Oil, Gas and Chemicals systems

TANAP Project: Securing the natural gas needs of Turkey and Europe

Providing SCADA and telecommunications infrastructure for the pipeline

Power and productivity
for a better world™

Introduction

The 1,850 km Trans-Anatolian Natural Gas Pipeline (TANAP) will bring Azerbaijan's natural gas directly to Europe.

ABB will deliver the SCADA, telecommunications, pipeline monitoring and security systems.

The TANAP pipeline is the largest section of the $45 billion 3,500km Southern Gas Corridor, which will transport gas from the Shah Deniz 2 field in the Caspian Sea through Azerbaijan, Georgia, Turkey, Greece and Albania, to join the European network in Italy.

TANAP is a company formed for the execution of the project, with SOCAR of Azerbaijan, BOTAS of Turkey and BP as shareholders.

The $11 billion TANAP pipeline will interconnect with the South Caucasus Pipeline (SCPx) at Turkey's border with Georgia and the Trans Adriatic Pipeline (TAP) at its border with Greece.

The natural gas transportation network will comprise the pipeline, compressor stations, metering stations, off-take stations, block valve stations, supervisory control and data acquisition (SCADA), main control centre (MCC), back-up control centre (BCC), fibre along pipeline, physical/cyber security systems, pipeline monitoring systems, internal and external telecoms and control systems, along with other related equipment and installations in Turkey.

TANAP project phases

The project consists of a 56" and 48" diameter onshore pipeline system of 1,814 km in length with a 21 km offshore section beneath the Marmara Sea comprised of two parallel 36" diameter pipelines.

The gas pipeline, which is buried a metre below ground for almost all its length, will include seven compressor stations, four measuring stations, 11 pigging stations, 49 block valve stations and two off-take stations.

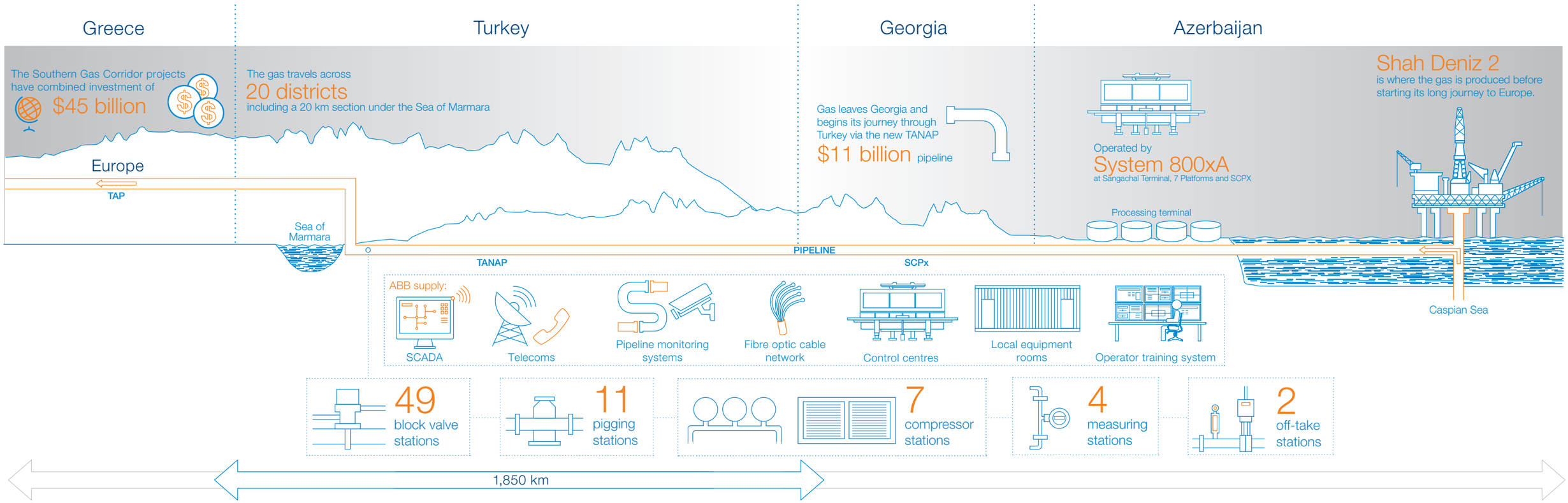
The TANAP system will be fully automated with main and back-up control centres to meet the requirements of gas transmissions and associated environmental and safety considerations.

Phase 0
During the initial phase of operation starting 2018 the flow of 6 bcma will be delivered to BOTAS in the Eskişehir off-take, compressor station 5 will be operational

Phase 1
6 bcma at Eskişehir off-take point, 10 bcma at TAP, compressor station 1 also becomes operational by 2019

Phase 2
Throughput of 24 bcma and 3 off additional compressor stations by 2022

Phase 3
Throughput of 31 bcma & 2 off additional compressor stations by 2026



Why ABB

"Technology innovation and leadership is a cornerstone of ABB's Next Level strategy. ABB's leading System 800xA software and integrated telecoms solution will allow TANAP to safely and reliably operate the pipeline across vast distances from multiple locations," says Peter Terwiesch, President of ABB's Process Automation Division.

ABB has been active in the Caspian region since 1995. The journey to success started back in 2001, when BP commissioned ABB to supply the first automation systems in the area.

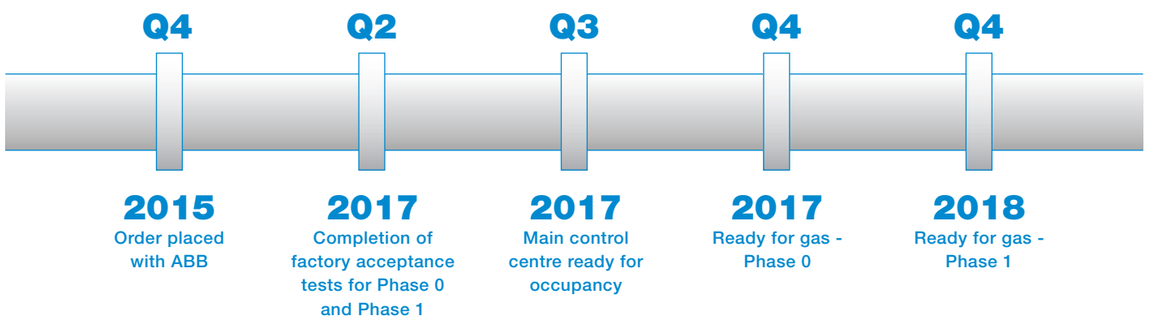
Over the next 15 years, ABB delivered control and electrical solutions to the BTC and SCP pipelines in Turkey and the Caucasus, the Sangachal terminal and seven offshore platforms in the Caspian Sea. When TANAP is complete more than 4,500 km of pipeline in the region - supplying more than 5 percent of Europe's gas - will be controlled by System 800xA.

ABB's proven technology and capability in the oil and gas industry in the region and worldwide, as well as the project execution strategy, makes ABB best placed to implement the SCADA and telecoms scope for the TANAP project.

ABB is committed to operational excellence, flawless execution and start-up and this ethos is at the heart of its business model. Together with TANAP, ABB will consistently deliver significant improvements within the asset management environment.

"Our focus throughout this project is three-fold: to ensure compliance with all health and safety regulations and business and commercial governance, to review project risks to ensure schedules are met and alignment is achieved with all third parties through good interface management and to maximise the facilities available in Turkey for local manufacture and production of key systems including local equipment rooms, cabinet build and fibre blowing, as examples," says Martin Grady, Oil, Gas and Chemicals Hub Business Unit Manager.

Key milestones



Project execution

Project challenges

The TANAP pipeline is the largest diameter, longest pipeline ever built in Turkey.

The project is executed in two main centres, in co-operation with a number of suppliers, with a tight project schedule. Hence project management, interface management and logistics are key elements in the successful completion of the project.

There are also a number of geographical challenges:

- High altitude regions with short construction season - only 110 days in mountainous areas
- Large sections of the pipeline's route is very remote and rugged
- The altitude of the onshore route varies between 2,500 m and sea level
- The pipeline will have to cross many natural and human-made obstacles, including mountains with steep slopes, marshes, roads, railways, existing pipelines and the congested Dardanelle Straits

This is the first time that the leak detection system will be deployed for a subsea water crossing.

In addition, there is a climate that moves between extremes of hot and cold, a lack of infrastructure in some areas with the added challenge of security unrest in the surrounding region.

Project organisation

The project will be executed from the ABB Main Execution Centre in St Neots, UK and a new TANAP project office located in Ankara.

The Ankara office will provide facilities for TANAP management and engineers which will improve the effectiveness of the data exchanges and interfaces between TANAP and ABB. This office will be retained for the life of the project and will be the focus for interfacing with TANAP during the design and testing phases of the project. It will also support the site work through the construction, commissioning and completions works.

The core engineering and management team is from ABB in the UK and Turkey supplemented by local Turkish labour.

The project will be controlled by management and lead engineers located in the ABB Ankara office, supported by the UK Main Execution Centre. ABB Turkey will have design responsibility and their designs will be overseen, validated and endorsed by the Main Execution Centre.

Safety in design

ABB will ensure that the engineering and equipment delivered is safe by design. A policy of design reviews and safety challenges will be adopted throughout the project. Design optimisation reviews will be scheduled at key stages of the design. Any subcontracted design will similarly be subjected to design reviews at key stages.

ABB project scope

ABB will deliver SCADA, telecoms, pipeline monitoring, security systems and install fibre optic cables to transmit data along the pipelines. The pipeline will be controlled and automated by ABB's world-leading System 800xA process automation system. The software solutions will integrate with the SCADA systems and the telecoms that control the gas flows, detect leakages or intrusions and make closed circuit television (CCTV) coverage available for safety and security purposes.

ABB scope of supply for TANAP:
- SCADA
- Telecoms systems: WAN/LAN, CCTV, towers, VSAT, PAGA, radio systems, weather observation system
- Pipeline monitoring system (PMS) including fence intrusion detection system (FIDS), buried intrusion detection system (BIDS), pipeline intrusion detection system (PIDS) & leak detection system (LDS)
- Fibre optic cable network
- Main control centre and back-up control centre buildings
- 57 off local equipment rooms (LERs)
- Uninterruptible power supply (UPS) systems
- Operator training system (OTS)

Control

System 800xA offers all the necessary pipeline control functions as standard and integrates them in a leading edge system that can be easily upgraded so that it continues to be state-of-the-art. The controllers make use of ABB's redundant network routing protocol – the backbone of System 800xA's network technology – to increase the robustness of the control system, and also offer a broad set of communication modules to connect with third-party devices, thereby increasing its versatility.

Particularly important is the feature called point of control (PoC): a function that was added to System 800xA and deployed on the BTC and SCP pipelines. PoC allows the transfer of authority to operate parts of the pipeline to be passed between central and local HMIs, while automatically maintaining the integrity of the system. Using PoC, the engineers are able to quickly and safely transfer control from the central control room to local operational staff on request. The central control room retains a view-only access until the control is transferred back. This standard feature of System 800xA sets it apart from many of its contemporaries.

Telecoms systems

Running alongside the SCADA system are the telecom systems, which are separate from System 800xA, but integrated where required. Both control and telecom systems data are carried along a fibre-optic backbone that runs the length of the pipeline. This takes the form of one 48 core and two 96 core fibre-optic cables installed in high-density polyethylene ducts.

As well as these standard functions, there are a number of back-up communications available such as TETRA radio, used by emergency services and satellite phones for unmanned stations that are off the mobile phone grid. There are also meteorological networks at the compressor stations.

Leak detection and pipeline monitoring

The most important and sophisticated of the telecom systems is leak detection and pipeline monitoring. This shares information with ABB's System 800xA through firewalled connections, but is separate from it, with its own dedicated servers. Leak detection is carried out directly using distributed acoustic sensing (DAS), which relies on the fact that sound waves hitting a cable cause minute changes in the optical properties of the fibre contained within it, as do changes in temperature. Laser pulses sent down a cable can report these changes using a technique known as coherent optical time domain reflectometry (COTDR), and algorithms on the servers can interpret the data, pinpoint where the leak has occurred and verify it using other data, such as the pressure wave that usually accompanies a break in the line.

Intruders are detected in the same way as leaks, with laser pulses. All the pipeline's stations, manned and unmanned, are surrounded by fences, and all the fence lines and surrounding areas are fitted with a fibre optic cable that are automatically monitored 24 hours a day.

Corporate communication

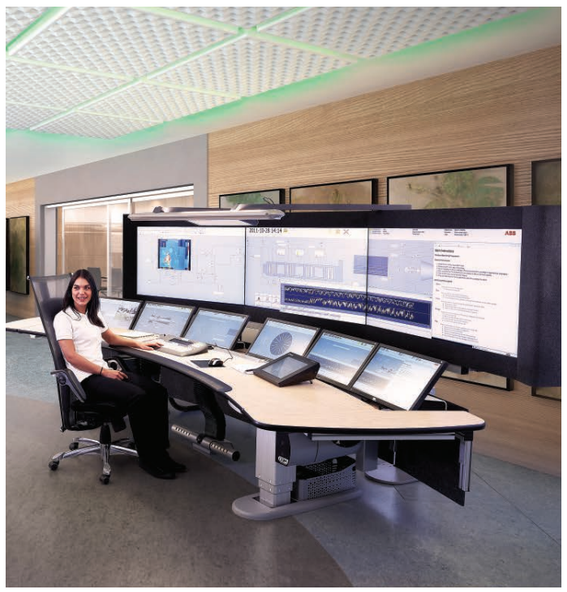
The telecoms network supports corporate communications and It also carries multiple safety and security systems such as public address/general alarm, CCTV, access control and intruder detection. Dedicated and physically separate local area networks are provided for the PMS, SCADA, security, corporate and telephony systems where each network has its own pair of cables in the backbone ducts.

Security

All the pipeline's stations are surrounded by fences, and all the fence lines and surrounding areas are fitted with a fibre-optic cable that are automatically monitored 24 hours a day. If any suspicious activity is detected, the system can attempt to verify it using CCTV. If the system thinks it can 'see' something untoward, it can sound the alarm, present the operator with the evidence and even suggest what standard operating procedures the operator should follow next.

Cyber security

TANAP is critical infrastructure and therefore needs to be secure from cyber-attacks. ABB uses a defence-in-depth approach that involves multiple layers of security controls placed throughout the system. Cyber security is an important factor in all phases of the system lifecycle and it is an integral part of the SCADA and telecoms solution. ABB addresses it at each stage on a project – from design and development to operations and maintenance.



Work packages

ABB has the responsibility for the design and management of its own and other subcontract packages. The project execution strategy for other packages is to place a number of major subcontracts where the subcontractors will provide fully engineered and tested packages to meet project specifications and requirements under ABB management.

Design and system integration

ABB will engineer the SCADA requirements and coordinate the internal supply and external procurement of components where required and then fully integrate and test the systems at their works.

Engineered packages

The main packages are:

- Buildings
- Local equipment rooms
- Fibre installation
- Pipeline monitoring system and intruder detection system
- Operator training, leak detection and pipeline application systems
- Telecoms
- SCADA

Interface management

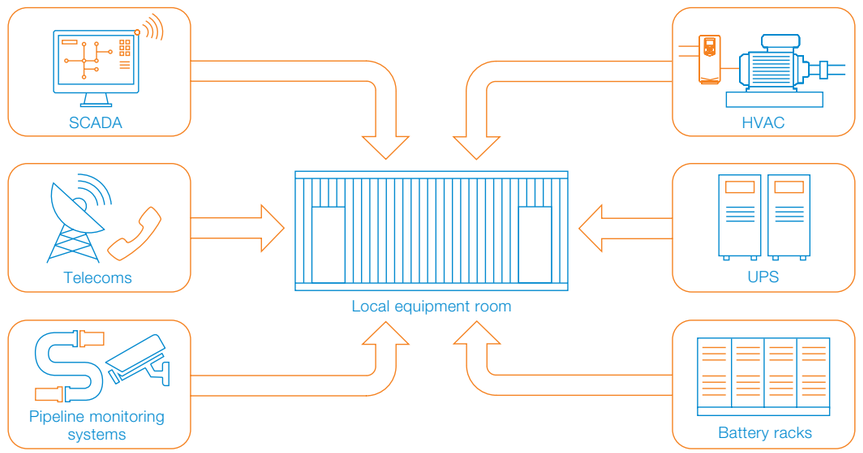
Interface management is a key discipline for successful project execution. It is essential that all interfaces on the project, both internal and between third parties, are identified and managed.

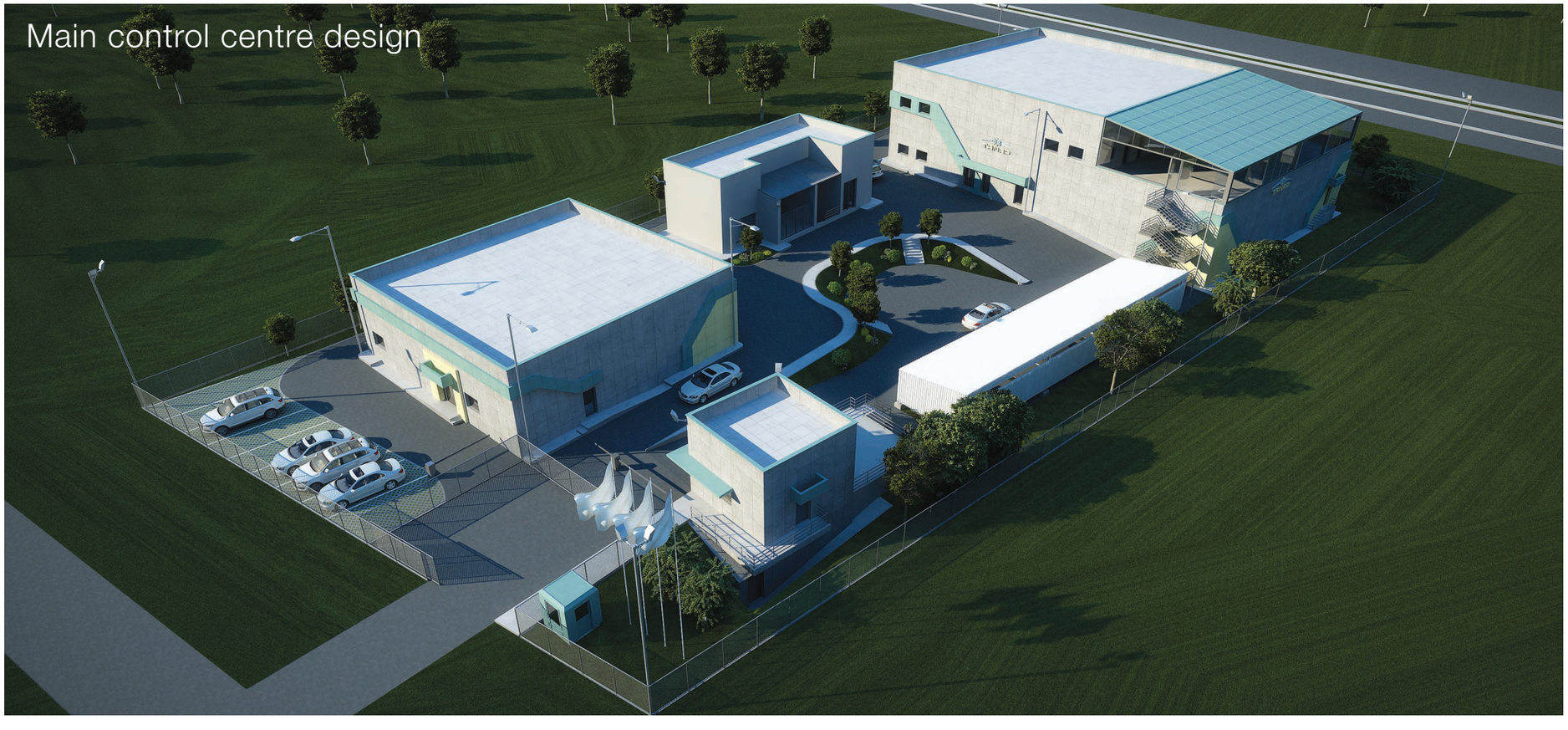
Fibre cable installation

The design, permitting requirements and installation of the fibre-optic cable along the length of the pipeline and along the E90 highway will be subcontracted. An experienced and approved subcontractor will undertake this specialist task. The approved subcontractor will be managed and supervised by ABB.

57 local equipment rooms fitted with:

- **SCADA & telecoms cabinets**
- **Pipeline monitoring system cabinets**
- **HVAC**
- **Uninterruptible power supplies**
- **Battery racks**





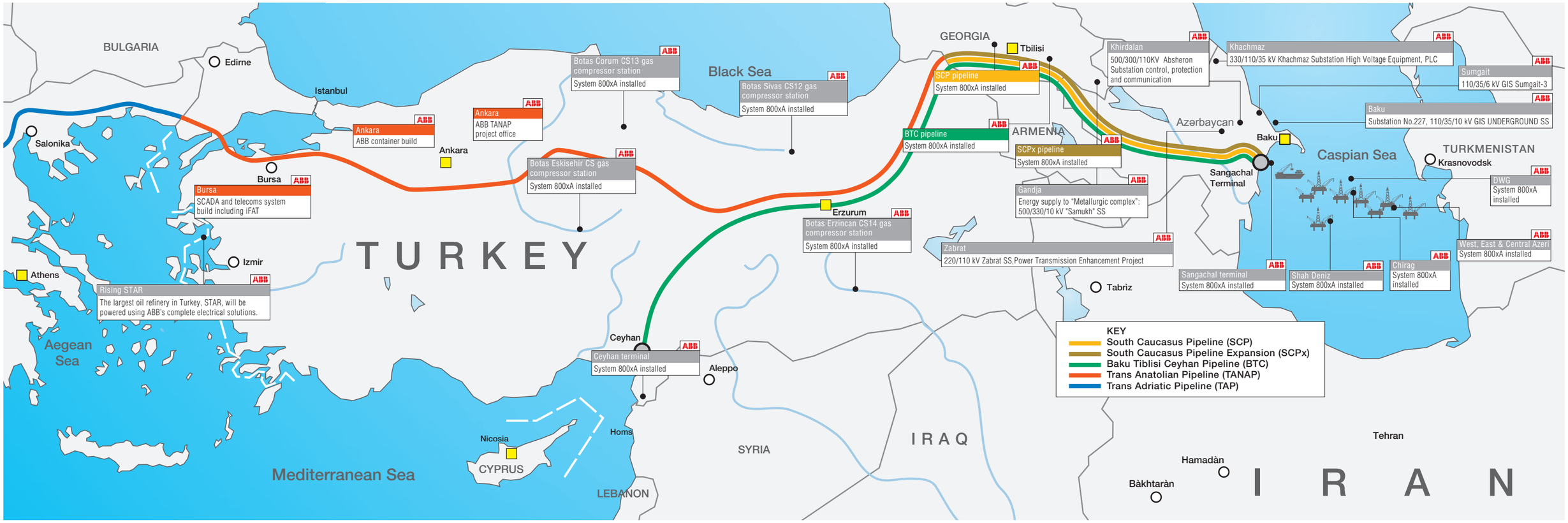
Main control centres

The design, permitting, construction and commissioning of the main control centre and other buildings will be subcontracted to an approved Turkish construction contractor experienced in the construction of buildings to the standards and specifications required on the project. The building will be subcontracted as a turnkey contract such that the subcontractor will take the building to a habitable state and will obtain the habitation certificate.

SCADA & telecoms local equipment rooms

Once the FAT is completed, the equipment will be installed in the local equipment rooms and shipped to site for installation, completions and commissioning. All local equipment rooms for TANAP will be built by an ABB subcontractor in Ankara, Turkey. The integration of the UPS, fire & gas suppression, internal cabling and the installation of telecoms and SCADA cabinets, along with the free issue cathodic protection equipment, will all take place at the subcontractor's premises.

ABB in the Caspian, Georgia and Turkey region



2001 Caspian contract awarded and first system build commences

2002 ABB appoints General Manager for Caspian project

2003 Local engineers recruited, office opened training school set-up and first system delivery

2004 More local engineers recruited, BTC system deliveries start, West Azeri system delivered and healthcare contract awarded

2005 Start-up services begin, East Azeri system delivered, spare parts management set-up and SCP system delivered

2006 More local engineers join healthcare and sales teams. Phase 3 onshore and offshore system delivered

2007 Azeri engineers start working on offshore support

2008 ABB continues full life cycle support to BP assets throughout the Caspian region with an expanding, dedicated team in Baku

2011 ABB signs long term service agreement with BP

2012 SCPx order received

2013 Shah Deniz control room at Sangachal ordered. ABB's new learning center opens. BP evolves to next generation automation technology

2014 TANAP project bid submission and contract award

2015 TANAP engineering and manufacturing execution throughout the year

2016

ABB in oil and gas

ABB is a pioneering technology leader in electrification products, robotics and motion, industrial automation and power grids serving customers in utilities, industry and transport & infrastructure globally. For more than four decades, ABB is writing the future of industrial digitalization. With more than 70 million devices connected through its installed base of more than 70,000 control systems across all customer segments, ABB is ideally positioned to benefit from the Energy and Fourth Industrial Revolution. With a heritage of more than 130 years, ABB operates in more than 100 countries with about 135,000 employees including over 7,500 dedicated oil and gas employees in 40 countries. ABB employs 8,500 scientists and engineers, invests more than more than $1.5 billion annually in R&D and collaborates with 70 universities worldwide.

ABB is the largest provider of power and automation products, systems and solutions to the oil and gas industry, with a complete and integrated scope of supply capability that ranges from plant electrification to control, optimisation and safety systems, smart field instrumentation, analysers and telecom systems.

Our multi-scope capabilities are unique in the industry, providing our customers synergies of cost, quality and consistency. The combination of specialised expertise enables us to engineer seamlessly integrated telecom and automation solutions.

ABB in Azerbaijan

ABB maintains a large established engineering and technical support centre in Bridge Plaza, Baku. The Baku office expanded to support the significant upstream and midstream projects in the region, employing more than 100 people at its peak. Local resourcing lies at the core of ABB philosophy in Azerbaijan. The local management & sales teams are fully staffed by Azeri nationals. These teams are in-turn supported by the engineering team who also employ a high proportion of local resource. The service operation, managed from Bridge Plaza in Baku hosts an engineering support and small projects centre that works across multiple assets in the region. This ensures that our customers have support and the right skills locally, whenever they need it.

The ABB Installed base in Caspian Region:

- 14 parallel projects across 3 countries
- 7 major oil & gas platforms, 2 major pipelines (1780km), 2 world class terminals with tanker loading
- Largest 800xA Integrated Control and Safety System in the world (270,000 I/O points)
- Huge electrical installation across all sites
- 6 strategic or major ABB customers, plus 8 international EPCs
- Set up of service / healthcare & full training school facilities for Azerbaijan
- Localisation and training of Azeri and Turkish personnel for long-term roles
- All supported by our global engineering infrastructure

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