Coating selection for Field Joint, feedback from an end user

Thierry KERZERHO,

GRTgaz, France, Thierry.kerzerho@grtgaz.com

For an end-user, current work from ISO groups is very helpful for coating qualification. But when it goes down to product selection, there are many parameters the coating engineer has to deal with and not only performance related:

- Type of project: new construction or rehabilitation,
- Size of the pipeline,
- National regulation,
- Budget,
- Applicators,
- Feedback from previous projects.

Since 2012, GRTgaz has been developing his network with more than 500 km of 36” and 48” pipelines built. Mainline coating used is 3LPE (Three Layers Polyethylene). For field joint coating, different products have been used such as PE tapes or Heat Shrinkable Sleeves.

Application is the most important part, to ensure the best quality. A product qualification is made before the project and applicators have to be trained. In addition, a third party inspection has been implemented to control the process.

Regarding maintenance, GRTgaz inspect around 2500 km of pipeline per year with Intelligent Pig or ECDA (External Corrosion Direct Assessment). Products selection for rehabilitation is essential, application is performed in the ditch with aggressive conditions such as low temperature, high humidity, old coating removal…

Keywords: Field Joint Coating, Rehabilitation, Inspection, Application

Introduction

GRTgaz operates more than 32 000 km of gas networks. This transmission system consists of a primary pipeline system, 6,100 km of big diameter (DN400/16” to DN1200/48”), and the regional system which supplies gas to industrial customers and public distribution network.

Regarding coating selection for corrosion protection, new project and maintenance should be distinguished: conditions, contractors, applicators are different. Therefore, the choice of coating has to be made considering all those factors.

Scope of new projects:

Since 2012, GRTgaz has started a project in the north of France. It consists of building an extra connection capacity between Belgium and France, making possible to expand gas trading in North Western Europe. The total length of this project is more than 500 km.

The map below shows the route of 3 major projects: Artère des Flandres, Arc de Dierrey & Val de Saone.

Figure 1 Project location

The characteristics of the different projects are summarized in table 1.

Project	Arc de Dierrey	Artères des Flandres	Val de Saône
Commissioning	November 2016	November 2015	2018
Size	48” / DN1200	36” / DN900	48” / DN1200
Length	300 km	130 km	190 km
Operating pressure	67,7 bars	67,7 bars	67,7 bars
Mainline coating	3LPE	3LPE	3LPE
Field Joint Coating	20% PE Tapes 80% HSS	HSS	HSS

Table 1 Project characteristics

Mainline pipeline selected is 3LPE. This is a typical choice in Europe. Polyethylene has good mechanical properties and the Fusion Bounded Epoxy layer gives an extra anti-corrosion protection.

Field Joint Coating Specification

For field joint coating, the ISO 21809-3:2016 standard gives multiple choices such as wax/petrolatum tapes, polymeric tapes, non-crystalline low viscosity polyolefin based coatings, heat shrinkable sleeves, liquid epoxy, polyurethane, flame-sprayed polyolefin…[1]

Some coatings systems are used for offshore or insulated pipelines, therefore, they are not included in the selection. Field joint coating shall be compatible with the 3LPE used as a mainline coating to ensure continuity of the corrosion protection. Another criteria is the maximum service temperature of the system which shall be at least equal to the pipeline design temperature.

In addition, IPLOCA, *International Pipe Line & Offshore Contractors Association*, states that the most common field joint systems for a 3LPE coated pipeline is three layers heat-shrinkable sleeves and PE Tapes as an alternative [2].

GRTgaz field joint coating specification is based on the ISO standard and also from the feedback of previous project. For new projects, 3 types of systems have been selected: Polyurethane, Heat Shrinkable Sleeves over an epoxy primer and PE Tapes.

Qualification process & coating selection:

All field joint coating systems have to pass a qualification procedure. This procedure is a general qualification for GRTgaz and is not project-related. The properties of the material have to be conformed to the ISO 21809-3:2016.

In addition, in GRTgaz specification, two categories are introduced based on pipeline nominal diameter: HR (*Haute Résistance/ High Resistance*) and THR (*Très Haute Résistance/Very High Resistance*). The threshold between the categories is DN600/ 28” pipe. Some other criteria are modified such as impact resistance, the value has been set to 15 Joules for DN<600 and 20 Joules for DN≥600 instead of a specific value in J/mm for each different type of coating.

Suppliers has to pass tests according to the specification with a third party laboratory to verify the conformity of the product. GRTgaz manages a list of qualified product and applicators. This list is provided to the contractors who made the final choice.

Another key point is the budget allocated to Field applied coating operation, the figure 2 below shows the percentage dedicated to FJC and welding for the Arc de Dierrey project. FJC operations, including materials, surface preparation and application represent 1% of the total costs of a new project where welding represents 5%. Although FJC is one main point to look at for corrosion protection.

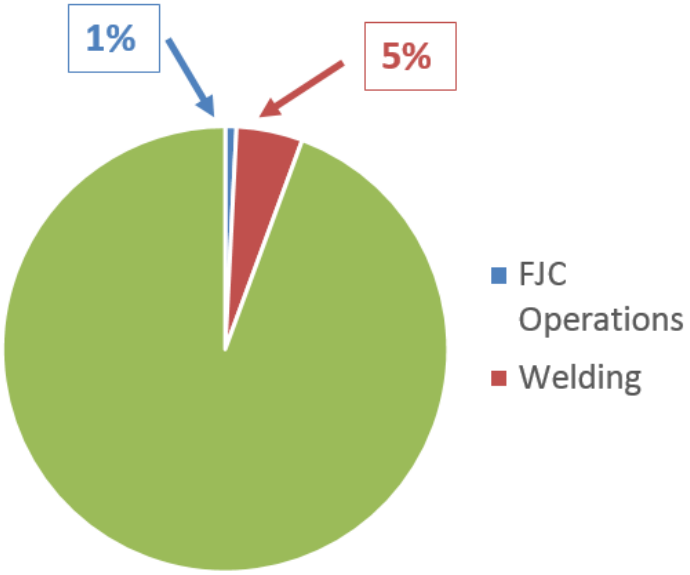

Figure 2 Welding and FJC Costs compare to total project

A procedure shall be written by the contractor and verified by GRTgaz representative. Also, at the beginning of the project, a pre-production test is performed to ensure the quality of the application including applicators skills, equipment review and metrology.

<u>Inspection:</u>

Third party inspection has been implemented during pipe construction. Inspectors has to verify differents points:

- Procedure,
- Applicators skills,
- Equipment,
- Metrology,
- Product quality,
- Surface preparation,
- Application,
- Quality control.

A daily report is made from the inspection. This document summarize all the important information from the field such as weather conditions, QA/QC; number of joint coated, name of the applicators and pictures.

Feedback from the project

Training and experience are the main point to verify. Equipment for applicators shall be sufficient and spare parts shall be available for reducing time lost. A normal rate of production is 50 joints/day, it is important that this rate is equal to the welding rate of production to save time loss. High standard equipment such as automatic sand blasting or induction heating.

Case study:

During the seventies, PVC Tapes has been used as main coating. Bare pipes were delivered and welded on site and all the coating was performed before laying down. Pipes characteristics were the following:

- Construction: 1977
- DN300
- 107 km

In 2004, Pigging has been performed. The table below list the main results of this inspection:

Featuring	1193
Metal loss	1060
Digs	31
Defects identified	78
Cuts	5
Composite repairs	4

Table 2 Inspection results on PVC coated pipe

This case study is representative of a wrong choice for coating. During the project, application might have been satisfactory but defects have been discovered years after. This means that qualification shall be well managed and application supervised.

Rehabilitation:

Rehabilitation is another major concern for a Transmission System Operator. French regulation states that all pipelines shall be inspected every 10 years. Two methods are used, in line pigging, when possible, or External Corrosion Direct Assessment (DCVG or Pearson). All the data collected by the inspection are analysed and a rehabilitation plan is prepared.

GRTgaz performs spot repairs. Coating defects might have different origins:

- Ageing,
- Application,
- Design,
- Third party damage,
- Soil condition.

The pictures below show some example of extensive coatings defects.

Figure 3 Ageing

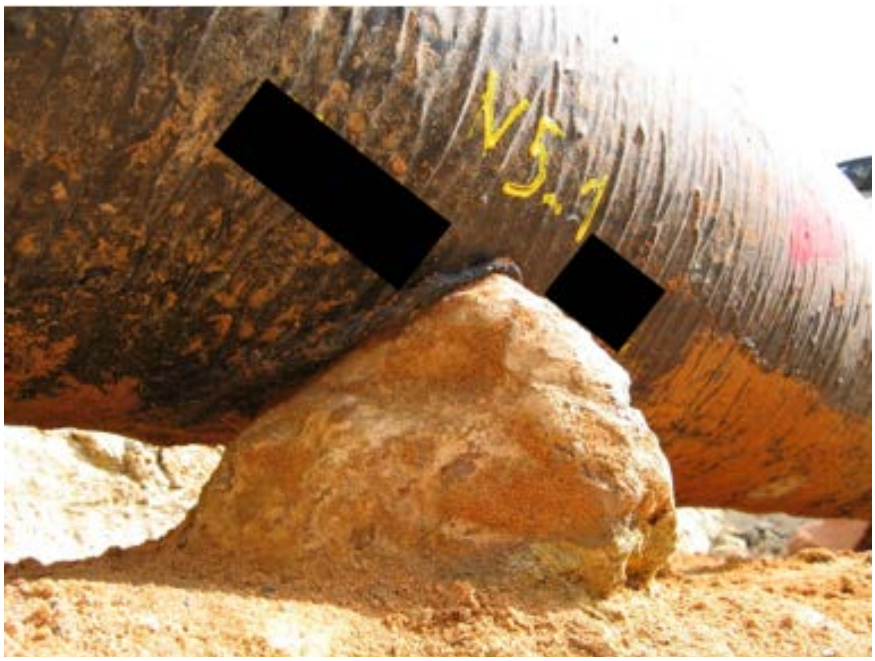

Figure 4 Soil condition

For rehabilitation, coating operations represent around 10% of the total cost. The figures 2 shows the reparation between material, patent coating removal, surface preparation and coating application.

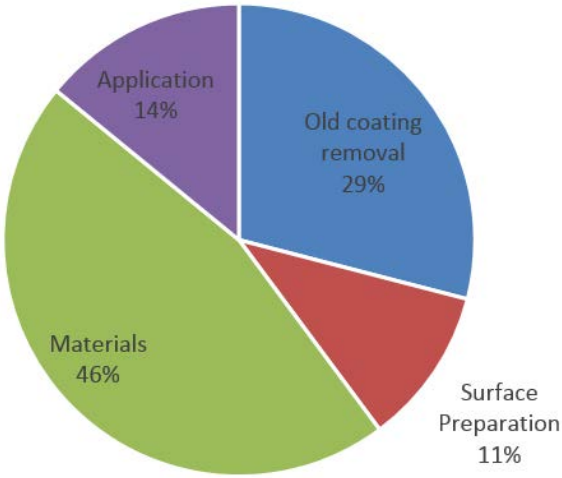

Figure 5 Repartition of the costs for coating operations in rehabilitation

During those operations, applicators have to work in tough conditions in terms of weather conditions, ditch conditions, pipeline operating pressure and parent coating removal. Operating pressure has a big impact on application. It limits the possibility to heat up the steel and remove the moisture. Therefore, if it is not possible to reduce the flow, the coating system selected shall be humidity tolerant.

Coating selection shall also take into account the applicators skills. Work is often performed by local contractors with low experience in corrosion protection. Applicators shall pass a training from the coating supplier to verify their ability.

Figure 6 Ditch conditions

GRTgaz selects two type of coating for repairs:

- PE Tapes,
- Wax/Petrolatum Tapes.

If conditions of humidity, temperature and surface preparation are satisfactory, PE Tapes is choosen. Otherwise, Wax/Petrolatum is a good option to ensure a proprer protection against corrosion.

Conclusion:

For an end-user, coating selection shall be considered depending of the type of project. For new construction, contractors work with dedicated crew or sub-contractors, the personnel are normally experienced. The field joint coating system shall meet the charectics of the mainline coating. Use of equipment such as sand-blasting or induction help the applicators to reach this goal.

For rehabilitation, condition of application is a big issue, humidty and temperature are difficult to mitigate because of pipeline pressure or ditch conditions. The system selected shall be prevent future maintenance.

Reference

1. ISO 21809-3:2016, “Petroleum and natural gas industries – External coatings for buried or submerged pipelines used in pipeline transportation systems – Part 3: Field Joint Coating”.
2. IPLOCA “Onshore Pipelines, the road to success”, September 2013, Appendix 11.1.2