CORROSION PROTECTION MONITORING AND ADJUSTMENT SYSTEM

This is a continuation-in-part of U.S. patent application Ser. No. 08/422,799, filed Apr. 17, 1995 now abandoned.

BACKGROUND OF THE INVENTION

The present system pertains to monitoring systems; more particularly, the present system pertains to monitoring systems for distributive cathodic corrosion protection systems used in pipelines.

It has long been known that if a small direct electrical current is applied to a metallic object in a corrosive environment, both the onset and the progress of corrosion of the metallic object is inhibited. This corrosion delay or corrosion protection principle has been applied to metallic pipelines. Because of its effectiveness, government regulations now require that an electrical corrosion protection system be used on pipelines such as those pipelines which carry natural gas all over the United States.

In an ideal world, electrical pipeline corrosion protection would be effected by a large source of electrical energy placed on one end of a pipeline. This large source of electrical energy would cause sufficient electrical energy to pass through the entire pipeline to protect it against corrosion. In practice, however, the utilization of a single electrical energy source for corrosion protection of a long pipeline is impractical. Therefore, instead of using a single source of electrical energy, a series of rectifiers, which convert commonly available alternating current to more usable direct current, are placed at intervals along the length of a pipeline. A corrosion protection system which uses a plurality of rectifiers distributed over the length of a pipeline is referred to as "distributive cathodic corrosion protection."

Each rectifier provides direct current electrical energy to a section of the pipeline. The use of a plurality of individual rectifiers at intervals spread all along the length of the pipeline assures that the entire length of the pipeline bears a small electrical charge. This small electrical charge inhibits both the onset and the progress of corrosion of the metallic pipe sections which make up a long pipeline.

To ensure the effectiveness of a distributive cathodic corrosion protection system installed on a pipeline, it is necessary to periodically monitor and check the electrical energy output characteristics and performance of each individual rectifier located over the length of the pipeline.

Such periodic monitoring and checking of the electrical energy output characteristics and performance of individual rectifiers can be done physically by sending a person to the location of each rectifier and taking direct readings of various electrical output and performance measurements. Alternatively, the monitoring and checking of rectifier output has been accomplished by including a small data transmission device with each individual rectifier. The small data transmission device sends signals based on the electrical energy output characteristics of each individual rectifier to a central monitoring location. The central monitoring location then records and monitors the operation and condition of an entire array of individual rectifiers at regular intervals or even continuously.

Communications systems that have been used to send the electrical output information from the small data transmission device have included RF transmission, hardwire telephone lines and, more recently, cellular telephone systems.

While cellular telephone system transmission of rectifier output and performance is adequate in many ways, it still has

some drawbacks. Specifically, all pipeline rectifiers are not located in cellular telephone coverage areas. This is because only about 85 percent of the continental United States is presently accessible by cellular telephone. While cellular telephone coverage may increase in future years, it is anticipated that there will still always be a small part of the United States where cellular telephone coverage is not available. If an individual pipeline rectifier is located in an inaccessible area, such individual rectifier must still be physically checked. Physical checking of a rectifier is both inconvenient and expensive. Additionally, if the pipeline rectifier is physically checked by a technician, human error may result in disconnecting a wire or breaking a connection. Such inadvertent acts may render the rectifier inoperative and may not be discovered until the next physical check.

While cellular telephone communication has provided an effective avenue for short-range data transmission, the reliability and dependability of cellular telephone communication is oftentimes somewhat less than desired when longer distances are involved. Further, cellular telephone communication may be rendered ineffective in certain situations . . . specifically, near large trees, buildings or mountains. There is, therefore, a need in the art to provide a system for monitoring the electrical output and performance characteristics of an array of pipeline rectifiers wherein the reliability and dependability of the communication means for transmitting and receiving the operational data is increased.

In addition to the problems with cellular telephone communication systems, available designs for electrical current monitoring systems only allow for monitoring the output and condition of the pipeline rectifier. If more sophisticated electrical testing of corrosion protection systems on pipelines is required, such as momentarily shutting down major sections of the cathodic protection system and then measuring the residual electrical charge imparted to the pipeline from the array of rectifiers, it is necessary to do special custom physical, on-site programming of the remote rectifier monitoring units. Such custom, on-site programming is required because there is no existing system by which individual pipeline rectifiers can be cycled off simultaneously so that a measurement of residual electrical charge in the pipeline can be made before turning the rectifiers [taken and then cycled] back on to re-energize the distributive cathodic corrosion protection system.

One attempt at monitoring corrosion, as distinguished from corrosion protection, has been described in U.S. Pat. No. 5,306,414. Such system is based on the monitoring of electrochemical corrosion sensors, not on the monitoring of remote pipeline corrosion prevention rectifiers.

There remains, therefore, a need in the art to provide a communication system for use in a distributive cathodic corrosion protection system wherein communication with monitoring units for remote individual pipeline corrosion prevention rectifiers is continually available irrespective of the location of the rectifier. Additionally, such communication system should also provide for adjustment of the electrical operating parameters of each individual rectifier, should such be necessary.

SUMMARY OF THE INVENTION

The corrosion protection monitoring and adjustment system of the present invention provides a system for continuous worldwide communication for distributive cathodic corrosion protection systems irrespective of the location of the rectifier.

The system of the present invention for obtaining information from and adjusting the corrosion protection provided