

10 SERVICES

Based on long experience with regards to requirements and in-house resources of domestic and international clients, we have developed technical expertise, resources and reliable business relationships to provide complete range of services to carry out all types of cathodic protection activities, works and projects, irrespective of their nature, size, complexity and location.

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|---|---|
| <p>SITE SURVEY</p> <ul style="list-style-type: none"> ■ Data Collection ■ Soil Resistivity Measurements ■ Current Drain Tests ■ Location of Groundbeds ■ Location of AC Power Sources ■ Location of CP Stations ■ DC Interference ■ AC Interference ■ Stray Current |  |
| <p>DETAIL DESIGN</p> <ul style="list-style-type: none"> ■ Survey Report ■ Protected Objects ■ Design Philosophy and Criteria ■ Scheme and Calculations ■ DC/AC Interference Mitigations ■ Material Specifications ■ Construction Procedure ■ Commissioning Procedure ■ Operating Instructions ■ Maintenance Instructions |  |
| <p>MATERIAL</p> <ul style="list-style-type: none"> ■ Design and Manufacture ■ Procurement Services ■ Follow-Up Delivery Schedule ■ Factory Inspection and Testing ■ Specialized Packaging ■ Shipping |  |
| <p>CONSTRUCTION AND SUPERVISION</p> <ul style="list-style-type: none"> ■ Project Management ■ Construction Work ■ Regular Project Review Meetings ■ Follow-Up Construction Schedule ■ Reporting System |  |
| <p>TESTING AND COMMISSIONING</p> <ul style="list-style-type: none"> ■ Equipment Test ■ Pre-Commissioning ■ Final Commissioning ■ Commissioning Documentation |  |
| <p>JOB TRAINING</p> <ul style="list-style-type: none"> ■ Classroom Training ■ Field Training |  |
| <p>AFTER SALES SURVEY</p> <ul style="list-style-type: none"> ■ Remote Monitoring and Control ■ Spare Part Service ■ Service Round-The-Clock, Worldwide |  |

11 SPECIALIZED SERVICES

Regular Monitoring and Routine Maintenance

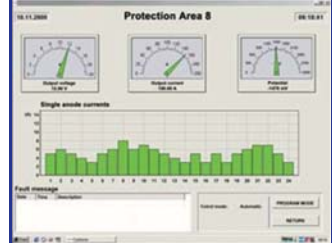
PSE is providing this service to a large number of clients in Germany for many years. The company always has greatest concern for health and well-being of systems / installations under its periodic surveillance and maintenance and considers them as reservoirs of knowledge and experience.

Long relationships between the company and clients are cemented by mutual trust and understanding. The company is also providing this service to a number of its international clients on "as and when required basis" and has resources to station its surveillance team(s) on annual contract basis, anywhere in the world. Scope of work for periodic monitoring and routine maintenance service is finalized in accordance with our experience-based practice, health of the system and client's requirements.



Remote Monitoring and Control Service

In addition to skilled maintenance technicians, the company provides remote monitoring and control system for new or existing CP-systems. Our engineers design, install and maintain the highest quality systems by using wire- or wireless communication systems. CORROCONTROL systems are capable of being remotely controlled and monitored for all CP-system performance and functions. This capability allows operation and maintenance for unattended CP-stations, providing totally unmanned service with only the need for periodic physical on-site maintenance.



Intensive survey

The basic objective of these surveys and investigations, is to determine whether or not does exist a limitation which is not visible to the "naked eye" of routine system monitoring surveys but may reveal themselves under the "micro-scope" of an intensive survey and investigation.



Stray current investigation

Effects of stray currents from direct current (DC) systems (railways, tramways, mines HVDC transmission, cathodic protection etc.) are so well-known that investigation and implementation of remedial measures against them, has become a normal activity of CP Projects. Nevertheless, some problems are unique and require special investigations. Effects of stray currents are investigated and remedial measures are introduced generally after some damage has already been caused. The company also provides services for the survey and investigation of proposed systems so that necessary remedial measures may be planned in advance to avoid delays in their implementation, which are usually experienced if the interfering and interfered systems belong to different owners.



Pearson survey

Based on method first introduced by Mr. J. M. Pearson, the company has versatile equipment and manpower to carry out this survey to determine

- location and depth of underground buried metallic pipeline, structure, cable etc.
- location of defects in corrosion protective coating
- location of electric contact between the test signal injected and nearby pipeline etc.

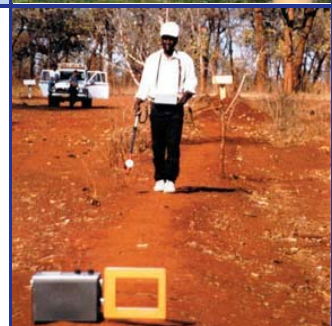
This survey has been very extensively used in the past. The company continues to provide services to carry out these surveys but recommends the computerized CIPS (Close-Interval Potential Survey) for determining the location and real size of defects in corrosion protective coating including their (coating defects) on effectiveness of cathodic protection system for underground pipelines.



Fault location

Cathodic protection systems may have faults which could be observed after the start-up of the system. These faults reduce or prevent the adequacy of cathodic protection. Usually, they are caused by faulty insulating joints, contact with other metallic structures such as foreign pipelines, cables, sheet piling, reinforced concrete structures, casing etc., or due to the presence of insulating valves and expansion joints. To determine the location of such faults is not yet an easy and conventional operation.

The company offers experience-based different measuring methods and services of its experienced personnel for determining the location of trouble spots and removal of trouble in minimum time.



Survey of Subsea Pipelines

The company provides its services for the external survey of subsea pipelines in collaboration with experienced and well-equipped marine survey companies. For these surveys the company is responsible for all matters concerning cathodic protection and the marine survey company determines the exact location and route of pipeline. The survey involves the use of radio positioning system, marine survey equipment such as echo sounder and side scan sonar to provide data about seabed, sub bottom profiler or equivalent equipment to determine the location and depth of pipeline, towed/remote controlled vehicle for proper positioning of reference electrode, etc., and computers for online recording and processing of data. We and the marine survey company undertake overall responsibility for the execution of this type of survey projects, depending upon scope of work and client's requirements.



Close Interval Potential Survey-CIPS

In order to analyse the external corrosion of buried pipelines, pipe/soil potential measurements are made. Pipe/soil potentials are normally measured at fixed test points spaced about 1 km to 5 km along a pipeline. However, reliable information about the status of CP of the pipeline between these test points is unknown since measurement is only valid at the reference electrode location.

High local differences in soil resistivities, interference and other effects may cause corrosion at intermediate locations even having good potentials at the test points. Therefore, the necessity to decrease the distance between successive potential measurements yields more accurate information concerning the CP-conditions on the pipeline and hence a "close-interval" or an "intensive" measuring technique was developed with potential measurement in steps of 5 m or less over the line.

Reasons to use closed interval potential survey - CIPS

It is impractical and uneconomical to measure pipe/ soil potentials manually at close-intervals of 5 m along a pipeline. Recording these results and plotting them by hand especially for a long transmission pipeline system, uses lots of time even when using strip-chart recorders for potential measurements. Therefore, a quick and reliable system has been developed.

CIPS overcomes these problems by automatically recording, storing, calculating and displaying the potential data. The data is given in table and graphical forms by a micro-computer for this purpose.

The MoData2 is used for field recording of pipe/soil potentials and voltage drops in cathodic protection measurements. The measured potentials are displayed. Pipe-to- soil potential data are recorded in the internal memory of the MoData2, Multifunction Instrument.

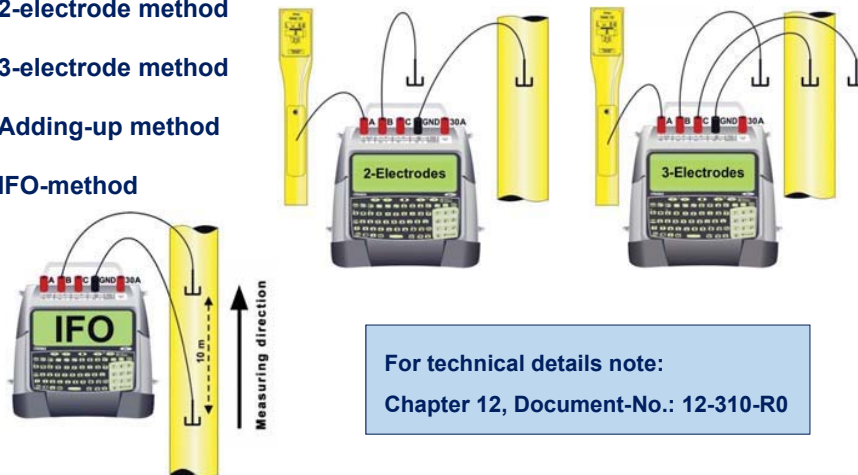
4 measuring methods are directly integrated into mobile software package:

2-electrode method

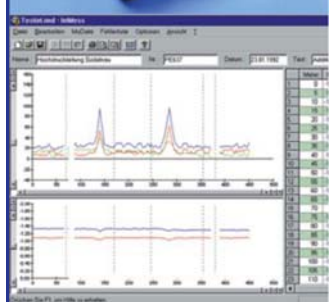
3-electrode method

Adding-up method

IFO-method



**For technical details note:
Chapter 12, Document-No.: 12-310-R0**



Computer based calculation of AC induced high voltage

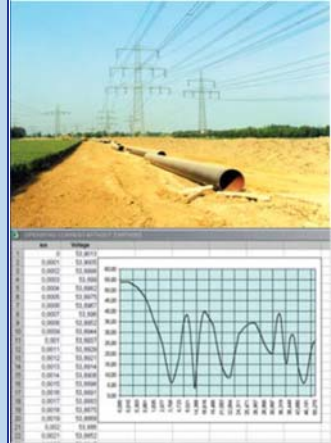
Effect of alternating current is a matter of serious concern for safety of pipeline, connected equipment and operating personnel. This problem has become more serious now than what it was in the past due to rapid increase in the number and voltage levels of AC transmission lines in the right of way of underground pipelines and improvement in the quality of pipeline coating.

Maximum permissible safe voltage up to which personnel and equipment may be exposed under various conditions are defined in safety codes and standards. It is obligatory for the owners to maintain voltage levels within safe limits. With increasing awareness of the public with regards to human and environmental safety, it is necessary to give due weightage to problems of AC interfered pipelines.

The magnitude of AC induced voltages can be measured in existing pipelines. But it is generally impossible to determine correct remedial measures to control the magnitude of permanently induced voltages. It is also impossible to determine the magnitude of voltages which would be induced when a pipeline is laid in the right of way of AC transmission lines. Because of these practical considerations, the company has developed a computer software and procedure to investigate and provide correct remedial measures for the safety of pipeline, connected equipment and operating personnel.

The scope of services includes:

- collection of design and field data
- calculation of AC induced profiles along the pipeline
- dimensioning of AC voltage earthing measures
- supply, installation and testing of recommended remedial devices
- field measurement of induced AC voltages
- preparation of reports



Computerized Geophysical Soil Survey

The determination of electrical soil resistivity to assess the corrosivity of soil and designed performance groundbeds, especially deep groundbeds protection systems, has been a part of various projects of the company.

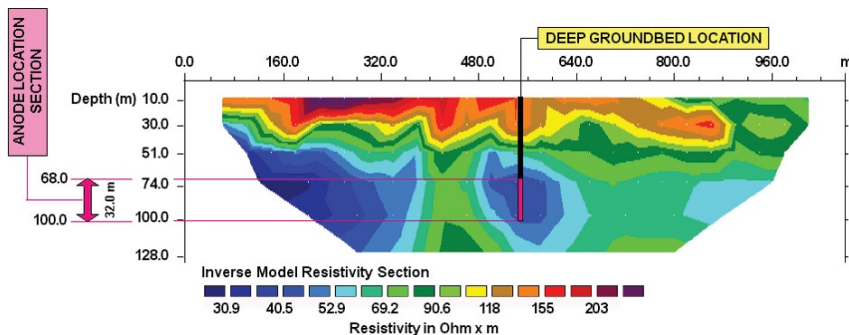
The company carries out soil resistivity measurement surveys for its cathodic protection and power distribution line projects and provides trained personnel with equipment and accessories to carry out this survey in accordance with requirements of various clients.

This instrument has been developed for the determination of specific soil resistivity based on experience. Most of the commercially available earthing meters fail to provide correct measurable values for soil below 30 m depth.

Correct data on resistivity of soil at greater depths is of special importance for designing of deep anode groundbeds.

The instrument is a state-of-the-art portable earth resistivity meter with memory storage of readings and user defined measurement cycles. It provides the highest accuracy and lowest noise levels in the industry.

Special survey for determination of electrical resistivity and geographical profile of test area, involves computerized measurements with test electrodes and special software for processing of data and presentation of results.



Data management software

Each software program is tailored for clients under consideration of specific requirements and the structure of CP-systems, substantially eliminating paper work, document retention and duplicate efforts.

The data management system software allows users to import all relevant data and records either from hand-held data loggers via interface or from computer network data files.

The data storage structure has been carefully refined over many years based on experience of storing millions of records of site data.

Users can navigate through the various task names of pipe sections, tank farms, pumping stations etc. to see just the data they need. They can create printed reports, save the data on disk or copy it into another Windows program.

The software is fully integral to all Microsoft applications and requires minimal training.



Training and development seminars

Depending upon client's specific requirements, the company provides services for the training and development of manpower.

The range of this service includes:

- **Management / Executive Appraisal Program**
- **CP Design and Engineering Course for Pipeline and Plant Engineers**
- **Corrosion and Cathodic Protection Basics**
- **System Monitoring and Maintenance**
- **CIPS, Pearson and Other Surveys**
- **Office and Field Application of Computers**

The training can be arranged at the PSE offices, client's offices or at site depending upon its nature and number of participants.

The program content is finalized in consultation with the client and includes tests, appraisals, assignments and field works for performance evaluation.

