply with the restrictions that apply to construction activities in the vicinity of the pipelines so that there is no deterioration or damage of the pipeline as a result of their activities.

APPENDIX 1

REFERENCED DOCUMENTS

1. Aerial Photographs of the pipeline route between kP25 and kP 55
2. Krtsanisi Aerial Photographs
   AGT002-2000-GI-GRM-03931-Sht 006
   AGT002-2000-GI-GRM-03931-Sht 007
   AGT002-2000-GI-GRM-03931-Sht 008
3. BTC Preliminary Alignment Sheets (Georgia kP 35 to Georgia kP53)
   BTC004-B210-PL-ALS-00535 Rev Z04
   BTC004-B210-PL-ALS-00536 Rev Z04
   BTC004-B210-PL-ALS-00537 Rev Z04
   BTC004-B210-PL-ALS-00538 Rev Z04
   BTC004-B210-PL-ALS-00539 Rev Z04
   BTC004-B210-PL-ALS-00540 Rev Z04
   BTC004-B210-PL-ALS-00541 Rev Z04
   BTC004-B210-PL-ALS-00542 Rev Z04
   BTC004-B210-PL-ALS-00543 Rev Z04
   BTC004-B210-PL-ALS-00544 Rev Z04
   BTC004-B210-PL-ALS-00545 Rev Z04
   BTC004-B210-PL-ALS-00546 Rev Z04
   BTC004-B210-PL-ALS-00547 Rev Z04
   BTC004-B210-PL-ALS-00548 Rev Z04
   BTC004-B210-PL-ALS-00549 Rev Z04
   BTC004-B210-PL-ALS-00550 Rev Z04
   BTC004-B210-PL-ALS-00551 Rev Z04
   BTC004-B210-PL-ALS-00552 Rev Z04
   BTC004-B210-PL-ALS-00553 Rev Z04
4. SCP Preliminary As Built Alignment Sheets, documents:
   SCP004-MS30-PL-ALS-00528 Rev Z03
   SCP004-MS30-PL-ALS-00529 Rev Z04
   SCP004-MS30-PL-ALS-00530 Rev Z04
   SCP004-MS30-PL-ALS-00531 Rev Z04
   SCP004-MS30-PL-ALS-00532 Rev Z04
   SCP004-MS30-PL-ALS-00533 Rev Z04
   SCP004-MS30-PL-ALS-00534 Rev Z04
   SCP004-MS30-PL-ALS-00535 Rev Z04
   SCP004-MS30-PL-ALS-00536 Rev Z04

SCP004-MS30-PL-ALS-00537 Rev Z04
SCP004-MS30-PL-ALS-00538 Rev Z05
SCP004-MS30-PL-ALS-00539 Rev Z04
SCP004-MS30-PL-ALS-00540 Rev Z04
SCP004-MS30-PL-ALS-00541 Rev Z02
SCP004-MS30-PL-ALS-00542 Rev Z02
SCP004-MS30-PL-ALS-00543 Rev Z02
SCP004-MS30-PL-ALS-00544 Rev Z02
SCP004-MS30-PL-ALS-00545 Rev Z02
SCP004-MS30-PL-ALS-00546 Rev Z02
SCP004-MS30-PL-ALS-00547 Rev Z02
SCP004-MS30-PL-ALS-00548 Rev Z02
SCP004-MS30-PL-ALS-00549 Rev Z02
SCP004-MS30-PL-ALS-00550 Rev Z02
SCP004-MS30-PL-ALS-00551 Rev Z02
SCP004-MS30-PL-ALS-00552 Rev Z02
SCP004-MS30-PL-ALS-00553 Rev Z02

5. Desktop Population Density Report (extract from Quantitative Risk Assessment)
6. Typical Pipeline Construction Drawings

   410088-00-L-PL-MI-004 (Typical Open Cut Road Crossing)
   410088-00-L-PL-MI-005 (Typical Open Cut Stone Track Crossing)
   410088-00-L-PL-MI-010 (Typical Foreign Service Crossing)
7. ESIA Documents taken from Project Web Site in 2004
   - BTC Technical Design Basis (Document ROR-0000-00001-U01)
   - Oil Spill Response Plan (including appendices)
   - Various SCP ESIA documents
8. Reports by Venton & Associates to CAO prepared in 2004
   - 125-R-001 BTC Georgia / Rustavi Complaint
9. E-mail correspondence between Venton and Mr Dave Morgan of BTC
10. Design Standards
    - ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
    - ASME B31.8 Gas Transmission and Distribution Piping Systems