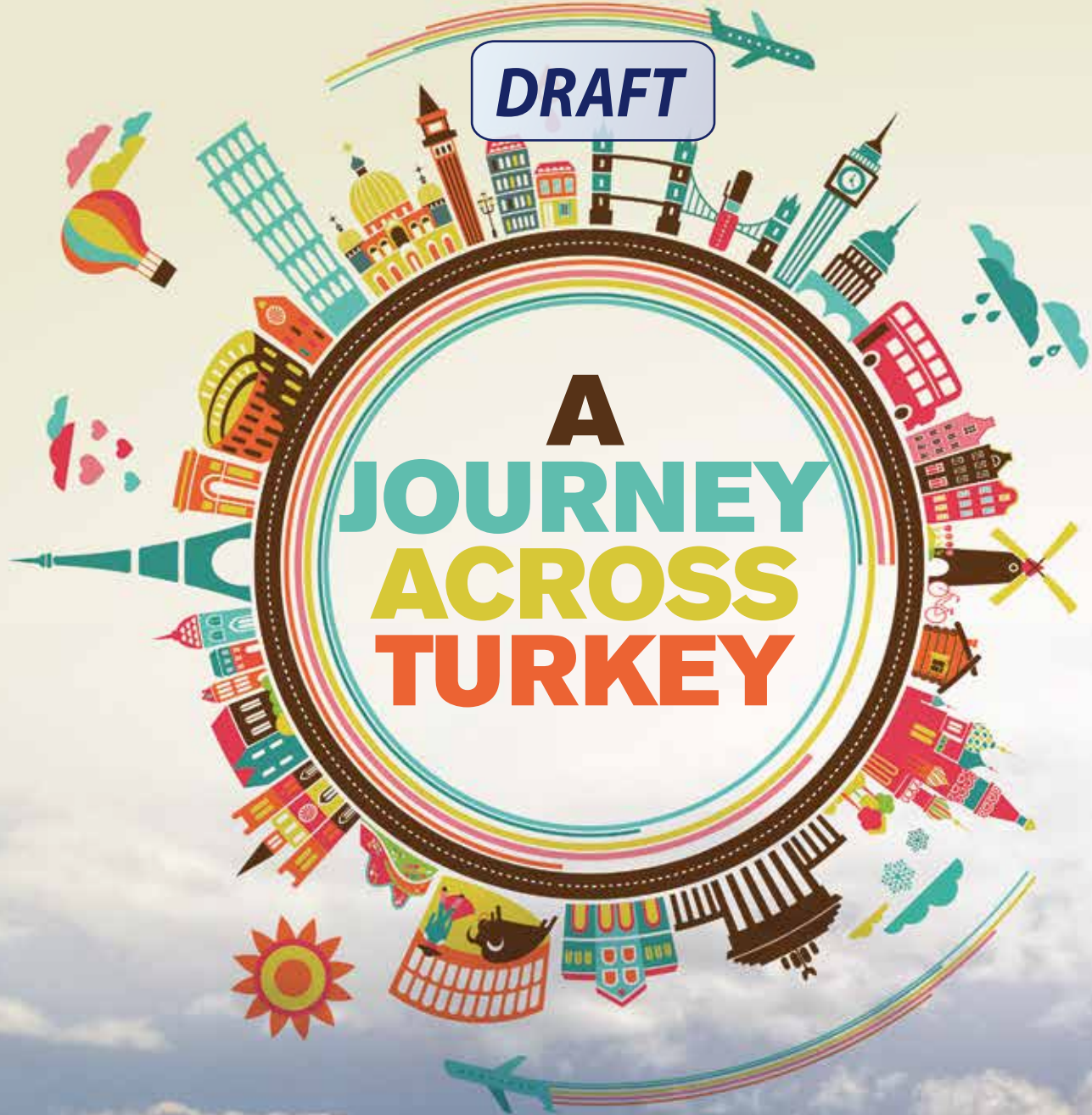


**DRAFT**

**A  
JOURNEY  
ACROSS  
TURKEY**



**Peter Brookman, EA Technology, UK**, presents a journey across Turkey to inspect the Baku-Tbilisi-Ceyhan pipeline and keep the oil flowing into Europe.

**T**he Baku-Tbilisi-Ceyhan (BTC) pipeline is the second longest pipeline in the former Soviet Union. It covers a vast, geographically diverse stretch of land, connecting Azerbaijan's capital city of Baku on the Caspian seafloor, through Georgia's capital Tbilisi to Ceyhan, a port on the south-eastern Mediterranean coast of Turkey.

Completed in 2005, the pipeline is owned by joint venture company the BTC Pipeline Company (BTC Co.). Responsible for both its construction and operations, BTC Co. recently appointed power-engineering specialist EA Technology to undertake a thorough technical assessment of the Turkish stretch of the pipeline.

A team of six, highly skilled engineers were sent out to assess the earthing and lightning protection of

all of the pipeline assets. The Turkish section of the pipeline, operated by BOTAS International Limited (BIL), a subcontractor to BTC Co.'s Turkish branch, runs from the Georgian border of Turkey to Ceyhan Marine Terminal (CMT), covering approximately 1074 km.

### **Unique challenges**

Despite being experts in the field, this would be the largest overseas technical assessment project EA Technology had ever undertaken. Chosen because of its proven capabilities to take on large scale petro-chem diagnostic projects across the world, as well as its inherent impartiality and commercial independence, the BTC project presented the EA Technology team with some truly unique challenges.

Figure 1. Ceyhan marine terminal. ©Peter Brookman







Figure 2. Ian Holmes, EA Technology, ensures all the correct safety forms are filled in. ©Peter Brookman

Peter Brookman, Technical Lead on the project and EA Technology's HV earthing expert, said: "What we were essentially tasked with was a benchmark condition assessment of the pump stations, CMT and associated equipment along the length of the pipeline; however the conditions we worked in were anything but routine.

"Although the pipeline was built relatively recently, these assets require regular, thorough inspections and considering the terrain, was an enormous challenge."

Steve Holmes, Business Development Manager at EA Technology, adds: "Much of what we were doing was checking the earthing – the safety, the lightning protection and possible transients on the network. Everything on the pipeline needs to be correctly earthed, and there really is a skill to doing this properly.

"The pipeline goes through landscapes that – in every sense of the word – broke new territory for EA Technology. It was a hugely exciting yet challenging experience for the team members individually and the company as a whole."

The team's itinerary along the length of the pipeline were four pump stations, two intermediate pigging stations, 51 block valve stations and the Ceyhan Marine Terminal (CMT).

The testing specification for each site was extensive, consisting of: earth resistance measurement; soil resistivity measurement; full earthing analysis; fence earthing survey; earthing system continuity and integrity survey; touch, step and transfer voltages; lightning systems survey; and a partial discharge test of the MV equipment at every location.

## Erzurum

In November the journey began in Erzurum, a city in eastern Turkey, but the weather soon got the better of the team and the trip was unexpectedly postponed after several feet of snow blocked them into their accommodation.

Peter said: "Temperatures in Erzurum during the winter are astonishingly cold. It dropped well below freezing and we actually woke up one morning with 5 ft of fresh snow outside our door. It was simply impossible to work in."

The project was resumed in March, when the team flew to Adana to begin their inspection of the Ceyhan Marine Terminal, close to the Syrian border. Having been caught out in the severe snow of Erzurum, a thorough logistical plan for the project had to be put in place for the safe transportation of staff across the country.

Peter said: "We had to chase the cooler weather. The temperatures in Ceyhan in March were 35 - 38 °C and at the peak of summer will get up to 50 °C. Wearing full fireproof clothing during temperatures like that would have been very difficult.

"We had over 1000 km of land to drive across and were only permitted, for safety reasons, to travel through daylight. Some roads were incredibly rough, dirt tracks, so travelling through the dark would have been very dangerous.

"The nature of our work meant that we could only work from March to August, due to the severity of the winters and the fact that we were following the milder weather north."

## Ceyhan Marine Terminal

Work at the CMT had its own issues to tackle, the main one being the length. At over 2 km long, the safety and logistics of undertaking earthing and lightning protection surveys along the length of the jetty took hours of planning to ensure efficient and accurate measurements were completed safely (Figure 1).

Ramiz Ahmed, EA Technology's Project Manager on the task, said: "One of the things that probably surprised me the most along the way was the huge diversity in both the landscape, which ranged from the flat, hot Mediterranean cities, through to vast mountainous regions which were sparsely populated with traditional farmers using horse and carts."

## Sivas

The team left the Ceyhan area and headed north, stopping at block valve terminals along the way to then survey the next pump station at Sivas.

Sivas is 1278 m (4193 ft) above sea level and the seat of the Sivas Province in central Turkey. The work in Sivas presented unique health and safety challenges.

Peter said: "The field work we did in Sivas presented the highest risks. The land we were surveying was rife with ticks and snakes. One tick we were warned about in particular was one which gives you Crimean-Congo haemorrhagic fever, which if caught is incurable and has a fatality rate of up to 40%."

Snakes also proved to be a hazard for the team. Steve said: "One member of the team actually got bitten on the foot by an extremely venomous snake.

"Thankfully it only penetrated the safety boot and not the engineer's skin, but in any case the health and safety



Figure 3. EA Technology engineers walking through the grasses of Sivas. ©Peter Brookman

team were incredibly efficient and had everything ready in case the worst had happened. Despite it being quite a scary near-miss the response was such that we all felt very reassured about the people we had with us and the systems that had been put in place.”

Peter added: “The health and safety training given to the EA Technology team by the BTC Pipeline Co. left no stone unturned. The engineers and staff we had with us were incredibly supportive, and at every stage of the journey we were prepared for the terrain and the associated risks (Figure 2).

“During the time in Sivas we were paired up and kitted out in specialist clothing that included long white socks, so that should a tick jump onto us it could be easily spotted. Thanks to the thorough training we were given we were well equipped to handle the situation should the worst happen.” (Figure 3)

### Erzincan and Erzurum

The next major cities to travel through were Erzincan and Erzurum.

The Erzincan region was also noted for having the highest lightning risk of all the areas surveyed. This area was extremely mountainous, with one Block Valve Terminal being located at the top of a mountain at a height of over 2600 m (8530 ft). The access to this site was via a steep dirt track only accessible a few months of the year, with snow still lying at the top of the mountain



Figure 4. Storm clouds closing in around the Erzincan site. ©Peter Brookman

even in the height of summer. At one point work was stopped due to a storm cloud covering the site, with staff retreating to the relative safety of the vehicles until the storm passed.

What stood out for the team in Erzincan was the lightning protection assessment. Peter has specialised in lightning protection since 1999 and been on the British Standards Panel for Lightning Protection for two years.

He says: “There’s no specialist equipment we use for assessing the lightning protection equipment – it’s a purely visual assessment that relies completely on the quality and experience of the staff.

“Lightning protection systems at all locations were noted as being in a very good condition and consisting of a Faraday Cage to divert the lightning strike away from the buildings/structures. When undertaking our survey work, we are generally trying to ensure the safety of people and



Figure 5. EA Technology staff celebrate the end of the survey work at Posof, on the Georgian border. ©Peter Brookman

the process being undertaken by the different locations. Lightning strikes in a flammable environment can be extremely damaging, with the risk of explosion very high.

“Erzincan’s lightning was quite incredible – you could almost set your clock to it striking at 2 pm every day. With millions of gallons of oil pumping through the buried pipeline, the lightning protection equipment is crucial to prevent something truly catastrophic happening.” (Figure 4)

### Kars

The last major area was Kars, with the last block valve terminal located on the Georgian border and almost 1200 km from the CMT where the work started months before.

Peter said: “Kars was incredibly remote and sparsely populated. Having started in an area like Adana, Kars seemed incredibly far away from normal society, with subsistence farming the norm. What struck us most throughout the project was the friendliness, generosity and hospitality of the Turkish people at every location we travelled together with a fantastic variety of food.”

### A successful start

In all, the EA Technology’s team was in Turkey for over five months, and did not leave the country until the job had been completed. Each of the pump stations took about a week to assess, with every one of the 51 block valve stations – each around a quarter of the size of a football pitch – taking a day to complete.

This was the largest overseas services project of its kind that EA Technology had ever done and each member of the team came away with their own unique cultural experience.

Ramiz said: “Personally, it was the biggest project I’d ever managed and it really was a baptism of fire in terms

of resource and safety management. We are extremely proud of the high quality of work undertaken. When considering the scale of the project, the fact that we had no significant safety issues is a testament to the policies and training put in place by both BTC Co. and EA Technology.

“There were also unprecedented logistical issues, but overall I feel that we proved we have the right resources, knowledge and capacity to carry out such huge undertakings. It was a fantastic project to manage.”

Peter continued: “For me, it was great to see the quality of the work done, by both ourselves and by the engineers from BTC Co. who accompanied us at every location. By the end of the project we had all made some new friends and still keep in regular contact with many.

“The quality of the health and safety procedures – the training, the equipment and the rigorous procedures set in place was essential to ensure the success of the project. Despite the difficult terrain, the wildlife risks and the weather, we felt safe at every stage of the journey.”

Steve Holmes reflected: “This entire project proved to be an enormous confidence boost for EA Technology. We’ve known for years what a talented and technically brilliant team we have, and successfully completing a project on such a massive scale was a huge achievement.

“It’s opened our eyes up to the possibilities – having handled the logistical challenges presented to us in Turkey, I don’t think there’s anything we can’t take on.” (Figure 5)

Peter closed by saying: “The findings of the survey work have allowed BTC Co. to have a detailed overview of all their earthing and lightning protection systems. Only the Turkey section of the BTC pipeline was surveyed so hopefully the journey is only halfway through.” 