Northeast GAS ASSOCIATION
NYSEARCH

Technology Brief

Rapid and Accurate Voltmeter for High Contact Resistance Surfaces

Description: Retrofit hardware and software solution to enhance voltmeter measurements and improve accuracy in varying impedance conditions. This solution is particularly useful for voltage measurements over pavement.

Status: Project completed. Prototype built and tested. Demonstration completed.

BENEFITS

Shortcomings exist for voltage measurements on pipes under roads/highways or other areas where a high contact resistance exists. To avoid the problem with the voltage measurements of Close Interval Survey for Direct Assessment of pipes, methods are used today to decrease the input impedance such as placing water on the ground at the point where the reference cell makes contact or by drilling holes in the pavement to reach conductive soil. This process makes the survey less productive and more costly. Therefore, a voltmeter enhancement that eliminates the problem of inaccurate readings in areas of high contact resistance will eliminate the cost and re-work that is currently required. Also, because of concern about errors associated with this problem, there has been discussion at various levels (including NACE) about the validity of the use of voltmeters over pavement. If this option were eliminated, there would be excessive additional cost, less safety and less ability to conform to pipeline integrity requirements.

Prototype Enhanced Meter

BACKGROUND

In the NYSEARCH/NGA RFP to identify new technologies to address difficult or special applications of DA, difficult applications include pipes in hard-to-reach areas such as in the middle of a road or highways. As the corrosion experts will attest, contact resistance can vary by orders of magnitude in a small area, particularly on pavement, based on the interface between the reference cell used for the voltage measurement and the surface. When the voltmeter input impedance is comparable to the measured circuit resistance, errors arise in the voltage measurement and therefore the accuracy of the CIS or DCVG method is compromised. Some methods are used today to decrease the input impedance such as placing water on the ground at the point where the reference cell makes contact or by drilling holes in the pavement to reach conductive soil. This process makes the survey less productive and more costly.

CC Technologies (CCT) identified and patented a potential solution to the input impedance problem by analyzing the equivalent electrical circuit and determining that through the use of multiple input impedances, the problem can be solved to account for the impedance at the cell/surface interface and the actual and accurate voltage measurement can be derived.

TECHNICAL APPROACH

CCT first proved the concept on a bench-scale level using breadboard design. Then they tested the system using a commercial variable input impedance meter to determine whether their calculation of actual voltage was accurately determined and to find the range of input impedances that reflect the CIS and DCVG measurement situations over pavement. [Note, commercial high input impedance meters are not typically used to address this problem because they do not incorporate an important feature which allows a return to zero volts when the circuit is open; an important condition to provide feedback to voltmeter operators.]

Following the tests and definition of input impedance range and design parameters, algorithms were developed and a prototype voltmeter was built. The prototype meter incorporates a rapid switching device that allows an automated switching between multiple input impedances so that the new tool will be able to get a snapshot of the actual input impedance at the measurement site before it changes. The actual number of input impedances that will need to be available and incorporated into the electrical circuit will be verified through laboratory testing of the prototype device.

The hardware was implemented on a handheld PDA platform. For the prototype, the software was implemented using LabView programming language for PDA modules and 2003 Mobile Windows environment.

PROJECT STATUS

CCT demonstrated in the classroom the improved accuracy of the Enhanced Voltmeter. In a live demonstration during a October 2005 visit to the NYSEARCH/NGA test bed, the accuracy could not be demonstrated as the input impedance conditions of the concrete slab placed in the test bed field (on a wet, rainy day) were not high enough for an improvement over traditional voltmeters to be demonstrated.

Following the test bed activity, the NGA DA Working users wanted to first try a plug-in commercial impedance "buffer"(to boost input impedance by 6 orders of magnitude) to use to re-assess the frequency of the high impedance problem in the field. Ten buffers were provided for the corrosion engineers to use. Only a few corrosion engineers used the buffers and repeated attempts for information from the users did not result in feedback that indicated they were convinced of the need for the alternative solution. The project has been closed.

Highlights

- Accurate method for measuring voltage in high contact resistance situations was designed, built and tested
- Bench-scale demonstration proved approach for improved accuracy
- Limited live demonstration did not convince users to pursue commercial partners at this time

FOR ADDITIONAL INFORMATION

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