



Commission 2

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Paper 5 - 2

Remote Monitoring and Control of Cathodic Protection in Grupo Gas Natural
Fenosa

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Abstract

The goal of the report is to explain our experience with remote monitoring and cathodic protection control systems (RMC).

Firstly, I will introduce Grupo Gas Natural Fenosa (GNF) and I will tell you about the scale of our main gas distribution systems in different parts of the world. Currently, we have operations in six countries (Argentina, Brazil, Colombia, Italy, Mexico and Spain), supplying more than 11,2 millions customers with a distribution network of over 114,000 km of pipelines, of which more than 35,000 km are steel.

The RMC project began in 2003 and the first phase ended in 2009 with the selection of a supplier. Presently, we are installing data loggers in the following countries:

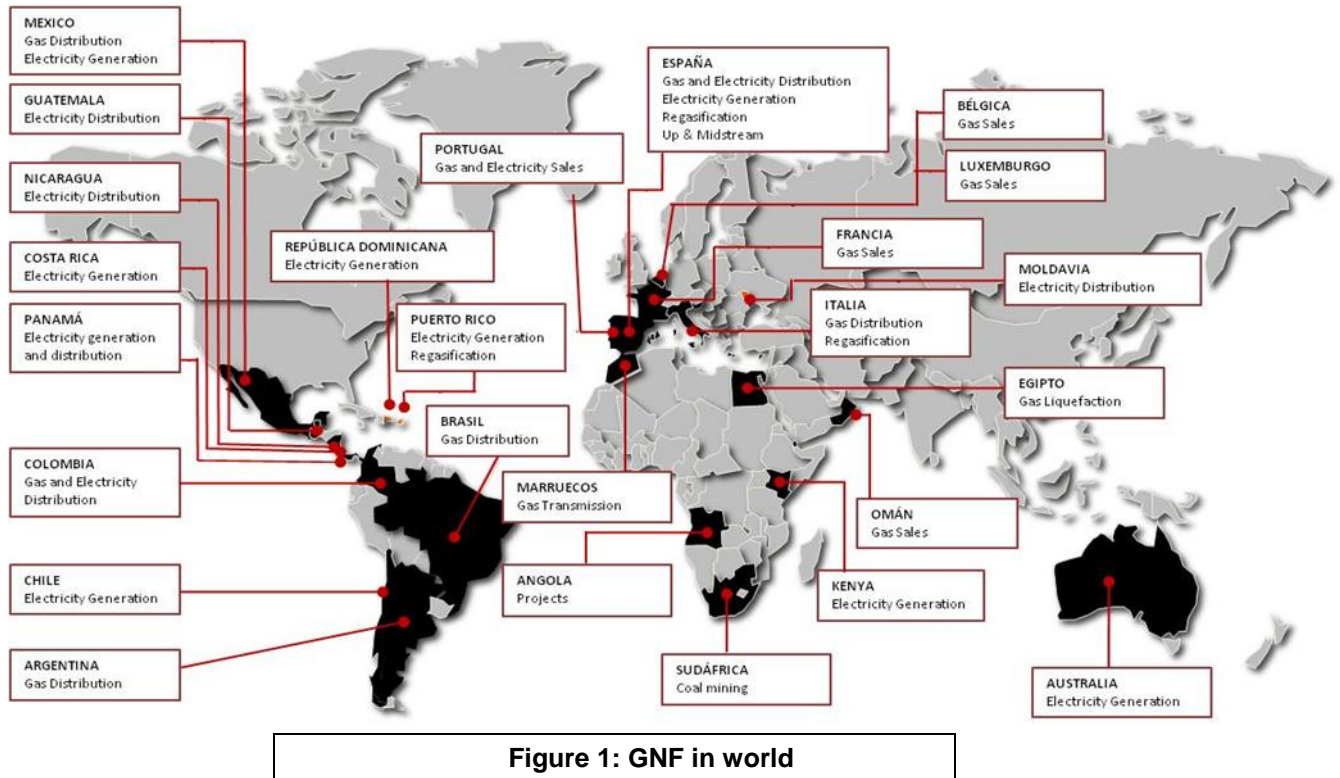
- Spain, nearly 1,500 units in the 2010
- Italy, almost 1,000 units in 2010 and 2011
- Mexico, around 500 units in the 2011
- We are studying projects in Colombia and Brazil

In the report, I will explain the entire process for:

- Defining the technical specifications for our RMC. In this part, it is very important to consider:
 - the standards of each country,
 - the measurements for every kind of equipment,
 - the AC/DC measurements, and
 - the structure of hardware, software and communications.
- Selecting the supplier.
- Explaining the next steps.

1. Introduction

GNF is the first company in Spain to integrate the gas and electricity sectors. *GNF* has a presence in 25 countries on four continents (see figure 1).



All of *GNF*'s activities are associated with different aspects of energy production and distribution

- Gas transmission, distribution and commercialization
- Electricity generation (fuel, gas, coal, nuclear, hydraulic, wind, solar, etc.)
- Electricity transmission, distribution and commercialization
- Coke Mining
- Gas Liquefaction
- LNG transported by tankers
- Mid & Upstream
- Regasification

2. Gas Distribution System

GNF is involved in gas transmission and distribution in Argentina, Brazil, Colombia, Italy, Mexico and Spain, but its main activity is gas distribution (see figure 2).

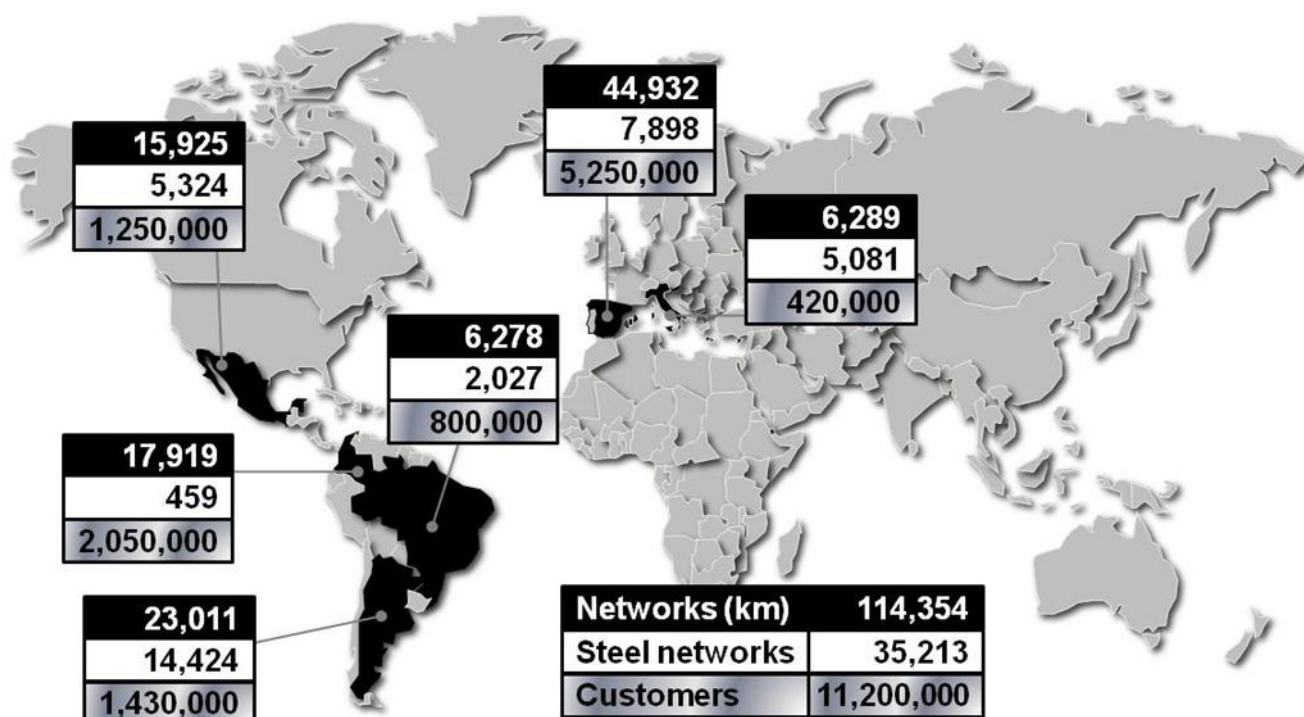


Figure 2: Gas Distribution Systems ¹

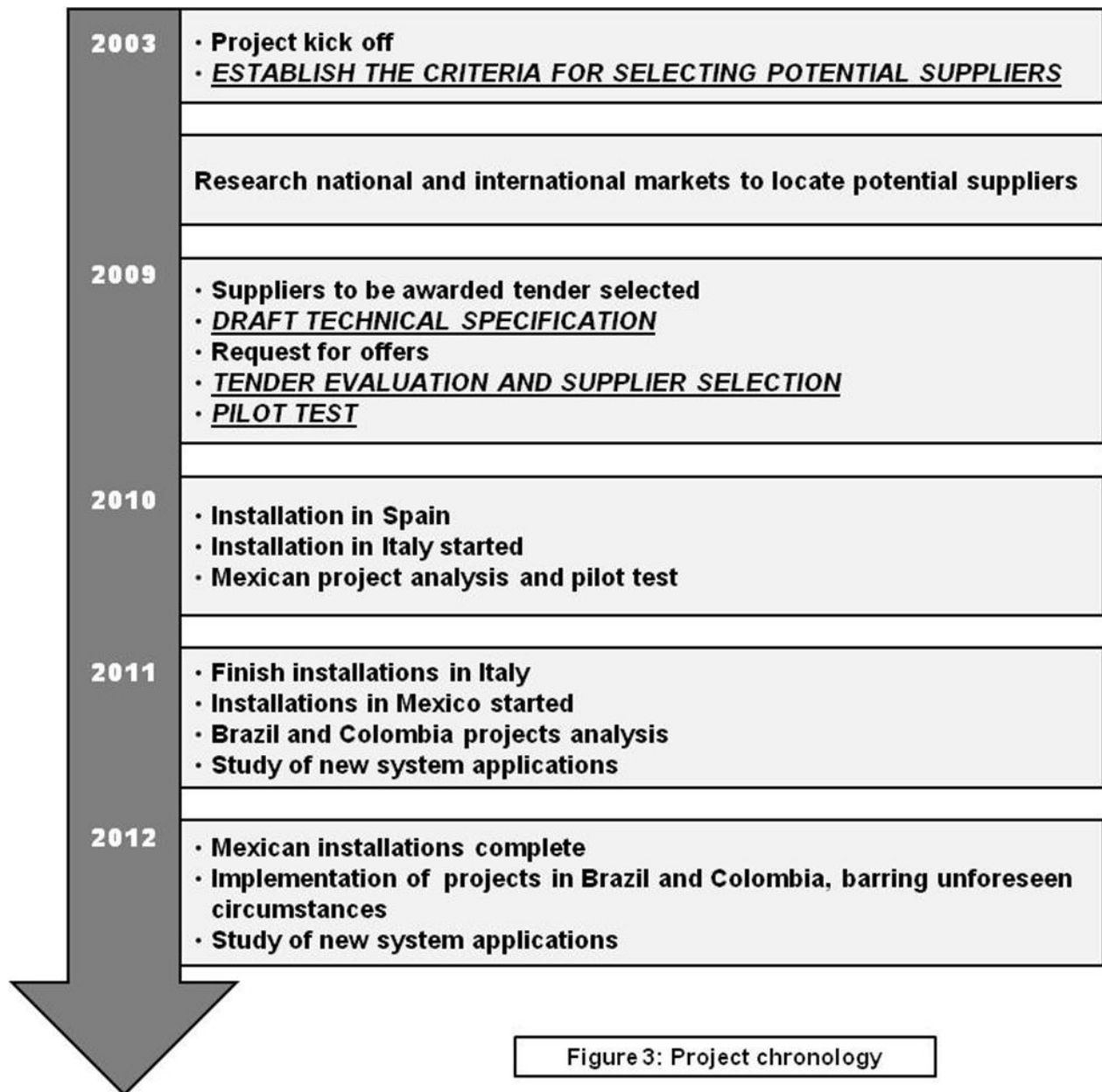
Cathodic protection facilities by country

Country	Impress Current Stations and Drainage Stations	Test Points
Argentina	473	8,610
Brazil	301	2,060
Colombia	20	447
Italy	363	5,183
Mexico	184	1,694
Spain	442	17,282
Total	1,783	35,276

¹ Annual Report 2009

3. Project Milestones

The project chronology is shown in figure 3:



The most important milestones in the project are the following

- Establish the criteria for selecting potential suppliers
- Draft technical specification
- Tender evaluation and supplier selection
- Pilot test

4. Establish the criteria for selecting potential suppliers

The first step was to conduct a search for manufacturers of specific data loggers for cathodic protection and analyse equipment performance. The initial results indicated that there were many suppliers and that there were significant differences between the data loggers and differences in cost as well.

The working group (WG) decided to establish the minimum requirements for the *GNF* system

- Hardware and software must be owned by *GNF*.
- Equipment must be owned by *GNF*.
- The data logger must accept at least the following measures
 - Voltage (U)
 - Protection current (I_P)
 - On potential (E_{on})
 - Off potential (E_{off})
 - Stray current (I_S)
 - On potential in a.c. (E_{on-ac})
- The data logger will calculate and send the following parameters on a daily basis
 - Minimum, maximum, modal and average value
 - Number of times that a measure has been out of range
 - Total time that a measure has been out of range
- The data logger will send its internal alarms in real time
- Users may request measurements from previous days to data loggers
- Users can query the data loggers through mobile phones messages
- Mobile phone cards are property of *GNF*
- Communications between the data loggers and the server should be done using GPRS type messaging
- The equipment may be powered by batteries or mains

Another important point was to define the scope project (see figure 4).

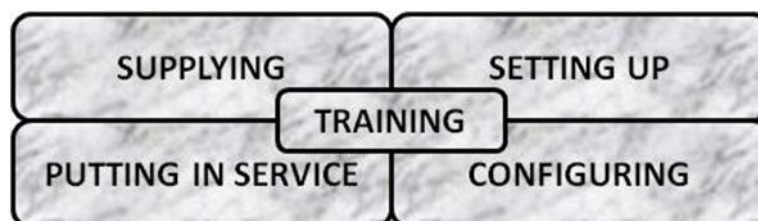


Figure 4: Scope of the project

The WG also defined the steps for analysing each of the potential suppliers in order to assess the equipment and each company's ability to respond and adapt. The four stages were

- Step 1.** Initial meeting for investigating the equipment's performance and degree of compliance with minimum requirements established by the WG. The companies' ability to adapt their data loggers to *GNFs* requirements.
- Step 2.** Test the equipment under real operating conditions and verify the communications systems.
- Step 3.** Meeting at the offices of the suppliers in order to analyze the strengths and weaknesses of the equipment and management software. Another important point was to identify the differences between the equipment's performance and *GNFs* requirements, and the willingness of manufacturers to adapt their equipment to our minimum specifications. Furthermore, knowing company's structure.
- Step 4.** The last step was a WG meeting to decide if the supplier was apt for the tender.

At the end, five suppliers were selected to take part in the tender.

5. Draft technical specification

This part of the project is the most important to select the best supplier for our conditions. Specification wording is based on the experience and knowledge gained during suppliers' selection for tender

The first point was to define the cathodic protection installations where the data loggers ought to be installed, in total there are nine installations types,

- EPC-DF: Impressed current station
- EPC-DD: Drainage station
- TP-L: Test point with reference electrode
- TP-PBT: Test point with reference electrode and coupon
- TP-MAN: Test point in closed insulating joint, with balancing resistance
- TP-SHU: Test point in closed insulating joint
- TP-FRO: Test point in opened insulating joint
- TP-CTL: Test point in between two pipelines

We defined the measurements for every type of installation (see figure 5)

	EPC-DF	EPC-DD	TP-L	TP-PBT	TP-MAN	TP-SHU	TP-FRO	TP-CTL
U	X							
I _p	X							
E _{on}	X	X	X	X	X ⁽¹⁾	X	X ⁽¹⁾	X ⁽²⁾
E _{off}				X				
I _s		X						
E _{on-ac}			X	X	X ⁽¹⁾	X	X ⁽¹⁾	X ⁽³⁾
I					X	X		

- (1) Measures on each side of insulating joint
(2) Measures on each pipeline
(3) Measure only on *GNF* pipeline

Figure 5: Measure types for installations

Technical specifications defined the system architecture (see figure 6)

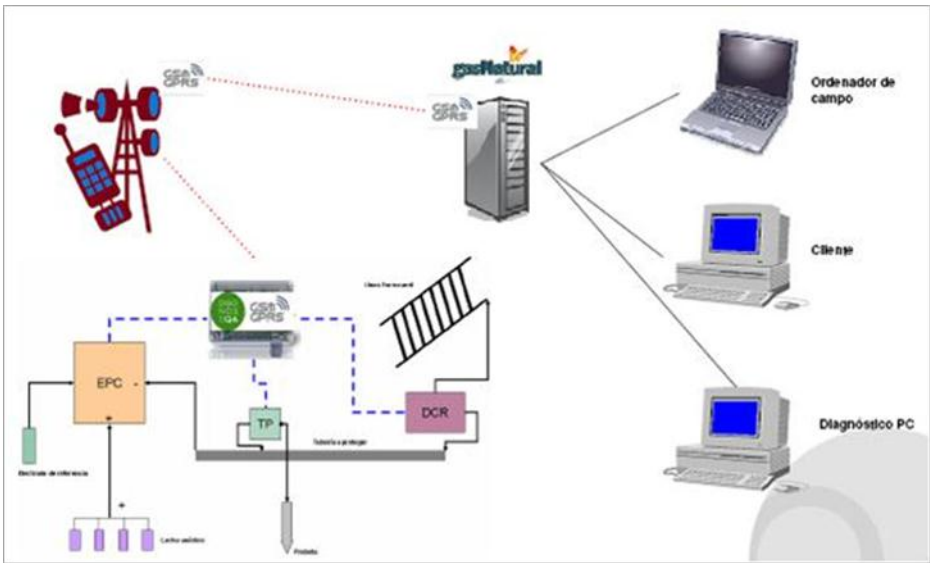


Figure 6: System architecture

- The main points of the system architecture are the following,
- Data loggers are *GNF* owned and installation is responsibility of the supplier. Also, they are responsible for equipment’s commissioning.
 - Communications between data loggers and server, if it’s possible, it will be by means of GPRS message. In the case that these GPRS communications couldn’t be possible, the system will automatically try communication by SMS or GMS.

- All the equipments will communicate with the central server, and the workstations will connect to it through the *GNF*'s internal network.

The project was defined like “turn-key project”, supplier must supply, set up, put in service and configure the equipments, and train users. Therefore in the specification is defined the work protocol between *GNF*'s departments and supplier.

During the step of “selecting potential suppliers” the WG verified that data loggers didn't comply with all minimum *GNF* requirements, and some equipments were prototypes. WG decided to introduce three months long “pilot test” in different areas of Spain with the goal of testing equipments and communications.

Of course, specification defines other issues as

- Number of facilities and their geographic location.
- Legal requirements
- Quality requirements
- Safety Requirements, ...

5. Tender evaluation and supplier selection

Tender evaluation began in February 2009 and it ended in July 2009.

Evaluation had three points of view

1. Technical, about cathodic protection
2. Hardware, software and communications
3. Economic and legal

The evaluation was conducted by experts in each area and three points were considered

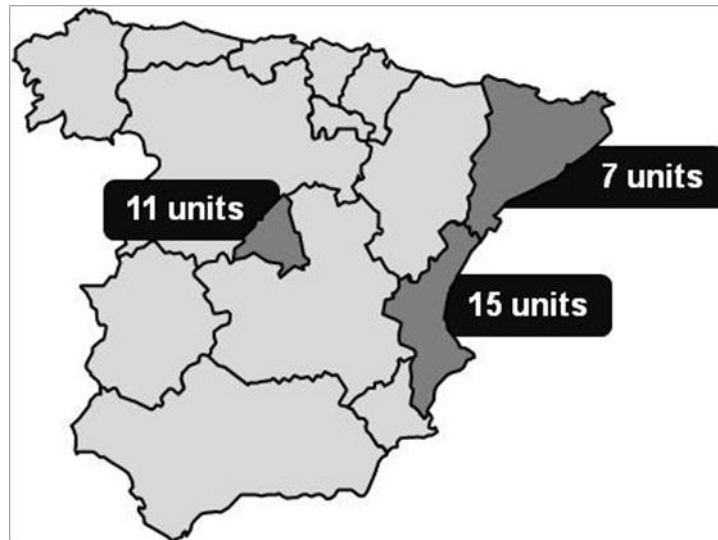
- a) Understanding the offer: This block appreciated the description and understanding of both the service required in the *GNF* Specification as complementary services offered by the bidder company.
- b) General requirements: This part will assess the level of compliance with respect to the requirements of the *GNF* Specification.
- c) Positive ratings: This phase evaluated contributions not required by *GNF*, but that enrich and add value to the project.

The final decision was made taking into account the technical assessment and economic evaluation.

It is important to note that, no supplier was totally compliant to the technical specification. Consequently, the WG decided to give a deadline to bring its winning supplier product specification and then submit to a pilot test.

7. Pilot test

The pilot test began in September 2009 and ended in December 2009, supplier had to install and put in service data loggers in three parts of Spain with different situations from the technical point of view.



At the end of the process, the Working Group decided whether the supplier had achieved the objective of adjusting its product to GNF specification. The result was positive and WG decided to end the tender evaluation phase.

8. Project today

8.1. Installation in Spain

GNF in Spain was born from the fusion of several gas distribution companies, so the cultures and approaches were very different between them and, consequently, there are many types of facilities. Another important point, the project is “turn-key project”. The implementation project was conducted in three stages

- a) The first work was to establish the points where to install the data loggers, and verifying its GPS situation and the necessary works to adapt the installation for the equipment. GPRS signal was verified too.
- b) The second step was the adaptation of the installation, and all the information was sent to the supplier.
- c) The last step was the installation and commissioning the data logger.

The installation was realized for Spain’s region and before the beginning the supplier did the training course.

The operation began in June 2010 and ended in November of the same year, in this period there were 131 working days and two teams were working in the installation, the team average was of 7 data loggers per day. Figure 8 shows the number of data loggers installed

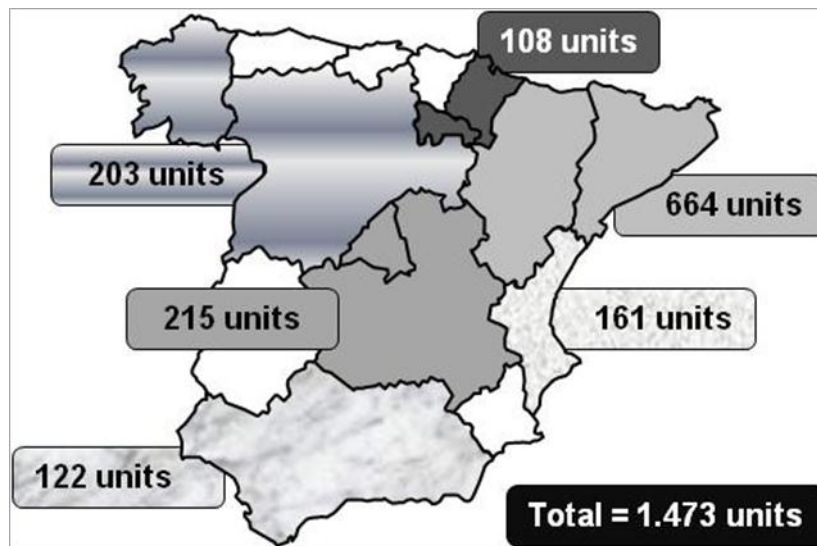


Figure 8: Installation in Spain

The error ratio was 10% and the problems were in the following points:

- Problems with batteries = 3%.
- Data logger, out of service = 6%
- Data logger, damaged = 1%

The main reasons for the “out of service” were an incorrect installation.

In conclusion, installation can be classified as successful.

From the economic point of view we have had:

- Investment of 1.20 M€
- Decreased spending of 0.5 M€/year

From the operating point of view we have had a 72% decrease of the operations in field (5,000 operations in front of 18,000).

8.2. Installation in Italy

The project in Italy had a different approach than in Spain, in Italy the project will be in two years (2010 and 2011).

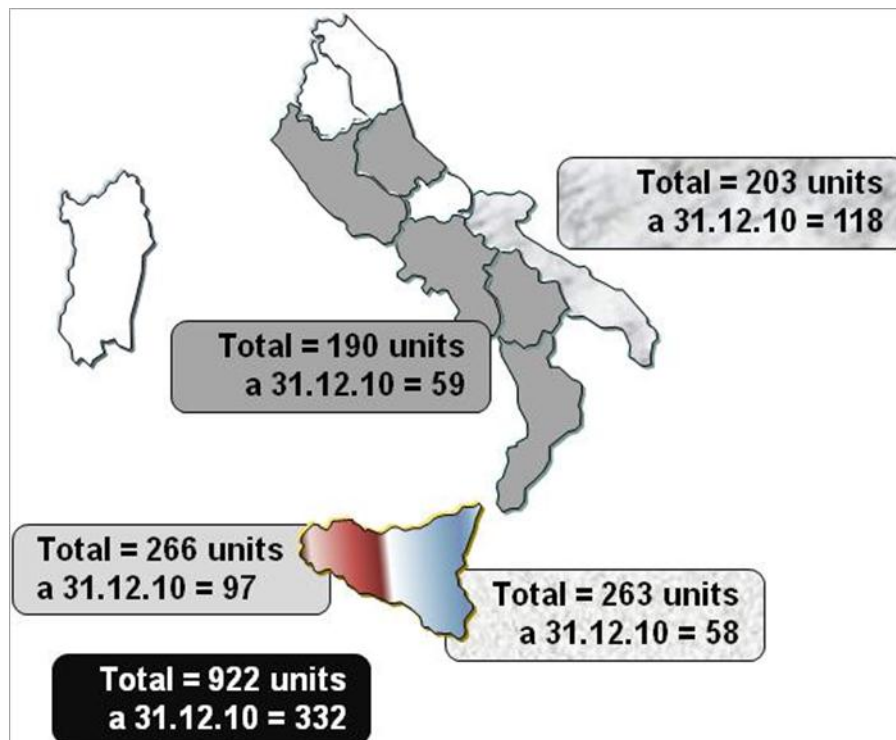


Figure 9: Installation in Italy

Our expectations in Italy are the following:

- Investment of 0.75 M€
- Decreased spending of 0.35 M€/year
- From the operating point of view we expect to have an 88% decrease of the operations in field (2,500 operations in front of 21,000).

8.3. Installation in Mexico

During 2010 in Mexico, we did the pilot test and the result was satisfactory. Afterwards, the WG prepared the global project and it was approved at the end of the year, the goal in Mexico is

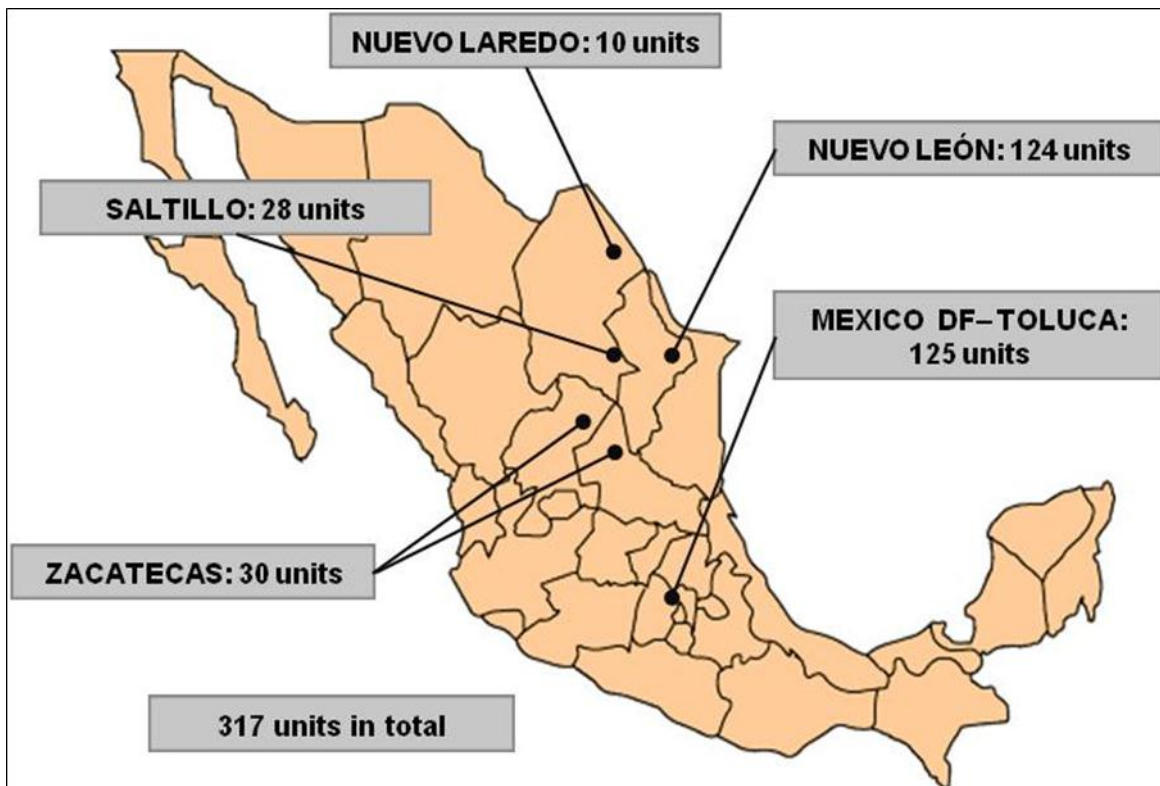


Figure 10: Installation in Mexico

Our expectations in Mexico are the following:

- Investment of 0.35 M€
- Decreased spending of 0.15 M€/year
- From the operating point of view we expect to have an 88% decrease of the operations in field (900 operations in front of 7,500).

9. Next steps

Evidently, the first goal for this year is to consolidate Spain's project and to end the projects in Italy and Mexico.

Now, we are working the Colombia and Brazil's projects. That includes the pilot test in each country. Our goal is to end the projects before summer 2011 with the aim of beginning the installation next year, provided that GNF's Direction approves the project and the investment.

During 2010, GNF carried out the definition of a parameter to measure cathodic protection efficiency; it is based on KT from Italy's normative. The goal for this year is to test it; and if it is OK, to include it in the GNF's internal normative.

Another goal is to implant On/Off measurements with coupons in Mexico, Colombia and Brazil with coupons. At the moment it's usual to make this type of measurement through synchronous interruption of the sources of DC current applied to the pipeline.

Another goal is to implant ddpAC measurements in Mexico, Colombia and Brazil.

It is important to improve the work station's interface with the aim of making easy the analysis to the operators. This job is developed together with the supplier; in this part is included thematic maps, ratio calculus, etc.

10. Conclusions

RMC project for *GNF* has the following advantages for *GNF*:

Before RMC	After RMC	Benefit
Monthly instantaneous measurements	Daily log measurements	<ul style="list-style-type: none">• More information
Measurements by operator	Measurements by data logger	<ul style="list-style-type: none">• More reliable information• Timely information on anomalies• Cost reduction• Operational standardization throughout <i>GNF</i>