CATHODIC PROTECTION REMOTE MONITORING METHOD AND APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/329,022 filed Oct. 12, 2001, and U.S. Provisional Patent Application Serial No. 60/348,845 filed Jan. 15, 2002, which are both hereby incorporated herein by reference in their entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable.

FIELD OF THE INVENTION

[0003] The present invention relates generally to a method and apparatus for remotely monitoring cathodic protection and more particularly to an apparatus for remotely monitoring cathodic protection of a pipeline. Still more particularly, the present invention relates to a remote monitoring assembly, resistant to power surges, that may be located at preferred remote locations along the pipeline and communicate cathodic protection operations to a central location.

BACKGROUND OF THE INVENTION

[0004] It is known that all metallic structures that come in contact with a medium having the properties of an electrolyte are susceptible to the phenomenon of corrosion. Such corrosion tends to destroy the metallic structure and, depending upon the particular corrosive conditions existing, destruction of the metallic structure may occur within a longer or shorter period of time. In many instances significant damage to the metallic structure may occur within a short period of time even though destruction of the metallic structure has not yet occurred. There are many structures subject to corrosion damage, including bridges, pipes, storage tanks, reinforcing steel of concrete structures, structural steel and piles. In most cases the electrolytes for such structures comprise water with dissolved salts and moist soils.

[0005] In order to prevent/minimize corrosion, cathodic protection systems (CPSs) are often employed. CPS design is influenced by numerous factors, including the type of metal to be protected, properties of the electrolyte (chemical, physical and electrical), temperatures, presence or absence of bacteria, shape of the structure, design life, constructability and maintainability. Cathodic protection (CP) is often applied to coated structures, with the coating providing a primary form of protection and an electric current providing a secondary protection.

[0006] In general, CPSs operate by utilizing an electrical current to oppose a corrosion current between the structure being protected and an electrolyte. There are basically two known systems for generating opposing electrical currents, "sacrificial systems" and "impressed current systems."In sacrificial systems, the current is supplied by another metal which is galvanically more reactive than the metal of the structure. For example, metals such as aluminum, magnesium and zinc are galvanically more active than steel and are used as "sacrificial anodes" to protect steel structures. In impressed current systems, a consumable metal is used to drain direct current (DC) supplied from an external source into the electrolyte, which passes to the structure to be protected. The parts from which the current is drained are called "anodes" and the protected structure is called a "cathode". In both sacrificial and impressed current systems of cathodic protection, a metallic path between the anode and the cathode is essential for flow of current to protect the structure.

[0007] As stated above, in impressed current cathodic protection, a DC current is applied to a buried structure and flows onto the structure at coating defects. The applied current changes the voltage across the metal/soil interface. This change in voltage changes the electrochemical state of the structure to the extent that corrosion ceases.

[0008] The voltage across the metal/soil interface can be measured by monitoring the voltage difference between the structure and a second dissimilar metal (reference electrode) in contact with the soil. By monitoring the voltage difference it can therefore be determined if corrosion protection of the structure is being achieved. The cathodic protection circuits may be monitored at "test stations," e.g., wire connections to the buried structure that terminate in some way above ground. If the structure is a pipeline, test stations are installed at regular intervals on a pipeline (typically one-mile apart) and often at road crossings for accessibility. A portable pipe-to-soil measurement unit is used to measure the voltage difference between the pipeline and the reference electrode at each test station by having an individual visit each test station along the pipeline and take manual measurements at each test station. The measured voltage level is termed a "pipe-to-soil" potential.

[0009] The pipe-to-soil potential measurement unit includes a volt meter having a test lead extending from the volt meter to the wire connection extending from the pipeline. The pipe-to-soil potential measurement unit also includes a reference electrode in contact with the ground above the buried pipeline. The reference electrode has an electrode potential that does not vary such that it supplies the pipe-to-soil potential measurement unit with a stable reference potential. The reference electrode typically includes a copper rod in a copper sulfate solution. The volt meter then measures the potential difference between these two half-cells and the value of this potential difference is the pipe-to-soil potential. The pipe-to-soil potential will vary depending upon the current that is being supplied to the pipeline by virtue of one or more of the cathodic protection systems along a particular length of the pipeline.

[0010] A cross-country pipeline will have numerous cathodic protection circuits with power source installations, or rectifiers, on each circuit to distribute the impressed current along the entire length of the pipeline. The spacing between cathodic protection circuits depends on many factors including soil conditions and coating quality, but typical spacing is approximately 10 to 30 miles apart.

[0011] Typically if there is no current being supplied to the pipeline by cathodic protection circuits, the pipe-to-soil potential is approximately –0.5 to –0.6 volts. This is referred to as the "static" or "native" potential. The "static" or "native" potential may be measured after the cathodic protection circuits have been off for such a period of time that the current from the cathodic protection circuits no longer influences the pipe-to-soil potential. As current is supplied to