Pipeline Corrosion Mapping

Pipeline failures in Australia are estimated to cost in excess of A$250M pa (WSAA, 1999) One way to make savings is to pre-empt any unplanned failures. To address this issue, planning and predictive models have been developed using statistical analysis to prioritise routine maintenance and rehabilitation in pipeline networks (Burn *et al.* 2001). However the results can be greatly improved if key physical properties are available to assist with predictions of condition. In particular the level of corrosion is considered a critical parameter in the condition assessment of DICL and other ferrous materials used extensively in Australia.

Observations of soil resistivity have been used for many years to indicate the potential level of pipeline corrosion and system failure. Corrosion is an electrochemical activity associated with a current flow between two sections of pipe. Conductive soils provide an external link between two segments containing an anode and a cathode. Consequently soil resistivity surveys can provide an indication of the maximum potential corrosion rate for critical pipeline assets. EGS client have commissioned surveys of this type to provide a systematic approach for the selection and subsequent exhumation of test pits for physical inspection (NDT).

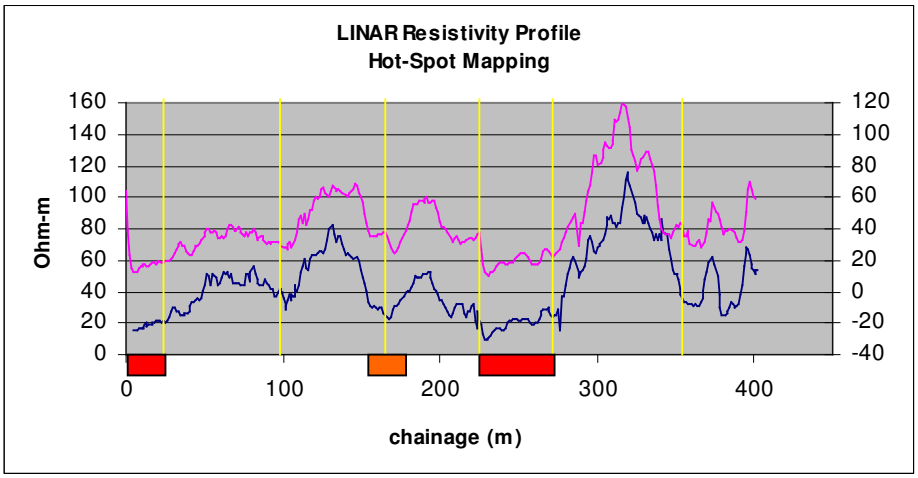

Figure 1 : LINAR resistivity profile indicating "hot-spot" corrosion for LPR extrapolation.

Since corrosion implies electrochemical activity it is also important to identify any natural sources of voltage (EMF) contained in the soil. Variations in soil chemistry amount to a change in the nature of local electrolytes and the generation of numerous sub-cells. As a result soils can generate a characteristic EMF or self-potential (SP) even where there is no industrial activity. In particular self-potentials can be generated by any groundwater migration. The resulting stray current equilibration may cause an acceleration of local corrosion at any exposed section of a pipeline. “Streaming” currents of this type are especially significant near coastal areas with topographic profiles driving the groundwater migration over long periods of time.

New geophysical survey methods developed by EGS can be used to identify any local variations in resistivity as well as indicating any sections with unusual levels of EMF. Resistivity variations along a critical pipeline may be readily assessed using linear arrays (eg Wenner Arrays). These surveys can be conducted at a relatively rapid rate with no surface impact and minimal disruption to traffic. Data can be obtained at close spacing to identify any lateral changes in soil properties which provide a focus for stray currents responsible for local corrosion “hot-spots”.

As well as conventional resistivity data the new instrument (LINARR) can be used to determine soil chargeability, ion activation and EMF using spectral sampling methods. The resulting high density continuous geophysical profiles can provide a more immediate and relevant indication of in-situ corrosivity (complementing the related linear polarisation resistance [LPR] method developed for individual laboratory samples).