AUDITING OF CATHODIC PROTECTION SYSTEMS.
GENERAL PROCEDURE.

The proper Auditing of installed Cathodic Protection Systems on Pipelines, Tanks and associated structures is composed of the following activities.

1. Audit of the installed CP Hardware. (Rectifiers, Insulating Flanges, Test Posts etc. Is the CP system adequate.)
2. Audit of the Monitoring and Maintenance of the CP systems.
3. Audit of the Record System and Actions taken to overcome inadequacies.
4. Audit of the Interpretation of CP Data and adequacy of the existing CP design.
5. Audit of Associated Activities affecting the effective application of CP. (Coatings, Metal Loss, Leak History etc.).

To conduct an Audit DCVG LTD usually use very experienced DCVG LTD CP Engineers, pre-thought lists of questions on detailed Inspection Sheets and a Computerised Analysis System. The outcome of the Audit is a Technical Assessment of all aspects of the CP. installations, their operation and control with a hit list of items, operations or activities that need to be upgraded. To produce a full Audit work should also cover the sensitive issue of Personnel, the level of Training, Work Scope (is it too large or too small), level of responsibility, adequate financing to do the job etc. The Client will have to provide direction as to the depth of the Audit.

DETAILED INFORMATION ON AUDIT PROCEDURES.

CP. Hardware Audit.

A CP. system is composed of a number of "building blocks" such as Test Posts, Rectifiers, Anodes etc. and how these "building blocks" are arranged constitutes the design of the CP. system. In the Audit, each one of the "building blocks" is examined in detail to identify if the "building block" is capable of doing the job for what it was intended and to identify any deficiencies that can give rise to poor application and control of the CP. Each "building block" has its own inspection sheet of pre-thought questions and procedures to carry out to ensure consistency in the Audit and that nothing is left out requiring multiple visits to the "building block" installation. As an example, some of the procedures and questions at a test post are as follows:-

Some Sample Test Post Questions and Procedures.

1. Location and Access.
2. Type of Test Post (Manufacturer).
3. Physical status of the Test Post. (Extent of any vandalism.)
4. Type of Cabling to identify use of Test Post. (Potential Measuring, Cross Bond. Multi-pipe Interbond, CP Drain Point etc.)
5. Visual status of cabling. (Is it adequate for job, is same cable used for potential measurement and cross bonding etc.)
6. Are the Test Post Cables connected to the pipeline, (for a client we discovered 5% of all 25,000 Test Posts were not actually connected to the pipeline). Are the cables shorted to Test Post if the Test Post is metal.
7. Is there a Coating Fault in the location of a Test Post. Evaluation of defect to determine if the presence of the defect dominates readings at the Test Post.
8. ON and Instant OFF potentials measured at the Test Post. Also to establish the extent of any variation in potential with variation in half cell location. Routine monitoring may have taken different locations at different times.
9. Establish extent of any DC Traction or any other DC and AC Interference. Estimation of True Pipe to Soil Potential of pipeline when subject to DC Traction Interference.
10. Measure the effective level of CP at the test post to identify the effective range (throw) of the CP Rectifier Systems to identify sections of the pipe with inadequate levels of CP.
11. Determine the amount and direction of any current flow at any cross bonding cables.
12. Determine the level of interference from any foreign structure. Is the level of interference within recommended limits.
13. Determine the proportion of current from different rectifiers influencing the test post to establish the level of vulnerability if a rectifier becomes non operational.
14. Variation of ON and OFF potentials with time (24hrs) to identify any inadequacies in the true representation of routine pipe to soil measurements.
15. Native state potentials.
16. 100mV shift compliance at areas where potentials less negative than -850mV.
17. Depth of burial and soil resistivity at Test Post Locations.
18. Soil Characteristics, (rock, clay, sand, pH, acid strength etc.).
19. What does the client see as his major hardware problem.

Are different types of pulsing of the CP system used in an evaluation ?

Each different “building block “ has its own set of questions and procedures.

Audit of the Monitoring and Maintenance of the CP systems.

Some typical Questions and Procedures from this section of the Audit are as follows.

1. Type of equipment available to Engineers to monitor the CP system.
2. Status and care taken of inspection equipment. Limitations of Equipment.
3. Is adequate and sufficient equipment available to monitor properly.
4. Do engineers know how to use equipment and understand the limitations of the equipment.
5. Procedure for taking CP measurements. Do written procedures exist.Is Training provided.
6. Identification of locations where measurements taken. Are measurements always taken at the same spot relative to the pipe at each location.
7. Full list of measurements taken and frequency. Is there any variation in procedures.
8. What measures are taken to ensure data is genuine and not made up. (Does Engineer actually visit each "building block" location to take readings.
9. Details of Third Party activity observation on pipeline right of way. (Techniques, actions, effectiveness.)
10. What is the procedure for initiating maintenance activities.
11. Are any routine maintenance activities carried out.
12. What is the percentage down time of rectifiers.
13. What is the response time to a rectifier being brought back on line.
14. Availability of Spares. (What is the common cause of failure)
15. Ease with which new additional installations can be made.
16. View Maintenance records.
17. Has any Coating Maintenance been done.
18. What does client see as his major Monitoring and Maintenance problems.

Audit of the Record System and actions taken to overcome inadequacies.

Some typical Questions and Procedures from this section of the Audit are as follows

1. How is data recorded, as hard copy or on computer or both.
2. What measures are taken to prevent wrong entries.
3. How are weaknesses in the CP system identified and by whom.
4. What is the route and time scale from observation of an inadequacy in the CP and any corrective action.
5. Is past data kept active. What comparisons are made to determine trends.
6. Are routine measurements compared to CIPS surveys.
7. What does client see as his major record keeping problem.

Audit of the Interpretation of CP Data.

Some typical Questions and Procedures from this section of the Audit are as follows

1. Criteria used to interpret CP effectiveness.
2. Are limitations of Criteria understood.
3. What do you do with readings that do not meet Criteria.
4. Why does reading not meet Criteria.
5. Assessment of the accuracy of the measured reading and its interpretation.
6. How has measurement and interpretation of CP data been satisfactory to stop Metal Loss. Comparison of Potential Data with any Metal Loss Data and leak/excavation information.
7. Assessment of CP data to meet criteria needed to give rise to Stress Corrosion Cracking.
8. What use is made of Historical Records to identify trends.
9. What response is taken if a trend is noted.
10. Is scatter of Potential data so bad as to hide trends, if so why.
11. What does client see as his major problem with CP data.

Audit of Associated Measurement Activities Affecting the Effective Application of CP.

Some typical Questions and Procedures from this section of the Audit are as follows:-

1. What associated measurement activities are used and why. (Coating Inspection, Metal Loss Tool, Interference testing. etc.
2. What action has been taken based upon coating surveys, CIPS surveys etc.
3. Have comparisons been made between different types of surveys.
4. What does client see as his major problem other than CP in the control of Corrosion.
5. What special training has been supplied to Engineers to ensure adequately trained for the job.
6. Degree of liaison with other pipeline operators, railways etc that affect clients pipeline.

It can be seen from the above that a DCVG LTD Audit is very extensive in all aspects of the Installation, Operation and Control of Cathodic Protection Systems. Such an Audit is very necessary as a starting point from which full control of the CP system can be achieved to contain external corrosion.

During the Audit it is considered very necessary for Client Engineers to be present so that techniques can be taught, problems discussed and maximum technology transfer achieved by the Clients Engineers and Technicians working along side experienced DCVG LTD Engineers.