Corrosion Technology Services

Case Study: CS-04-01-2012

Close Interval Potential Survey

Introduction

Close Interval Potential (CIP) surveys, are used as a method of assessing the operational condition of the Cathodic Protection (CP) system on an immersed metallic pipeline. The survey also identifies areas of increased current demand where coating defects may be present.

Scope of Work

CTS Europe (CTSE) have conducted CIP surveys on many different pipeline systems within the UK and Ireland. CTSE have surveyed over 5000 km of gas and oil pipelines within the UK for National Grid, Northern Gas, British Pipelines Agency, Murphy Pipelines, Wales and West and have also worked for Bord Gais in Ireland.

Corrosion Technology Services Group has experience globally in executing CIP surveys in some the remotest locations in harshest environments possible.

Field engineer during CIP survey, UK

Execution

A CIP survey records pipe to soil potential readings with reference to a $Cu/CuSO_4$, along the entire length of a pipeline. The potential readings consist of an energized on potential and an IR error free instant off potential. All sources of current influencing the pipeline must be interrupted in sync with each other, to allow the recording of accurate “instant-off” potentials. Whilst the CP system is energized there will be an error in the reading that is recorded, IR error, due to the flow of current from the sources of CP. At the moment in time that all sources of current are interrupted, an instant off potential can be recorded before the pipelines potentials start to depolarize.

To achieve this, GPS synchronised current interrupters are set up at each Transformer Rectifier on the electrical section of pipeline. The interrupters switch on a timing cycle with a ratio of four to one with the “on” period being the longer of the two. Data loggers are set up to record the instant off reading 150ms after the current sources have been interrupted. This is sufficient to allow for the IR error to dissipate but not long enough for the pipeline to start depolarising. Each iteration of the timing cycle consists of one “on” and one “instant- off” reading.

On and instant-off potentials are also recorded at a static location on the pipeline within 4km of where the survey team is located. This is to record the effect of stray current and interference on the pipeline. If a defect is recorded in the mobile data then the static data can be cross referenced to determine that the drop in potentials was local to that area and an actual coating defect. The static data is increased by 500mV on our graphs so that it can be clearly seen alongside the mobile data.

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Execution continued…

During the execution of a CIP survey the length of the pipeline is walked so that the potential readings can be recorded at 1 – 1.5 metre intervals. The pipeline is surveyed in sections between road crossings. A thin copper wire on a spool is attached to a test post at the beginning of each section to provide a constant connection to the pipeline. The current date, time and GPS coordinates are also recorded with every potential. The pipeline is scanned with a pipe locator to ensure the survey team is directly above the pipeline.

Results of CIP surveys

The main advantage of conducting a CIP survey on your pipelines is that you can determine whether the CP system is performing sufficiently at all points rather than just at test posts. A secondary benefit is that you can determine whether there is any stray current or other interference present on your pipeline.

During a CIP survey an “instant-off” of criterion of -850mV CSE is often used. A criteria of -950mV CSE is also applied to allow for the presence of sulphate reducing bacteria. Other criteria may be applicable under certain circumstances.

Defect Groups

The 4 types of defects that are recorded are described below:

- **Type I** - Both the instant off and on potentials fall below criteria. This is the most severe type of defect and would suggest that the pipelines coating is damaged in this area.
- **Type II** - Only the instant off potential is below criteria. This would also suggest a defect in the coating but is not as severe as a Type I defect.
- **Type III** – There was a drop in the instant off potentials but not severe enough to cause the potentials to drop below criteria. A small coating defect may be present at this location.
- **Type IV** – This type of defect indicates that there is stray current affecting the potentials in this area of the pipeline. This can potentially be a serious problem and can greatly compromise the effectiveness of the CP system. The interference can cause the potentials to drop below criteria at certain times and also cause the pipeline to become greatly overprotected. This in turn can cause excess production of Hydrogen and coating disbondment.

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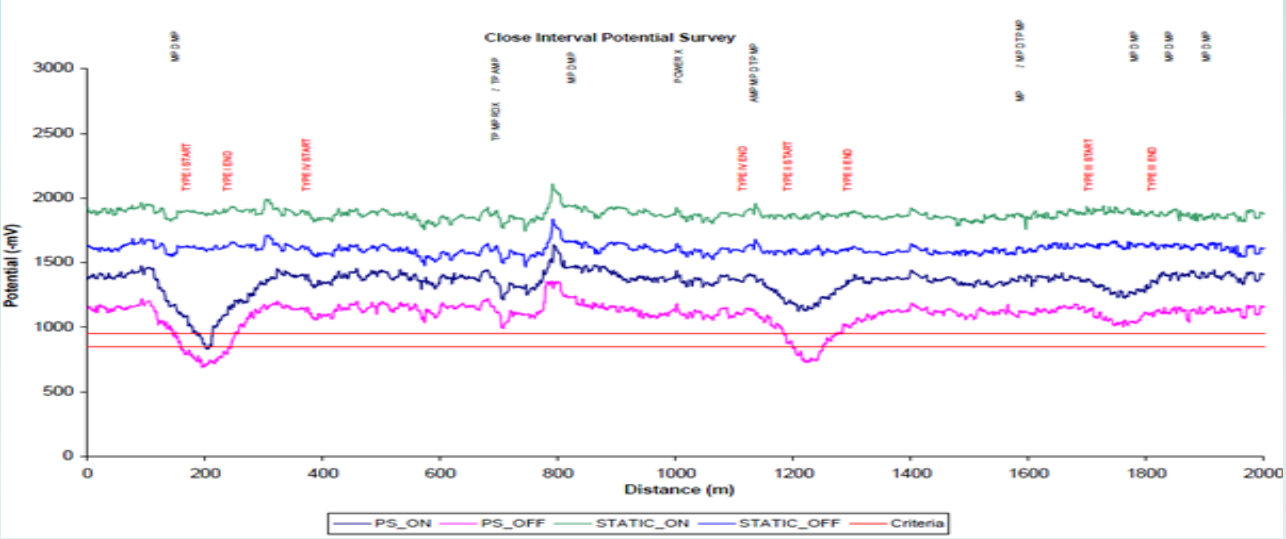
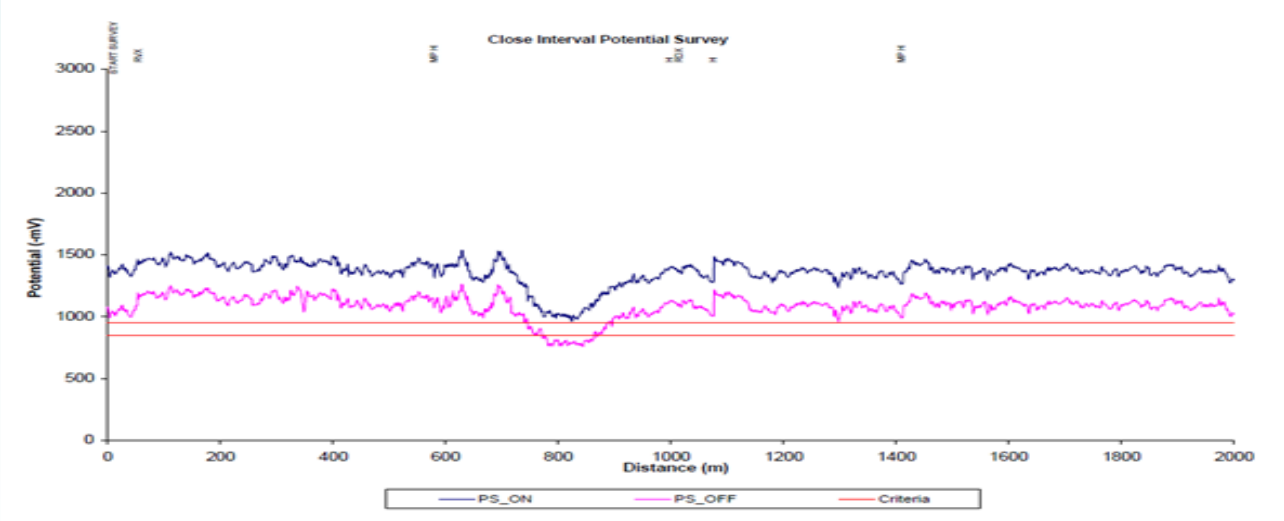
Graph 1 shows the data that is recorded during a CIP survey and also shows examples of the 4 types of defect (discussed on the previous page) that were recorded during a survey.



Graph 1

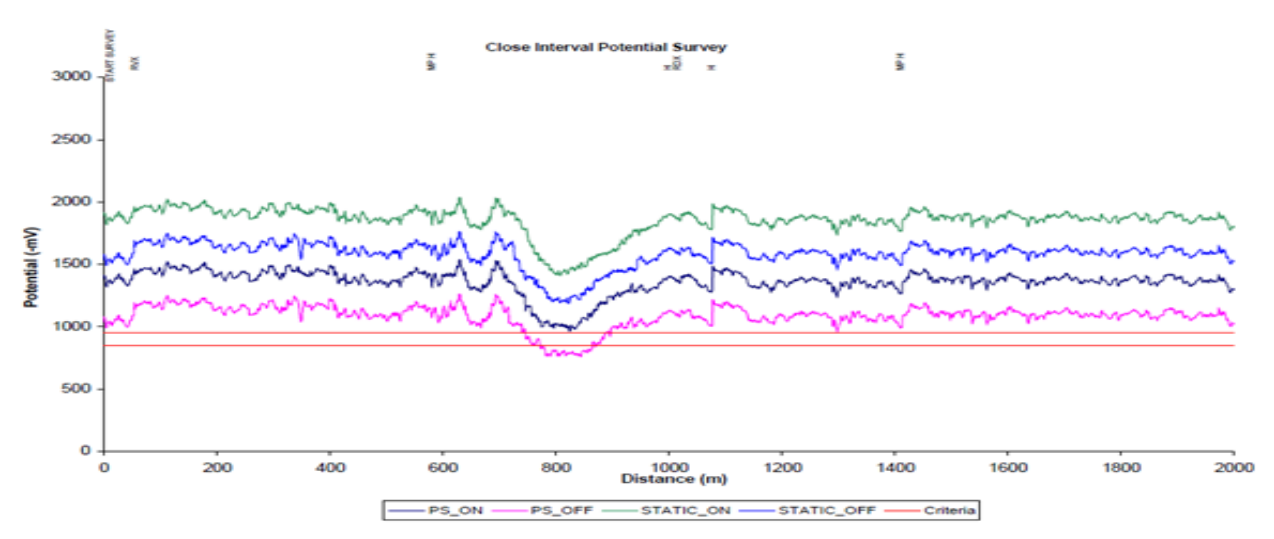
The importance of recording static data during a CIP survey is demonstrated in the following 3 graphs. **Graph 2** shows a CIP survey conducted without static data being recorded. There appears to be a defect at 800m.



Graph 2

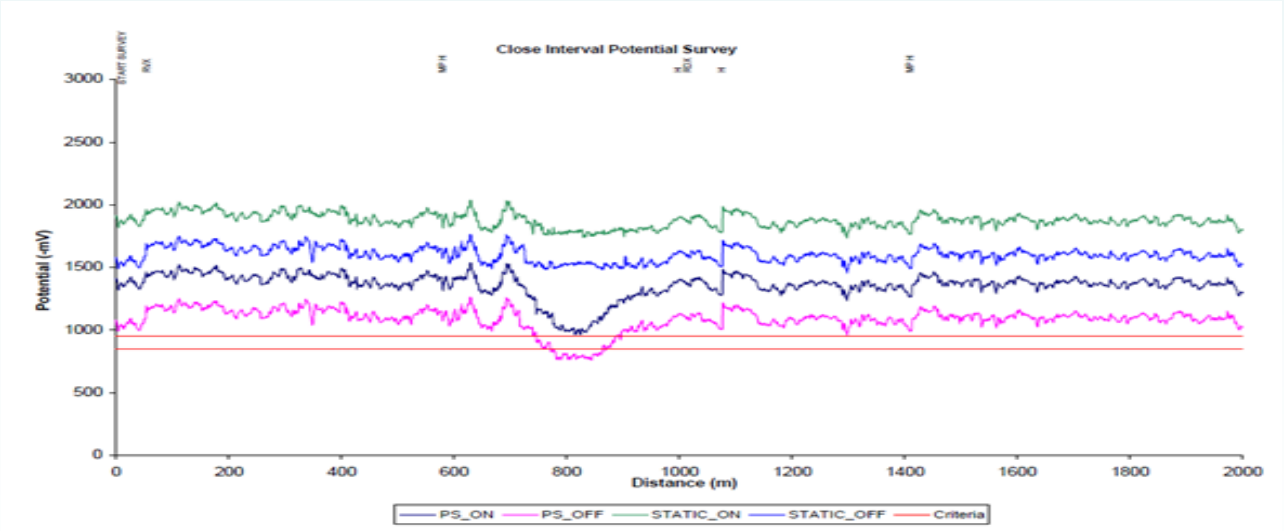
Close Interval Potential Survey

Graph 3 is the same as Graph 2 but static data has now been recorded. As can be seen the “defect” from the previous graph is now shown to be caused by interference on the pipeline. This means that this section of pipeline is under-protected at certain times of the day and is adequately protected at other times. There is no actual coating defect at this location.



Graph 3

Graph 4 shows the same section but this time there is no drop in the static data where the mobile data drops. In this scenario there could be a possible coating defect at 800 meters as the static data does not follow the mobile data.



Graph 4