

**Tecnosystem Group Srl - Pietro Fiorentini Spa**

**C. Calvi – Tecnosystem Group Srl - M.H.G. Juinen – Merrem & La Porte**

## **CATHODIC PROTECTION REMOTE MONITORING A.C. Influence**

### **Analysis of field tests with a new Data Logger Unit**

**Abstract:** The European technical specification CEN/TS 15280 is based on a criteria which is founded on the AC current density, and fixes an attention threshold at 30 A/m<sup>2</sup>, threshold on which there isn't an unanimous consensus among the operators. In Italy, the Politecnico of Milan is leading a study on the subject, to which different companies and associations, interested to the phenomenon, took part, study which is arriving at interesting conclusions, among those it is enhanced that the measure or even the estimation of the current density exchanged from a pipe is rather – when impossible – to measure, unless to adopt corrosion samplings, on whose reliability, as for the re-production of real conditions on the pipe (current exchange in correspondence to the coating defects) is legitimate to have doubts.

The potential measure is a way which can be better used with a simpler actuation and interpretation, on which the attention must be posed to individuate the criteria of the upcoming corrosion.

On the basis of these indications, as well as on the pressing and urgent request from operators for a new instrument which allows these kind of verifications, Tecnosystem has developed a new data acquisition unit for the remote monitoring of Cathodic Protection, which allows also the measure and verification of the AC current interference values. We will present, in this Paper, the results of field test effected for few months in the Netherlands, where we have effected remote monitoring measures considering also the alternate current component

## **1 – Cathodic Protection measurement: the current regulation**

Let's start from an overview on the current regulation in Europe as for Cathodic Protection controls:

- EN 12954 (currently in phase of revision and harmonization with ISO)
- EN 13509 (methodology of measurements)

In Italy:

- UNI 11094 with specific reference to frequency of measurements in case of electrical interference
- UNI 10950 with specific reference to remote monitoring

Up today, no specific exigencies arose in Italy as for a.c. current controls.

At the moment, a specific regulation is not existing

## **2 - CP measurement: a.c. corrosion likelihood**

The official document dealing with a.c. corrosion likelihood since 2006 is the EN/TS 15280

The technical specification is currently in course of revision by a CEN committee.

PURPOSE OF REVISION : in the presence of a.c. interference, the criteria given in EN 12954, Table 1, are not sufficient to demonstrate that the steel is being protected against corrosion

## **3 - Tecnosystem's experience in remote monitoring applied to CP**

Tecnosystem has been founded in 1988 to work in the field of Cathodic Protection

In 1999 the CCOL service has been created: the service concretize the idea of monitoring the remote control systems through the supply of an all inclusive service to the final customer who access to his own data available on the internet platform.

## **4 - Tecnosystem's experience in remote monitoring applied to CP**

Tecnosystem is currently providing to many different gas transmission and distribution companies in Italy and Europe, with more than 20.000 monitored point, for over 130.000 km of protected pipelines

Tecnosystem's experience in remote monitoring applied to CP

- up to day no particular exigencies / requests on the Italian territory as for ac corrosion (no high speed railway)

- in the last two years the requests coming from abroad, mainly from european customers, are more and more focusing attention on ac corrosion likelihood
- Tecnosystem started last year to project a remote control unit in order to monitor both DC and AC corrosion: the Hyperdrone

#### **4 - The new developed acquisition unit: the Hyperdone**



Technical specifications :

- 2 measure channels
- 3 selectable scales (DC / AC Measures)
- AC measure performed with RMS value
- QUADRI BAND Data transmission via:  
GPRS - GSM
- Potential and intensity measures
- ON OFF enhanced functions
- Selectable Volt scale among:  
 $+/- 150 \text{ mV}$     $+/- 10 \text{ V}$     $+/- 30 \text{ V}$
- Possibility of remote modification Internet:
  - As for current measure: the shunt value
  - As for tension measure: the tension scale
  - DC into AC measure and back

- Impedance of potential measure channels: 10 MegaOhm
- Temperature range:  $-30^{\circ}\text{C} +75^{\circ}\text{C}$
- Measure frequency: each second, that is to say 86400 daily measures per each channel
- Transmission of the detected values to the web site: each two days minimum
- Sampling frequency: 1 second
- Restitution of the statistical values of the day (minimum, maximum, average, standard deviation, number of alarms, out of limit time)
- Archive of the statistical values in case of transmission problems:
- minimum 3 days
- Dimensions: data logger, shunt, modem and transmission antenna
- are all integrated in one unique IP 65 container, containing also
- the battery package
- Installation: extremely easy. The operator does not need any specific knowledge, or any specific instrument

The Hyperdone standard working conditions are based on current evaluations about AC influence on corrosion:

- Standard threshold of -0,85 V is considered not efficient enough in presence of AC current
- AC current is measured through a 1 cm<sup>2</sup> coupon
- AC thresholds:
  - AC potential must be < 4V
  - AC current must be < 30 A / sq.m

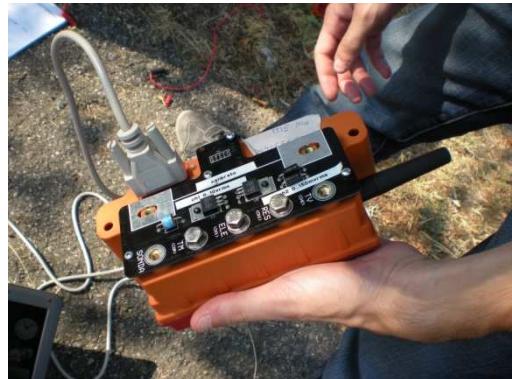
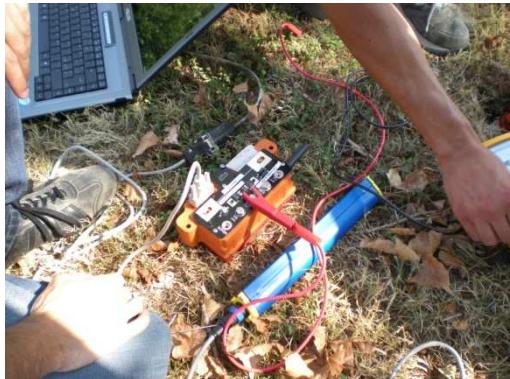
## 5 – The development of the unit

In consideration of the very good relationship between Tecnosystem Group and Merrem & LaPorte (NL) we decided to develop the Hyperdrone project on the basis of the Dutch experience, along with Mr. Marcel Juinen, who tested the unit in the field.

Here following few examples of installations:



Preliminary phases: field check with prototype in summer 2008



Tests have been performed using a Thinker and Razor datalog, a Volt meter, a dummy load to simulate AC interference and then comparing the readings with the Hyperdrone readings

Preliminary phases: field test with prototype have been carried out during summer 2008

## **6 - A case history: in the Netherlands**

### **The field test in The Netherlands**

The problem of AC influence on underground pipeline

The phenomenon influence of high voltage connections on pipelines as a result of which dangerously high tensions to the control can appear has been for years confessed security half-measure regulations is thus found (AC drainage) from the point of view security.

By the increasing number of high speed train connections in the Netherlands the AC influence on underground piping has considerably increased. These acting tensions must such become controlled so that there no dangerous situations, too high safety voltage or AC corrosion to act.

Where do we see AC interference?

- At places where Pipeline in the nearby of high voltage cables and lines lie (or crosses), dangerous tensions in piping can appear.
- At places close to railway track with AC traction can dangerous tensions in piping appear

### **Half-measure regulations against AC influence**

-Earthing off the pipeline (by means of a AC drainage)

- Care days that AC potential and the entering flow exceeds not the standard (standard NPR-CEN/TS 15280)
- Frequency of functional checks, every month or more frequently if stray current is severe

### **Which are the A.C. voltage and current (coupon) limits on buried pipelines**

#### **NPR-CEN/TS 15280**

To reduce the a.c. corrosion likelihood on a buried pipeline, the pipeline a.c. voltage, measured at selected test points should not exceed at any time:

- 10 V where the local soil resistivity is greater than  $25 \Omega \cdot m$ ;
- 4 V where the local soil resistivity is less than  $25 \Omega \cdot m$ .

These values should be considered as the threshold limits which significantly reduce a.c. corrosion likelihood. They are based on long term practical experience of European operators.

In practice, the evaluation of a.c. corrosion likelihood is on a broader basis as follows:

- Ja.c. lower than 30 A.m<sup>-2</sup>: no or low likelihood
  - Ja.c. between 30 A.m<sup>-2</sup> and 100 A.m<sup>-2</sup>: medium likelihood

7 – Evolution

The always growing and varying requirements arising from customers, led the company to immediately start the development of a new and more evolved acquisition unit, named Megadrone, which enhances and improves the Hyperdrone features in order to supply an always better and more detailed CP control with particular respect to AC corrosion likelihood:

Megadrone Technical specifications

4 channels;

Channel 1: voltage reading 120V	AC: full scale DC: full scale 20V
Channel 2: current intensity reading 150mV scale 150mV	AC: full scale DC: full
Channel 3: voltage reading 500V scale 100V	AC: full scale DC: full
Channel 4: current intensity reading DC: full scale 150mV	AC: full scale 150mV



(intensity reading performed by a shunt)

- QUADRI BAND Data transmission via : GPRS – GSM
  - Potential and intensity measures (intensity measure effected by a shunt)
  - ON and OFF time programmable
  - Option for synchronization mission ON/OFF via GPRS
  - Possibility of remote modification of wording parameters, shunt value, tension scale
  - Impedance of potential measure channels: 20 Mega Ohm
  - Calibration auto-check executed at each measure
  - Automatic system of signal to the Data Center in case of wrong data logger calibration
  - Temperature range: -30°C +75°C

- Potential in continuous mode - max error allowed: 1% full scale
- Measure frequency: each second, 86400 daily measures per each channel
- Powered by battery package, integrated in the unit
- Battery life: up to 48 months, at standard working conditions

## **7 – Conclusions**

The problem of induced AC currents on pipelines and its corrosive effects has been discussed for decades. The most recent research and field studies have provided more visibility to this issue. Research studies have indicated that pipeline AC current densities that exceed a specific threshold in Amps/m<sup>2</sup> at specific locations can exhibit AC corrosion, even though the cathodic protection levels on the pipeline are maintained within industry standards.

Even if the development of a relationship between a pipeline's cathodic protection level and AC current discharge from the pipeline is dependant upon local soil and environmental conditions, there is no doubt that an accurate understanding of the protection of the AC corrosion of coated steel pipes in soils can be greatly improved by the utilization of proper instruments, instruments which, above all, must be continuously improved and evolved. Providing new tools for allowing an always better, easier and more accurate control has been our mission in the years, and will continue to be.