

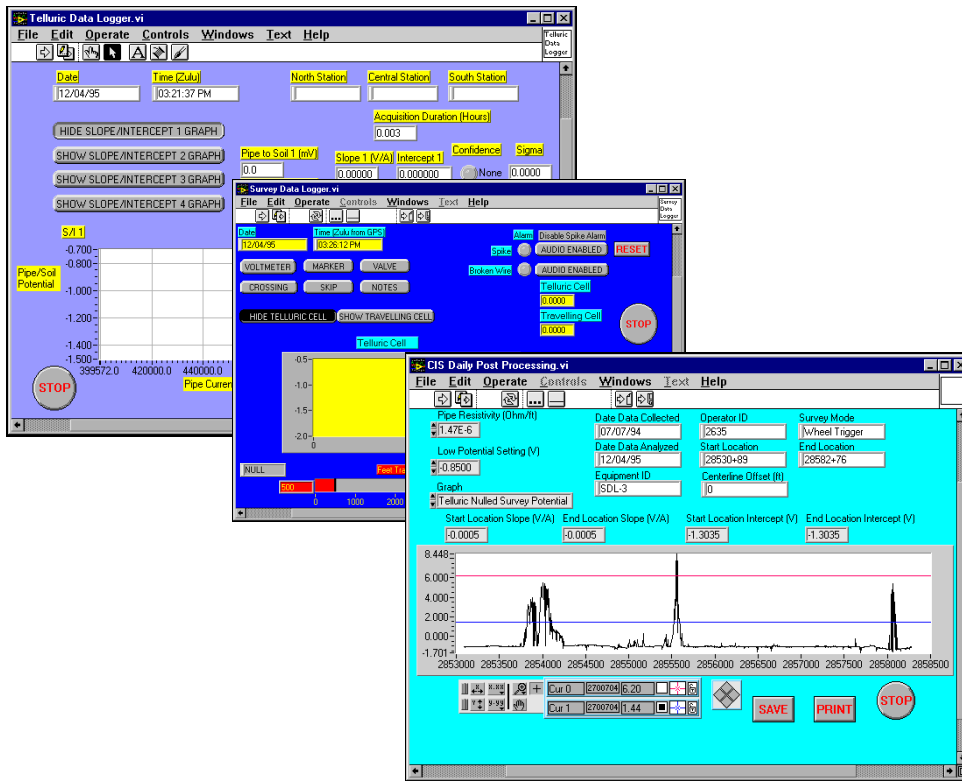
The Problem:

Like all companies that use buried pipelines for the transportation of oil, the Alyeska Oil Company is required to do a yearly survey of its pipeline for corrosion measurements. Corrosion levels are measured by taking a voltage reading between the pipeline itself and the surrounding soil. The galvanic potential is an indication of whether any corrosion protection schemes (such as zinc anodes) are still effective or whether there is any exposed steel. In most areas of the world, this would be a simple task, but in Alaska, there is a problem not normally encountered. The proximity of the Earth's magnetic north pole and the fact that the pipeline runs almost straight north to south, results in a current being induced in the pipeline. This telluric current can be quite large at different times of the year and at other times drop to nothing. While the current is beneficial in terms of corrosion protection, the voltage drop it created would make for false pipe to soil voltage readings. The pipeline operators as well as federal and state regulators were very interested in obtaining accurate corrosion measurements.

The Solution:

The first step was to instrument a specially prepared section of pipeline near Fairbanks, Alaska. Numerous sense points were wired to the pipeline, known defects were added and a variety of protection mechanisms were provided. Aspen Test built a test system that consisted of VXI based instruments as well as GPIB instruments. The VXI system was designed for high speed data acquisition and included switching, voltage measurement, and waveform capture. The GPIB instruments were a high speed digital oscilloscope and digital multimeters. All of this equipment allowed Alyeska corrosion engineers to characterize long term affects of telluric currents. LabVIEW software from National Instruments was chosen as the application framework because of its number of existing instrument drivers and the ease with which new drivers can be developed. The data acquisition system collected information throughout the fall and part of the winter of 1993. At the end of this time, corrosion engineers came up with a solution to the problem of taking pipe to soil voltage measurements. They determined that by plotting voltage versus current over a period of time, the slope and intercept of the resulting graph could be used to determine a telluric null potential for a section of pipeline. What was needed next were portable data acquisition systems that could perform the same basic functions as the fixed VXI/GPIB system. Two different systems were to be used. One, known as the Telluric Data Logger was to be semi-portable. Powered by car batteries and connected to a DC to AC inverter, they were to be setup at mile intervals along the pipeline. Aspen Test used AT_MIO 16X PC data acquisition cards mounted in "luggable" computers. These computers were to be used in the determination of the telluric null potential by measuring pipe current and voltage. When the results were determined to be statistically correct, a calculation of the telluric null was made. The second component was to be a portable computer known as the Survey Data Logger. The pipe to soil measurements needed to taken at six foot intervals along the entire length of any buried pipeline. This task was normally performed by a person walking the pipeline with a set of probes mounted on the ends of walking sticks. In many areas, the computer could be carried in a vehicle accompanying the walker. In some areas however, the computer needed to be backpacked through difficult terrain. The computer chosen used a pen for all data input to allow an operator to drive at the same time as controlling the computer. The computer's keyboard was detachable, making a lightweight and compact package. A PCMCIA DAQCard-700 from National Instruments was used in the portable computer. The computer itself was enclosed in a shock and water resistant case. The pen used an RF transmitter and all of the computer's functions were available even while fully enclosed. Besides the data acquisition card, the Telluric Data Logger also include a GPS receiver to provide a precise time stamp. This was done to provide a correlation to telluric activity being measured by USGS stations in Alaska. LabVIEW was used exclusively for all software. This was an important decision since the time

frame did not allow for the extended development time required for traditional languages and field modifications to the software were quick and easy.



Hardware Used (Phase 1):

- Fluke 8842A
- National Instruments VXIpc-486
- Tektronix VX1401
- Tektronix VX4240
- Tektronix VX4236
- Tektronix 53A-311
- Tektronix VX4332
- Tektronix VX4386
- Tektronix 73A-308
- Tektronix 73A-270
- Tektronix TDS420

Software Used (Phase 1):

National Instruments LabVIEW

Hardware Used (Phase 2):

- Compaq Concerto
- Datum BC627AT/BC620 AT GPS
- National Instruments AT-MIO 16X
- National Instruments DAQCard-700
- Promark PEP486

Software Used (Phase 2):

National Instrument LabVIEW
LabVIEW Application Builder