4.0 PROJECT ALTERNATIVES

Summary

The export of Azerbaijan's oil is broadly agreed to represent the greatest hope of creating economic development and reducing poverty in the region. Current oil export facilities, however, are reaching the limit of their capacity and are becoming increasingly unsafe, particularly in respect of shipping passing through the Turkish Straits.

The alternatives are to refrain from developing further the oil reserves of the area, or to find a safe way of supplementing existing export capacity. The Azerbaijan government wishes to take the latter course of action and a number of alternatives have been thoroughly investigated over a five-year period.

The optimal solution, calculated to offer the lowest environmental, social, cultural, technical and financial risks, has now been agreed by the national governments concerned. It is an underground pipeline passing through Azerbaijan, Georgia and Turkey, providing revenues for all three countries. The pipeline ends at Ceyhan, on the Eastern Mediterranean coast; from here the oil can readily be sold into world markets. Alternative solutions considered and rejected entailed eight combinations of road, rail, shipping and pipeline, across six routes.

The most appropriate option having been established, a refinement process has been followed in order to route the pipeline without causing undue trouble to local communities, archaeological sites or natural assets and minimising such risks as geohazards, security threats and oil spill. In this way, the pipeline route alternatives have been progressively refined to identify the final pipeline permanent corridor, that provides maximum benefits and minimum risk.

Where unavoidable adverse impacts have been identified, a programme of mitigation has been established. Potential impacts at each stage of the project, from construction to decommissioning, have been evaluated to identify robust mitigation measures.

The BTC project represents a world-class investment and the pipeline that will be built along the selected route will be constructed and operated to the highest international standards currently being followed in the oil and gas industry.

4.1 Conceptual Development

4.1.1 The 'no development' option

At the time of Soviet dissolution in 1991 the Azerbaijani oil industry, which led the world at the turn of the 20th century, was in decline, mainly as a result of under-investment over many years. The situation was exacerbated with the reduced access to traditional markets within the Former Soviet Union (FSU).

At the end of 2000, Azerbaijan had a level of economic output only 52% of that in 1989. The route back to 1989 levels, without taking advantage of its oil and gas resources, would be long and difficult, with no certainty of success. By utilizing the oil and gas resources, there is a chance that the recovery can be made more quickly and more completely. Among the reasons why Azerbaijan has not reformed rapidly are its inability to access the resources necessary for restructuring, its comparatively inaccessible geographic position in relation to international markets, and the ongoing use of subsidies to support inefficient industries. The proposed oil developments will give the country the chance to build on the limited transition reforms completed to date, and move toward the goal of sustainable economic development.

The 'no development' option would substantially restrict exports of Azerbaijani oil to the capacity of the existing pipeline and railway networks. Even if these networks were upgraded, the export volumes would be a fraction of the one million barrels per day (bpd) that the Azeri-Chirag-Gunashli (ACG) reserves could produce. The 'no development' option would therefore directly limit future earnings and act as a significant disincentive for future direct foreign investment in Azerbaijan. The combined effect would have significant negative economic and social consequences in Azerbaijan and, to a lesser extent, Georgia and Turkey.

Particular consequences of the 'no development' option are summarised as follows:

- revenues from the ACG full field development (FFD) are projected to exceed all other sources of public revenue in Azerbaijan during the next 15 years. Capital spending on the AGC Phase 1 alone could exceed $6 billion. The 'no development' option would mean that these revenues and investments would be substantially reduced. The transit fees that would otherwise be paid to Georgia and Turkey would not be realised;
- the implications for employment would also be significant during the construction period when upwards of 6,000 jobs will be generated by the BTC project across the three countries involved (50-80% of these jobs will be filled by nationals);
- poverty is a significant issue in all three countries. The development of the oil and gas sector and associated export pipelines presents the only realistic near-term prospect for economic development – and therefore poverty alleviation – in the region;
- as the development of ACG currently stands, flaring of associated gas from the Chirag sector is ongoing, though measures are in place to reduce this. The development of ACG Phase 1 will allow this gas either to be re-injected for reservoir pressure maintenance, used for offshore power generation, or piped to shore for domestic consumption, thus eliminating flaring. If no change occurs in the oil export capacity, the further development of ACG will be limited and it would continue to flare gas offshore. Heavier polluting fuels such as mazut (a locally produced product)

would continue to be used in combination with imported supplies from Russia to meet domestic energy requirements. This sequence of events would have detrimental environmental and economic implications; and

– unless an alternative solution is developed, all existing export options rely on only one direct gateway to world markets via the Turkish Straits (Box 4.1). The BTC pipeline represents the only realistic route for Caspian oil that will have the effect of relieving the growth in oil volumes passing through the Straits, and consequently reducing the environmental and public safety risk.

The 'no development' option therefore presents a bleak economic outlook, especially for Azerbaijan. The economic prognosis also has potentially serious social and environmental implications.

Box 4.1: The Turkish Straits

The Turkish Straits comprise two narrow maritime corridors that form the link between the Black and Mediterranean Seas: the Istanbul Straits (the formal name for the Bosporus) and the Dardanelles (Figure 1.1).

The 31km Istanbul Straits, which bisect the city of Istanbul with its population of more than 10 million, are particularly hazardous.

A major shipping thoroughfare, they have been the site of a number of serious shipping accidents – due to powerful currents and the narrow channel (only 700m wide at one point). They are an international waterway, over which Turkey can only introduce voluntary use of experienced pilots to navigate the waters.

The quantity of oil passing through the Istanbul Straits continues to grow as oil production in the Caspian region increases, raising concerns over the risk of a major oil spill or incident threatening public safety. This trend is predicted to continue as further reserves in the Caspian region are developed and other oil fields, such as Tengiz, realise their full potential.

Added to this is the potential for growth in the non-oil shipping sector servicing the Black Sea and heavy local passenger shipping that services the northern and southern shores of the Straits, effectively crossing the east-west route used by international shipping traffic.

4.1.2 Development of the concept

The development of the concept to establish a viable oil export supply route to enable ACG FFD has involved over five years of technical and commercial appraisal, and extensive consultation at international, national and local levels. The approach has involved multiple steps and numerous iterations, as outlined below.

The principal consideration in developing an export supply route was to develop a commercially viable option that minimised environmental risk – through avoidance of the Turkish Straits – and delivered the oil to an appropriate location to enable its sale on world markets. The route also needed to be analysed in consideration of its long-term security prospects, and would require the ongoing support of Azerbaijan, as the sovereign owner of the oil resources, and of the other countries whose territories it crossed.

A number of options were reviewed to test these considerations:

- a route directly to the eastern Mediterranean;
- a western route via Georgia to the Black Sea;
- a northern route to the Black Sea through Russia; and
- a southern route to Iran.

Both the western and northern options only delivered oil to the Black Sea, and therefore involved passing through the Turkish Straits and were thus deemed unacceptable. Political considerations external to BP ruled out the southern option, leaving the route through Turkey as the best alternative.

An independent Environmental Risk Assessment (ERA), commissioned by BP, examined the relative risks and expected environmental costs associated with the transportation of oil from Baku to a common point on the Mediterranean. This was subsequently refined to the port of Ceyhan for reasons of access, safety, and existing infrastructure (Section 6.3). Ceyhan Terminal was also the recommendation of the Turkish Government.

The ERA assessed five options involving several transport mode combinations:

- Baku-Supsa (pipeline), and ship to the Mediterranean (via the Turkish Straits);
- Baku-Supsa (pipeline), ship to a pipeline head in Bulgaria, and pipeline by-pass around the Turkish Straits to a terminal on the Mediterranean coast;
- Baku-Novorossiysk (pipeline), and ship to the Mediterranean (via the Turkish Straits);
- Baku-Novorossiysk (pipeline), ship to a pipeline head in Bulgaria, pipeline by-pass around the Turkish Straits to the Mediterranean; or
- Baku-Ceyhan (pipeline).

Georgia was selected as the transit country to enable the pipeline to reach Turkey, as political considerations external to BP ruled out both Armenia and Iran.

Historically, pipelines have proved to be a much safer means of transporting large volumes of oil over large distances than other viable alternatives such as ship or rail. In theory therefore, they represent the best option from an environmental and safety perspective. In practice, evaluation of the relative merits of pipelines versus shipping and rail requires a comparative assessment of:

a) the actual impact of the construction of a pipeline together with the risk and consequences of a spill during operation, and
b) the risk and consequences of a spill from shipping or rail.

The outcome of such an assessment is in turn dependent on a range of variables including the pipeline route, the likelihood of a spill, possible spill volumes and the resources potentially at risk from spills from all three modes of transport.

The Baku to Ceyhan pipeline option presented the lowest risk of an oil spill. In the event of a spill, this option was also assessed as having the lowest expected environmental cost – where the expected overall environmental cost was estimated using historical data from previous spills occurring worldwide and, in particular, data relating to the cost of clean-up, third-party liability and natural resource damage restoration.

From a regional perspective the risk assessment confirmed the environmental benefits of transporting oil by pipeline versus combined pipeline/shipping options. This is largely a result of:

- increased risks of spills at transfer points (ie, between different modes of transport, therefore disadvantaging options involving multiple transport modes to the point of delivery);
- differences in the potential release volumes and spread associated with different modes of transport;
- heightened risks associated with transporting oil by ship through the Turkish Straits; and
- different clean-up costs at sea versus land.

Regional pipeline options for exporting oil from the Caspian to world markets therefore appeared to involve lower environmental and social risk compared with options involving multiple modes of transport or passage through the Turkish Straits. This assertion is based on statistical likelihood rather than an actual predicted event (Table 4.1).

Table 4.1: Conceptual Export Considerations: Regional Options Assessment

No Project Option	**Status Quo** Does not meet host government and/or regional development aspirations	**Not favoured**
	Upgrade Existing Infrastructure Would not allow sufficient export capacity to justify commercially Full Field Development of ACG reserves. Also still requires oil shipments through Turkish Straits.	**Rejected**
Develop Alternative Export Option	**Iranian Option** Political considerations external to BP ruled out the southern option to Iran.	**Rejected**
	Russian Option Not favoured for environmental and safety reasons as it would result in significant additional loading on the Turkish Straits.	**Rejected**
	Turkish Option via Armenia Not acceptable to the owner of the oil reserves (Azerbaijan) due to absence of agreement over Ngorno Karabach, despite the 1994 ceasefire agreement between Azerbaijan and Armenia.	**Rejected**
	Turkish Option via Georgia • Georgia and Turkey willing to act as transit states. • Technically and commercially viable. • Avoids Turkish Straits.	**Favoured Option**

4.2 The selected pipeline option

The proposed solution to the challenge of how to safely and responsibly export Caspian oil to world markets was determined following the assessment over a number of years of numerous technical, financial, environmental, social, cultural and political issues. Any assessment involving a complex and changing set of issues will require complex decision-making processes to arrive at an optimum solution. An intensive investigation commenced to identify and refine the precise pipeline route and design, once the broad plan had been determined and endorsed by the Governments of Azerbaijan, Georgia and Turkey in the form of the tri-partite Inter Government Agreement (IGA) and respective bi-lateral Host Government Agreements (HGAs) (Section 6.1).

A five-stage iterative process was adopted whereby a 10km Corridor of Interest was defined before being narrowed down to a final 8m-wide Permanent Corridor that will be maintained throughout the operating life of the pipeline. The five stages were:

- 10km-wide Corridor of Interest;
- 500m-wide Preferred Route Corridor;
- 100m-wide Specified Corridor;
- 22m-wide Construction Corridor; and
- 8m-wide Permanent Corridor.

Box 4.2: Conceptual Description of Project

The proposed solution was determined to be a buried pipeline running west from Sangachal on the Caspian coast south of Baku, via Georgia and onwards through eastern Turkey to the Mediterranean port of Ceyhan. Oil will be temporarily stored at Ceyhan prior to loading onto oil tankers for export to world markets. The optimum pipeline capacity was determined as one million bpd and the proposed design life was 40 years. Construction is planned to commence in the second quarter of 2003 for the pipeline and marine terminal. First export shipments are due in early 2005.

The over-riding principle that applied throughout the corridor evaluation process was one of problem and issue identification and avoidance (Box 4.3). The prerequisite for adherence to this principle was a detailed knowledge of constraints and sensitivities along and adjacent to the Corridor of Interest. This was developed through a detailed assessment of a range of issues including terrain, environmental and social constraints, archaeological and cultural sites, geohazards, safety, technical feasibility, constructability, security, access, cost, schedule, and operability (Figure 4.1). Government and NGOs, local and international scientists and technical experts were consulted throughout this process and proved to be valuable sources of information.

The key considerations and constraints associated with route selection altered and were refined as the route was narrowed from a 10km-wide Corridor of Interest to the Construction Corridor, with the emphasis shifting from one of avoidance to one of optimisation and minimisation of impacts and mitigation (Section 6.3.1). In parallel with the route refinement activities, Conceptual Engineering design evolved through a series of

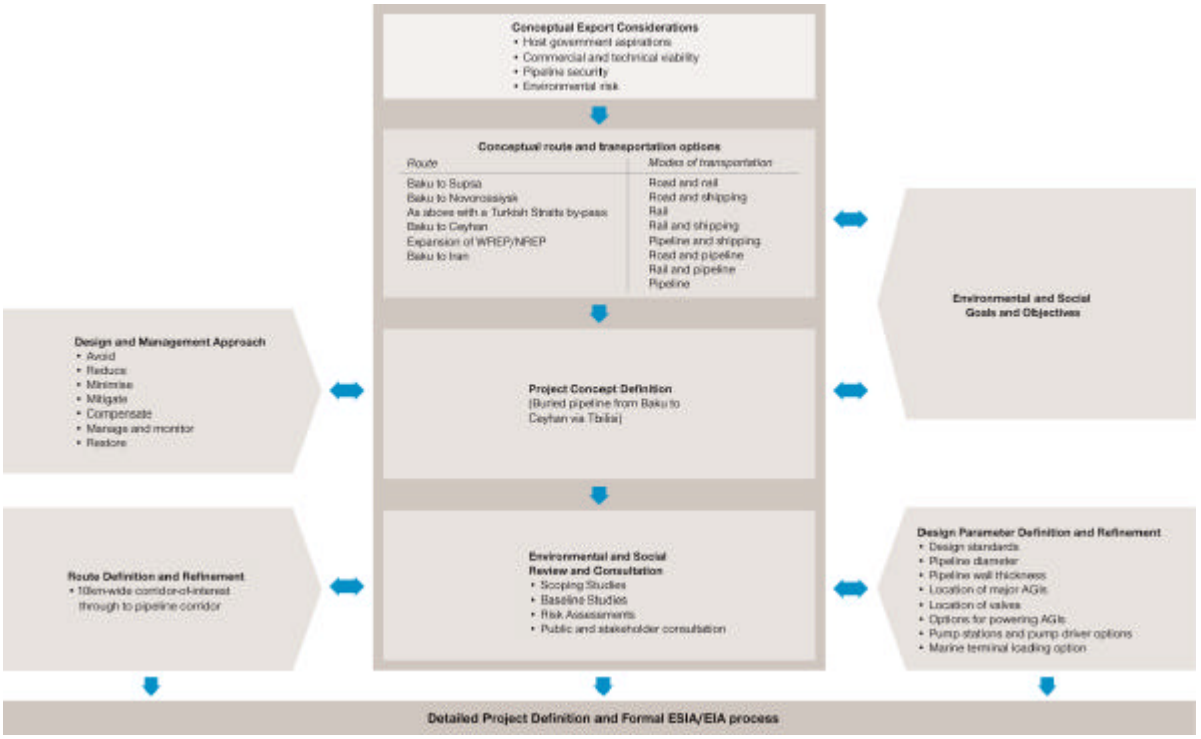
iterations into Detailed Engineering design, with the specification of critical pipeline elements such as pipeline diameter, the number and location of pump stations and other above ground installations (AGIs). The approach to this phase of the project is discussed in further detail in Section 6.

Box 4.3: Corridor Evaluation Activities

The 'problem and issues avoidance' principle was underlain by the following activities:

- Use of multi-disciplinary teams in corridor evaluations;
- Avoidance of known designated sensitive natural habitats;
- Constant verification of the route through field reviews;
- Avoidance of densely populated areas;
- Avoidance of known archaeological sites and cultural monuments;
- Avoidance of known geohazards where practical;
- Avoidance of high risk security areas or areas of regional instability;
- Minimisation of oil spill risk; and
- Minimisation of land-take and maximisation of reinstatement potential.

Figure 4.1: Conceptual development of an export supply route



4.3 Project description

4.3.1 Overview

The BTC project represents a world-class investment and the pipeline that will be built along the selected route will be constructed and operated to international standards. BTC Co, led by BP, is responsible for the overall construction and operation of the whole pipeline, with construction in both Azerbaijan and Georgia being undertaken by international contractors or consortia, and in Turkey by BOTAS under a Lump Sum Turnkey Agreement (LSTK).

Figure 4.2: Existing and proposed export pipeline infrastructure from Azerbaijan

The 1760km pipeline will be buried along its entire length (Figure 4.2). The principal features of the pipeline and associated infrastructure are summarised below, and the key pipeline statistics are given in Box 4.4:

- the **Azerbaijani** section of the pipeline will be 442km in length and have a nominal diameter of 42 inches (1067mm). The pipeline will largely parallel the existing Western Route Export Pipeline (WREP) oil pipeline route in Azerbaijan (Figure 4.2), apart from deviations at the beginning on exiting the Sangachal Terminal and to avoid known sensitive sites (eg, Gorchay and Shamkir Reserves);
- the Sangachal Terminal located south of Baku will be expanded to house the main pipeline control room as well as a custody metering station, as part of the ACG terminal expansion project;
- there will be one pump station in Azerbaijan: PS-A1 will be located within the Sangachal Terminal complex. Pump station PS-A1 will also accommodate pig-launching facilities and PS-A2 will house pig-receiving/launching facilities. There is also an option for a dedicated pig-launcher/receiver station (IPS-A1) in Azerbaijan. Twenty-one valve stations will be constructed along the pipeline route. Construction of PS-A2 will be deferred for several years;

- the **Georgian** section of the pipeline will be 248km in length and have a nominal diameter of 46 inches (1168mm). This section will initially be routed parallel to the existing WREP oil pipeline for a short distance at the Georgian/Azerbaijani border before diverting south-west towards the Turkish border at approximately KP19;
- there will be a custody metering station in Georgia, two pump stations (PS-G1 and PS-G2), each with pig-launcher/receiver facilities, one dedicated pig-launcher/receiver station (IPS-G1) and 25 valve stations;
- the **Turkish** section of the pipeline will be approximately 1070km in length and have a diameter decreasing from 46 inches to 42 inches to 34 inches (864mm) along the route. For approximately 30% of its length it will run parallel to the existing East Anatolian Natural Gas Pipeline (NGP);
- there will be a custody metering station located approximately 22km after the pipeline enters Turkish territory from Georgia. There will be four pump stations (PT1/2/3/4), each with pig-launcher/receiver facilities. There will also be a pressure reduction station upstream of the BTC Marine Terminal with one pig-launcher/receiver station. The Turkish section of the pipeline will be fitted with 52 intermediate block valve stations to facilitate isolation of discrete sections of the line in the event of any breach in the integrity of the system; and
- the pipeline will terminate at a marine terminal to be built at Ceyhan. This facility will be built within BOTAS property and will comprise seven 150,000m^3 floating roof tanks for intermediate storage of oil that has been transported down the pipeline, a fiscal metering station to measure the quantity of oil exported, and a berthing and loading facility to transfer oil to ocean tankers. Loading of crude oil cargoes on to tankers will be controlled from the control room within the BTC Marine Terminal. The terminal will also house a back-up control room for the entire BTC pipeline.

Operation of the pipeline will be fully automated. Flow rate control will be facilitated via pump speed and the number of pumps in operation. Centralised control will be exercised from the control room at the Sangachal Terminal. It will also be possible for key components of the pipeline system, such as pumps, isolation valves and emergency shutdown (ESD) valves, to be controlled locally.

The BTC pipeline project is likely to be developed together with the Southern Caucasus Pipeline (SCP) that will carry product from the Shah Deniz gas field, offshore Azerbaijan. This pipeline is approximately 690km in length, and is proposed to run parallel to the BTC pipeline from the Sangachal Terminal to the Georgian/Turkish border near Akhaltsikhe. In addition to paralleling the BTC Right Of Way (ROW) in Azerbaijan and Georgia, it is proposed that the SCP will supply fuel gas for the BTC pipeline pump stations. The SCP will be constructed after the BTC pipeline, requiring an alternative fuel supply for BTC during the interim period.

Box 4.4: BTC Pipeline Project Statistics

Source of Crude product	- Azeri, Chirag and Gunashli Full Field Development, lying in the Caspian Sea offshore from Azerbaijan.
Length of pipeline	- 1760km total length, buried with a minimum of 1 metre cover to the top of the pipe; and - Azerbaijan 442km, Georgia 248km, Turkey 1070 km.
Pipeline diameter	- Azerbaijan 42", Georgia 46", Turkey 42" (46" on the border with Georgia and 34" for the last 120km into Ceyhan).
Planned peak oil throughput	- 50 million tonnes per year (approx 1 million bpd).
AGIs	- 7 pump stations – Azerbaijan (1), Georgia (2), Turkey (4); - 13 pigging facilities; - 1 pressure reduction station (Turkey); - 3 crude topping plants; - 98 valve stations (21 in Azerbaijan, 25 in Georgia and 52 in Turkey); and - 4 metering stations (one each in Azerbaijan and Georgia, 2 in Turkey).
Pipeline ROW widths	- Construction right of way – 32 metre width (Azerbaijan and Georgia), 28 metres (Turkey) – less in sensitive areas, more at rivers and crossings; - 44-metre corridor for sequential use by BTC and SCP, if latter is sanctioned; and - Operations – 8 metres over the pipeline.
Pipeline Protection Zone	- 58-metre-wide protection zone (Azerbaijan & Georgia to cover both BTC and SCP pipelines, if latter is sanctioned); and - 7 metres on either side of pipeline (Health Protection Strip) in Turkey.
BTC Marine Terminal at Ceyhan	- Tank farm with 7 storage tanks (floating roof type) of maximum capacity 150,800m^3 each; - 2,562-metre-long jetty; - Ship-loading facilities (capacity 60,000 barrels an.hour); - Capacity for vessels 80,000-300,000 dwt; and - 350-400 ships per year (estimated).
Construction Schedule	- Commence construction early 2003 for the BTC Terminal, Spring 2003 for the pipeline; - Commissioning late 2004; - Commence operations early 2005; and - Design life 40 years for the pipeline.
Employment	- Construction approximately 2,300 jobs in Azerbaijan, 2,500 jobs in Georgia and 5,000 jobs in Turkey – total 9,800 (peak level); and - Operations approximately 250 jobs in Azerbaijan, 250 in Georgia and 350 in Turkey – total 850.
Cost of project	- US$ 2.9 billion.

4.3.2 Construction

Pipeline construction is a sequential process and comprises a number of distinct operations, each undertaken by a large range of specialised and general machinery and equipment known as the construction spread. One or more conventional construction spreads will be deployed in each country, together with special section crews that will be responsible for construction at river crossings and other locations requiring specialised installation equipment and techniques. The pipeline contractors in each country will determine the exact number of construction spreads deployed at any one time.

The rate of progress of each sequential operation will depend on local conditions, seasonal factors and the nature of the activity. It is estimated that, on average, approximately 700m to 1000m of pipe will be laid per spread, per country, per day. In favourable conditions, rates of up to 1.5km per day are possible. The elapsed time from initial excavation of the BTC trench to ROW reinstatement is expected to average two to three months at any one location. Local conditions may require longer periods.

A nominal Construction Corridor width of 32m (28m in Turkey) is envisaged although this will be reduced in selected areas that are deemed to be particularly sensitive and where a narrower working width would significantly reduce the impact.

The sequence of activities that are involved in standard pipe laying activities are:

1. setting out and surveying;
2. preparing the right of way (including topsoil stripping as necessary);
3. pipeline stringing prior to pipeline fabrication;
4. excavating the trench;
5. laying of pipeline in the trench;
6. backfilling with subsoil;
7. reinstating the right of way (including replacing the topsoil); and
8. erosion control and biorestoration.

These may vary slightly subject to particular conditions or constraints.

A number of permanent facilities including pump stations, metering stations, the marine terminal and associated loading facilities will also be constructed, as well as temporary facilities including construction camps, pipe storage yards, borrow pits and landfill sites. Access roads will be required to undertake the construction; some will remain after the construction period to service the permanent facilities.

The construction works will require the deployment of a significant quantity of earth-moving and specialist pipeline construction equipment. This equipment will be transported to site along existing roads, newly constructed access roads and the designated pipeline ROW.

International contractors will undertake the construction. The contractor selection process involved a detailed bidding procedure that included the need to meet specific environmental and social criteria and constraints.

4.3.3 Reinstatement

The pipeline ROW and all other project areas will be reinstated in accordance with Pipeline Reinstatement Plans and Specifications developed by the design engineers, with the exception of selected roads and some waste disposal sites that may be retained for use during the operational phase. The plans and specifications will be used by the contractors to prepare detailed method statements and will cover the following areas:

- ROW;
- construction camps;
- pipe storage yards;
- maintenance areas;
- roads and transport facilities;
- waste management and disposal sites; and
- non-operational areas at AGIs

The contractors will undertake the reinstatement activities and will remain responsible for the reinstatement for a period of time after the completion of construction, closely monitored by BTC Co.

Roads used during the construction phase will be left in a condition equal to or better than their pre- construction condition.

The ROW will be cleared of any residual construction debris, construction signs, and equipment. All construction debris and similar material dislodged from the ROW, including that associated with clearing and grading operations, will be disposed of in an approved manner. Timber will be harvested or made available to local communities. All soil and rock will be returned to the excavated areas wherever practicable. Any surplus subsoil or rock that cannot be returned will be re-used or disposed of at approved sites.

Final surface restoration will include detail grading to match, as far as practicable, the pre-disturbed landform contours. Permanent erosion control measures (e.g. diversion berms) will be installed where appropriate.

To facilitate natural re-vegetation of the ROW, the separately stockpiled topsoil and vegetation debris will be spread over the surface of the ROW following the restoration of the landform contours.

The contractor will be required to comply with all requirements for the reinstatement of environmentally and ecologically sensitive areas, and will be required to submit a reinstatement schedule and methodology that complies with BTC Co procedures and ESIA requirements. Areas of sensitive natural habitats or high erosion potential will be treated by specific reinstatement measures that may include seeding with native species, planting of native shrubs and trees, or specialised erosion control mechanisms.

The full width of the ROW and all other areas disturbed as a result of construction activities will be reinstated. In Azerbaijan and Georgia, however, should the proposed SCP construction follow on directly from the BTC pipeline construction, full reinstatement will be

carried out on sections that will not be disturbed by SCP construction activities, or in those sections of the pipeline where the time between the conclusion of the BTC construction activity and the commencement of the SCP construction programme exceeds 12 months. Interim reinstatement measures will be applied to all other areas.

4.3.4 Hydrostatic testing

The entire pipeline will be subjected to hydrostatic pressure testing ('hydrotesting') in accordance with industry design codes, to prove the strength and integrity of the pipeline system. This will involve filling sections with water and raising the pressure to a maximum of 105% of the pipe's specified minimum yield strength for a 24-hour period.

The pipeline will be tested in sections to:

(a) limit the test volume;

(b) limit elevation changes to maintain the test pressure between the minimum required test pressure and maximum pressure which the pipeline will safely withstand;

(c) suit availability of water sources and waste minimisation; and

(d) accommodate the maximum stress criteria for each wall thickness.

Water for hydrotesting will be clean, contain minimal concentrations of contaminants and be non-corrosive. Potential hydrotest water abstraction points identified by the contractors will be subject to an environmental and social review by the project team prior to their use. The design engineers have undertaken some studies on potential locations and water quality. All necessary permits required for water abstraction and disposal will be obtained from the owner/occupier/local authorities by the construction contractor and in accordance with environmental legislation and best practice. The test water will be analysed to check quality before and after use; the use of chemicals will be minimised but it may be necessary to add corrosion inhibitors, oxygen scavengers or biocides.

A detailed hydrotest plan will be written before activities begin.

4.3.5 Pre-commissioning

Pre-commissioning of the pipeline and block valves will ensure the pipeline system has been constructed in accordance with the project design drawings and specifications. Unlike hydrotesting, pre-commissioning activities will be carried out over the entire length of the pipeline.

Pre-commissioning activities will be carried out in sequence and will include the following activities:

- final internal cleaning of the pipeline using cleaning and magnetic pigs to remove any remaining metallic debris, such as welding material left over following tie-in welds and installation of main line block valves;
- geometric survey using a specialist calliper pig to confirm the internal geometry of the pipeline and location of heavy wall pipe;
- drying of the pipeline using either vacuum drying or dry air; and

- purging of the pipeline with inert gas such as nitrogen or with dry air. The pipeline will be purged to a positive pressure for preservation and left ready for the introduction of crude oil.

Pre-commissioning of the AGIs will include the following activities:

- internal cleaning of pipework by flushing with water;
- hydrotesting of pipework;
- internal inspection of pipework; and
- drying of pipework using either vacuum drying or dry air.

4.3.6 Commissioning

Commissioning activities for the pipeline and block valves will be carried out in accordance with a standard set of international practices and procedures.

The minimum requirement for the commissioning of the BTC pipeline facilities will typically comprise the following:

- start-up and limited operation of permanent items of equipment and utilities by system (eg, firewater, power generation, communications and control systems, etc);
- nitrogen and helium leak-testing integrity checks (including in-line critical valve leak testing) of hydrocarbon systems at the designated operating pressures of the plant;
- purging of plant systems prior to the introduction of hydrocarbons;
- closed-loop running of process plant and equipment using appropriate test instruments to prove system integrity and correct functioning; and
- plant performance trials conducted in accordance with specified performance criteria.

Following the successful completion of all required testing and the implementation of all necessary management/contingency plans, all hydrocarbon vessels and pipelines associated with the facilities will be purged with nitrogen. The pipeline and its associated facilities will then be brought into commission by filling the pipeline with crude oil from the Sangachal Terminal.

4.3.7 Operations and maintenance

There will be a manned, centralised control centre at the Sangachal Terminal with remote control units at pumping and metering stations, intermediate pigging stations and block valves. The remote control units contain the field interface instrumentation equipment for control, monitoring, supervision, shutdown, fire detection, mechanical packages and supporting utilities.

The filling and emptying of the crude oil storage tanks at Sangachal will be controlled from the Sangachal Terminal. Detailed information on the upstream supply infrastructure/plant status including tank levels and booster pump status will be provided to the BTC pipeline operator by the terminal management system.

Under normal conditions, pipeline throughput will be achieved by controlling the number of main oil line pumps in operation and their flow rates at the pump station within the Sangachal Terminal.

A maintenance programme will be undertaken at all stations and on the pipeline to ensure smooth operation and to preserve the integrity of the physical assets.

Regular pipeline surveillance will be undertaken and may include the following:

- ground patrols (on foot, horseback and vehicles); and
- liaison with owners/occupiers, tenants and other authorities along the pipeline corridor.

The surveillance programme will monitor the entire pipeline length. Particular attention will be paid to sensitive locations including river, road and rail crossings.

Maintenance pigging to remove wax will be carried out regularly. Intelligent pigging will be carried out approximately every five years to check the integrity of the pipeline. This is achieved by recording any changes in the pipeline thickness and shape, and by inspecting for indications of defects, pitting and cracks.

A detailed Emergency Response Plan is currently being prepared to cover the response effort that BTC Co will mobilise in the event of any major incident associated with the pipeline. A specific element of the Emergency Response Plan is the Oil Spill Response Plan (OSRP). In accordance with the HGA, the OSRP will be completed prior to the commissioning of the pipeline in late 2004 and will detail the response strategy and key considerations for an oil spill from the pipeline, the AGI stations, or the BTC Marine Terminal and associated loading facilities. A framework for the final OSRP has been produced (see Section 6.3).

During project development, BTC Co will develop a comprehensive training programme for all BTC operations and maintenance personnel. This programme will deliver operations, maintenance and safety training requirements as well as ongoing personal development.

4.3.8 Decommissioning and abandonment

The BTC pipeline system has a design life of 40 years, after which the option exists for BTC Co to extend the project life for two successive ten-year periods in accordance with the provisions of the HGAs. If BTC Co chooses to decommission the project at any time, the HGAs contain specific requirements in terms of the decommissioning and subsequent monitoring of the facilities. After 20 years the majority interest in BTC Co will pass to the Azerbaijan shareholder (Azerbaijan (BTC) Limited), a subsidiary of the State Oil Company of the Azerbaijan Republic (SOCAR).

Should any of the HGAs be terminated for any reason during the period of BTC Co ownership, the owners are required to provide to the relevant government a written Abandonment Plan. This will involve:

- removal of all surface installations;
- clearance of all equipment from waterways and marine areas that may pose a navigational hazard;
- drainage and disposal of any remaining oil in the facilities;

- disconnection of the pipelines from the supply of oil, and abandonment in place, or removal where abandonment causes a risk to the environment;
- filling all abandoned underwater pipelines with water or inert material and sealing the ends; and
- re-vegetation of the areas of the ROW disturbed during the abandonment process, consistent with the terrain features and other prevailing conditions.

The Abandonment Plan will be subject to government approval. An ESIA will be prepared prior to the plan's implementation to assess and minimise potential environmental and social impacts arising from the abandonment operations. This abandonment ESIA will also be submitted to the government for approval.

Upon completion of the abandonment operations an assessment of contaminated land will be prepared to record the final contamination status of the location of the project facilities. This assessment will be subject to government approval.

Further information

Further information about the economic and social aspects of the project relevant to pipeline routing and the detailed pipeline design can be found in:

- *National & Regional Review – economic, social and environmental overview of the Southern Caspian oil & gas projects.*
- *The country-specific ESIAs*

These documents can be accessed via the project's website www.caspiandevelopmentandexport.com.