

Considerations for Efficient, Accurate, and Safe Interrupted Surveys

Jay Warner
Dairyland Electrical Industries
PO Box 187
Stoughton, Wisconsin
USA

Randy Hilgart
Dairyland Electrical Industries
PO Box 187
Stoughton, Wisconsin
USA

ABSTRACT

Obtaining accurate polarized potentials (a.k.a. Instant-OFF potential) during an interrupted survey can be complicated by the introduction of a capacitance effect from DC decouplers in the circuit. Methods to obtain accurate polarized potentials in these scenarios exist, but there is some level of risk introduced to the pipeline and operating personnel. This paper will explain these existing methods, evaluate the level of risk associated with each and analyze a new technology that was developed for the purpose of improving data by providing accurate polarized potentials and avoids the risks or inaccuracies that other methods introduce. Field data will be presented to represent the performance of the new technology and compare it to having traditional decouplers in place.

The new technology reduces the time required for decoupler voltage to dissipate without having to disconnect the decouplers during an interrupted survey.

Key words: Close Interval Survey, CIS, Instant-Off Potential, Decoupler, Capacitance

INTRODUCTION

Electrical potential surveys are typically required to be completed on a periodic basis on cathodically protected structures such as underground pipelines. However, proving that a cathodic protection system is providing the degree of corrosion protection required can often be a time-consuming and error prone endeavor. It is a typical practice, and often required, to interrupt the CP source(s) to carry out these surveys, the accuracy of which is affected by several factors, including the presence and inherent function of DC decouplers.

This paper discusses how and why traditional decouplers can affect interrupted survey measurements including instant-off data and reviews some existing solutions to these issues. A new decoupler solution for ensuring the accuracy, efficiency and safety of interrupted surveys is reviewed.

INTERRUPTED SURVEYS AND DECOUPLERS

Watch Your Waveforms

The purpose of potential surveys is to evaluate the effectiveness of the cathodic protection (CP) system by measuring the polarized potential of the pipeline. However, pipe-to-soil potential measurements are influenced by the CP current, which introduces a measurement error known as IR drop. To eliminate this error, CP sources are synchronously interrupted momentarily, after which the potentials are measured, but before the pipe depolarizes. The potentials measured in this way are referred to as instant-off potentials. Such interrupted measurements are typically collected on a segment of the pipeline that is undergoing a Close-Interval Survey (CIS) or Close-Interval Potential Survey (CIPS). A typical instant-off potential response on a pipeline without decouplers installed is shown in Figure 1.

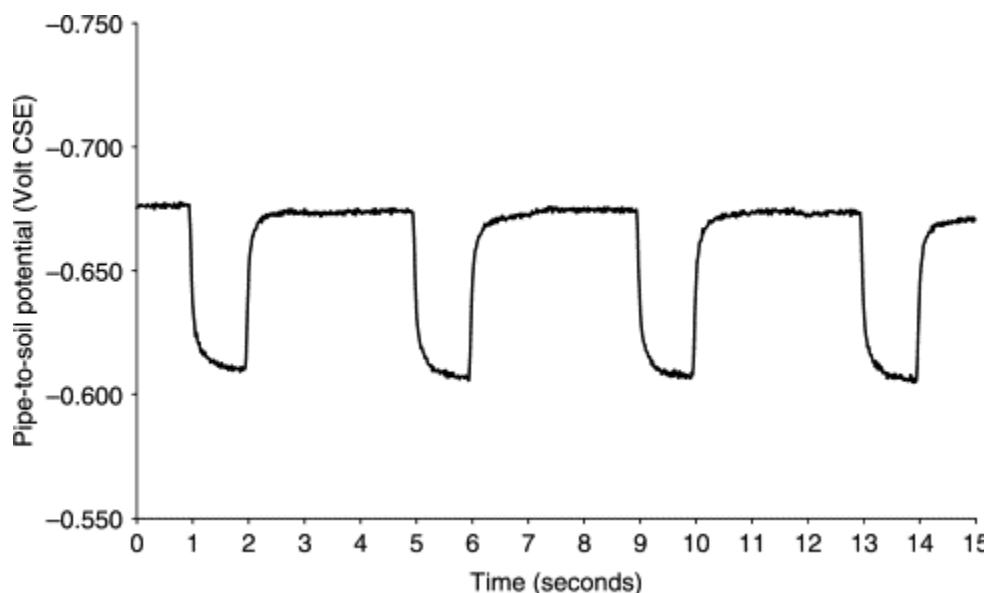


Figure 1: A typical instant-off response measured on a pipeline

Ideally, instant-off measurements are taken within 300-400 milli-seconds (ms) after interruption. This is usually a long enough time to avoid any spiking that may occur following the interruption, yet short enough to minimize depolarization of the pipeline and to minimize the duration of the OFF cycle, and thus the total time required to conduct the survey.

However, the interrupted response of pipeline systems can vary greatly depending on system parameters such as soil resistivity, length and diameter of the pipeline, pipeline coating, coating holidays and the number of decouplers present. Certain combinations of these parameters can significantly change the response and, if not accounted for, can lead to instant-off readings that are more electro-negative than the true polarized potential. Therefore, before recording instant-off measurements, CP Technicians should evaluate the interrupted response to determine the appropriate ON-OFF cycle durations and instant-off measurement times, as well as to account for any interference issues.

The Decoupler Dilemma

DC decouplers play a critical role in most CP systems by providing effective DC isolation of cathodically protected structures from other objects and earthing systems, while simultaneously bonding the structure to earth for AC (induced steady state and faults) and lightning. Commonly employed in AC mitigation systems, decouplers utilize a capacitor to provide a continuous conduction path for steady state induced AC current to pass to ground. The capacitor must be large enough to present a suitably low impedance to the induced AC and to minimize the AC voltage on the pipeline. However, this capacitance can have a detrimental effect on the instant-off response of interrupted surveys. This effect can be observed by comparing the waveforms shown in Figure 2.

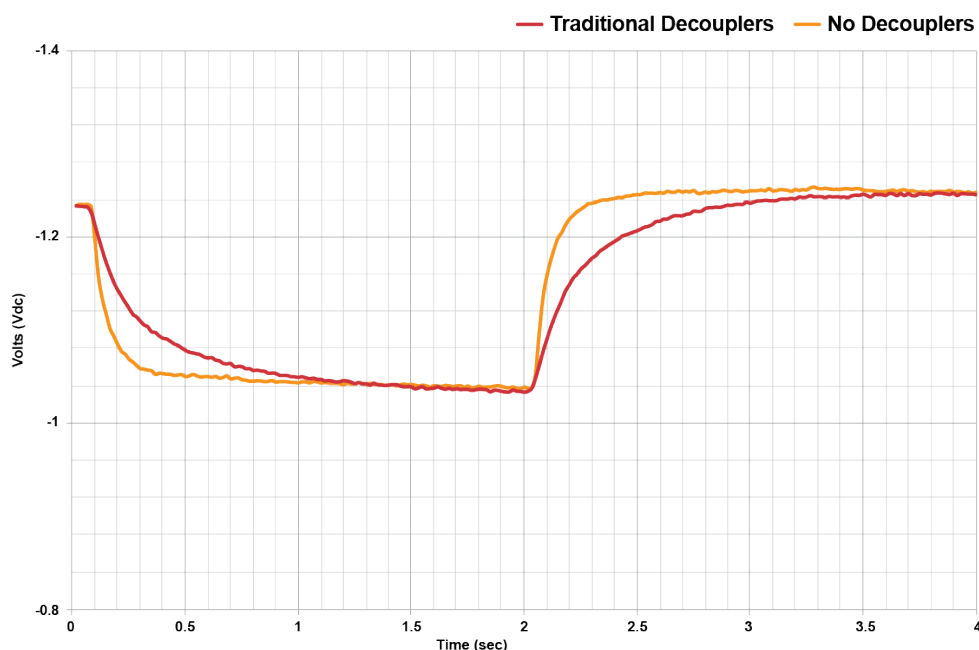


Figure 2. Instant-Off Response with and without a traditional decoupler

In the example shown in Figure 2, the pipeline segment is 33 miles long with eight (8) decouplers installed for AC Mitigation. Note that the change in the voltage response due to the addition of the decouplers can introduce a significant error in the instant-off measurement, depending on when it is sampled.

Knowing this phenomenon, several questions arise: At what point in the OFF cycle should the instant-off data be sampled? How late in the OFF cycle can an instant-off measurement be taken with confidence that the pipe has not depolarized? How consistent is this effect over the length of the pipeline? These are questions that have plagued CP personnel for years.

Why Decouplers Affect the Interrupted Response – A Simple Electrical Model

Similar to the way the ride and handling of an automobile depends not only on the spring rate of the suspension, but also on the shock absorbers and the mass of the vehicle, the instant-off response on a pipeline is influenced by decoupler capacitance in combination with other physical parameters in the pipeline/ICCP/decoupler system, predominantly the pipeline coating and soil resistivity.

To better understand how these parameters influence the interrupted response, it is helpful to analyze the pipeline/ICCP/decoupler system using a simple electrical circuit as shown in Figure 3.