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SECTOR A

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Methodology of evaluation of the preserving state of GRT Gaz Pipelines

P. France, Gaz de France - France

ASSESSMENT METHOD OF THE STATE OF TRANSMISSION NETWORK OF GRTgaz "ELECTRICAL SURFACE MEASUREMENTS"

Pierre FRANCE, Bernard MASSON, Sylvain FONTAINE, Christophe VIGIER [a]

Xavier CAMPAIGNOLLE [b]

[a] GRTgaz Val de Seine
Pole National d'Expertise, DEA PC
5 rue Ferdinand de Lesseps, BP 50 309, 60 203 Compiègne Cedex, FRANCE

[b] GAZ DE FRANCE R&D
361 avenue du Président Wilson, BP33
93211 Saint Denis La Plaine, FRANCE

SUMMARY

The Gaz de France Transmission Division (GRT Gaz) has undertaken, since 1992, the inspection of the state of its network, by means of electric surface measurements and visual inspection after excavation. The excavations are selected by sampling.

In 1999, a program of inspection was defined on the whole of the transmission network of gas. It is established according to a preliminary ranking of the pipelines to inspect by ILI or by « Electrical Surface Measurements ».

The program of inspection by « Electrical Surface Measurements » is established after determination of the sections and the defects to be excavated presenting risks of losses of metal, while following a methodology by "electrical measurements of surface".

Today, the acquired experience feedback, make it possible to improve methodology by identifying the various parameters of risk noted on our pipelines.

The detailed study of these parameters of risk, makes it possible to treat on a hierarchical basis the significant zones of the pipe to be inspected and to select the defects of coating more at the risk of attack to metal. Methodology makes it possible to evaluate, by selective excavations and associated electrical measurements, the state of conservation of the pipe.

The decision to complete the inspection with an intelligent pig can be taken according to the analysis of the observations resulting of excavations.

1 Methodology of inspection by « Electrical Surface Measurements »

To day, the methodology of inspection by « Electrical Surface Measurements » leans on the evaluation of the loss of metal risk all along the considered pipeline.

1) Preliminary study, which consists to determine the risk areas to be inspected by « Electrical Surface Measurements ». These areas are selected by giving **a first notation of the "risks parameters"** of the considered pipeline.

2) Close interval "coating defect research" in the selected areas.

3) Determination of the coating defects to be excavated (which can lead to a loss of metal), by using **a second risk notation** of "inspection parameters".

4) Realisation of checking reports relating to selective excavations by direct observation and measurement (state of the steel, CP level…). The results of these checking allow to establish a **third risk notation** "excavation parameters".

5) Evaluation of the preserving state of the pipelines.

6) Arranging follow-up depending on the results of the investigations: the evaluation allows to check up the coherence of the inspection according to the expected results and to reach a decision concerning the continuation or not of the inspection, either by "ESM" or with the intelligent pig.

The methodology aims at verifying the existence, or not, of lacks of metal and to prevent from their possible progression.

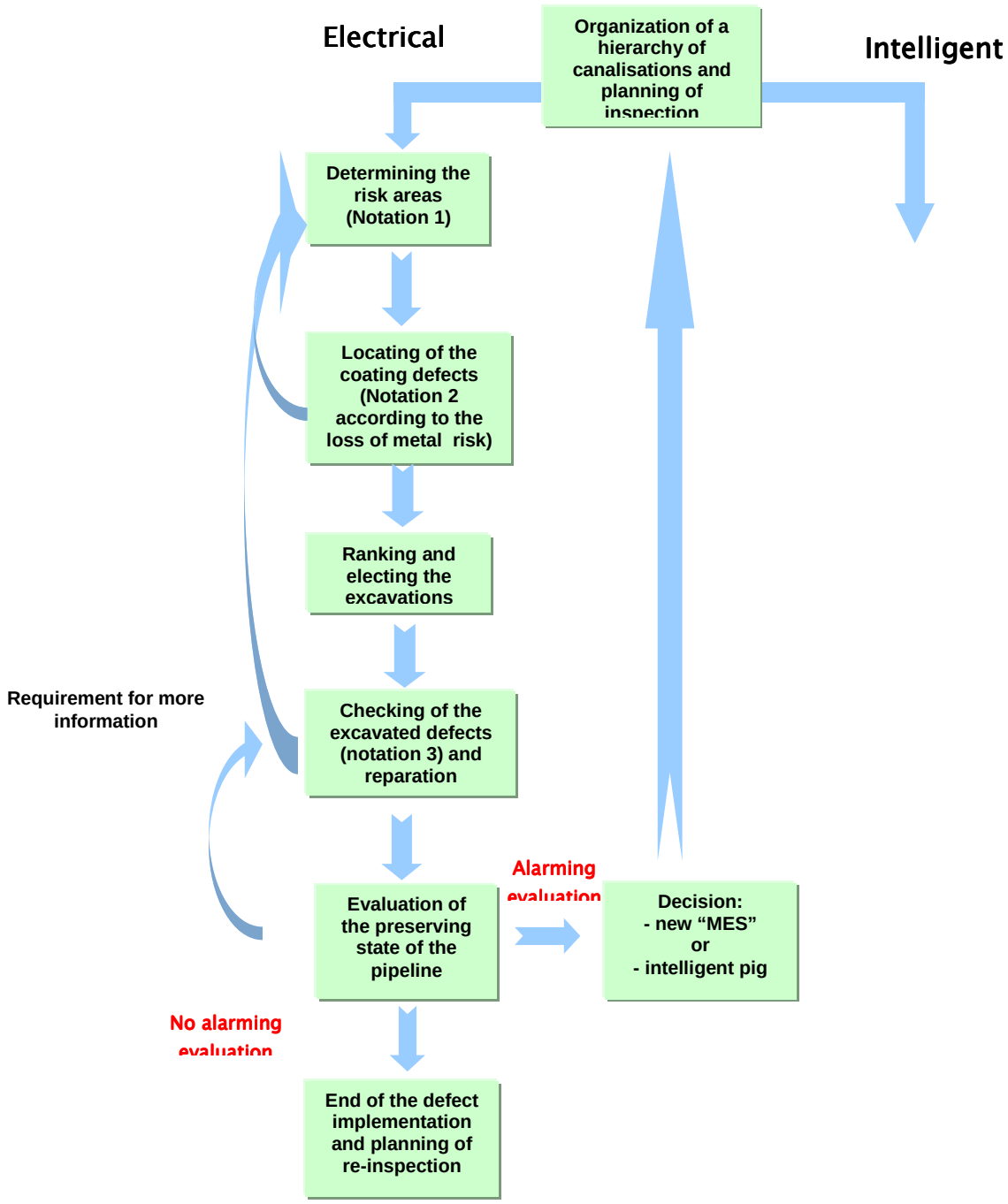


Figure 1 : Simplified description of methodology ESM

2 Preliminary study of the significant areas to be inspected

Notation of the corrosion risks all along the pipeline

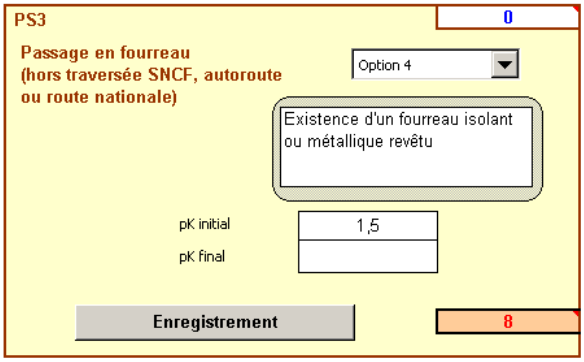
The preliminary study consists into a loss of metal risk study all along the pipeline. It takes into account a big number of risk parameters and leads to the attribution of a notation to each of them, depending on predetermined criteria. These parameters concern the following fields:

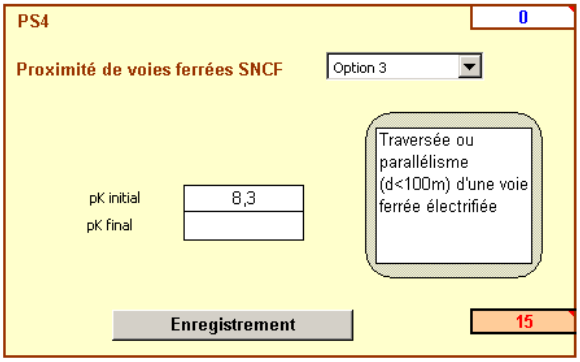
- characteristics of the pipeline,
- soil and surrounding medium of the pipeline,
- environment (urban, industrial),
- particularly sensitive or specific points,
- electrical interferences,
- effectiveness and historic of the cathodic protection,
- historic of identified or suspected incidents (third parts aggressions, corrosions, construction faults,…)
- estimation of the canalisation's state in the course of eventual previous inspections (attenuation, ratio of coating defect / km…)

Example of risk parameters specific to the field "Specific Points"

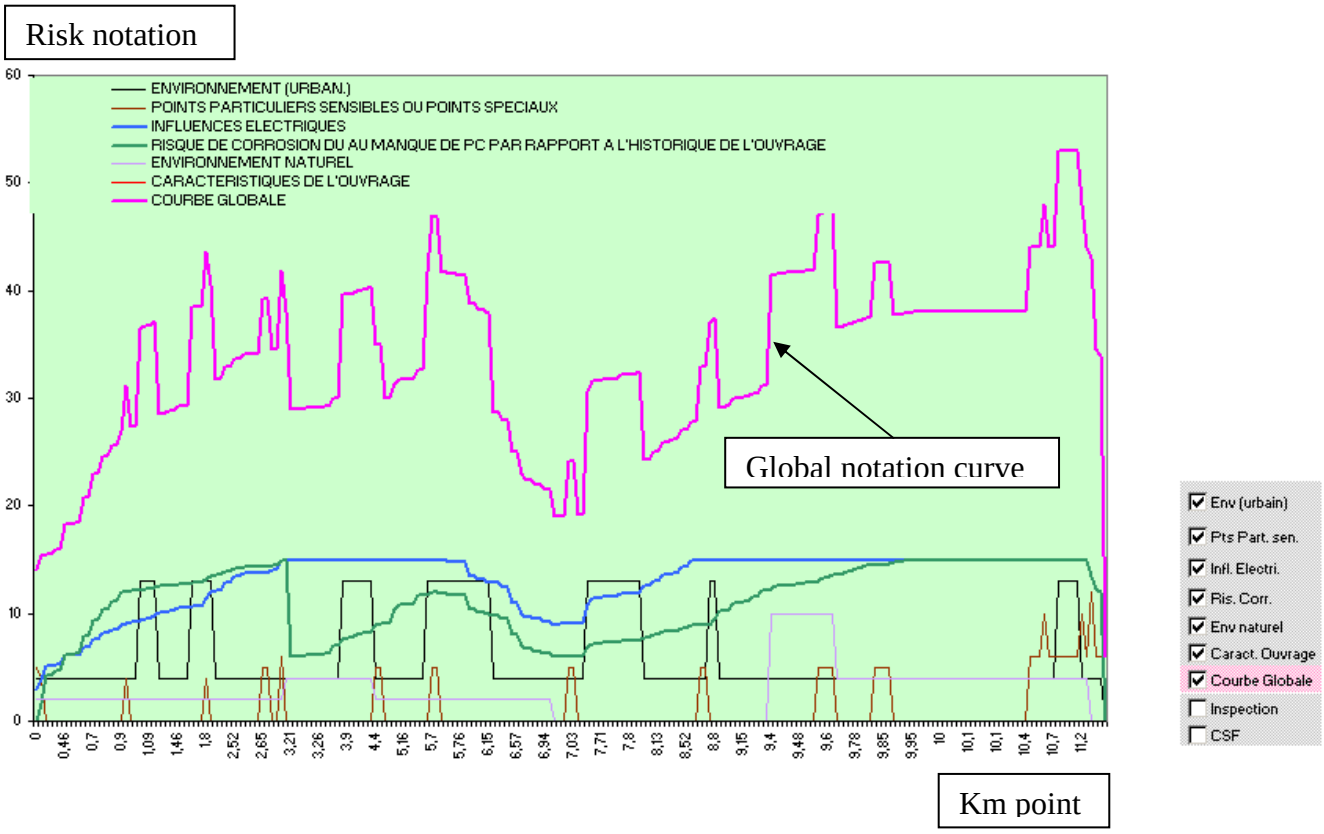
N°	Paramètre de risque	Risque	Note du paramètre de risque pour la sélection des zones à risques	Note du paramètre de risque pour la hiérarchisation des défauts localisés	Coefficient du paramètre de risque
PS3	Passage en fourreau (hors traversée SNCF, hors traversée d'autoroute ou de route nationale)	Risque de corrosion en extrémité de fourreau, Risque de contact avec fourreau, Risque d'agression lors de la pose	0 : aucun défaut détecté 2 : existence d'un fourreau béton ou béton à âme métallique 3 : existence d'un fourreau métallique 4 : existence d'un fourreau isolant ou métallique revêtu 5 : présence de contact dans un fourreau métallique (présumé ou confirmé)	0 : aucun défaut détecté 2 : défaut détecté dans un fourreau béton ou béton à âme métallique 3 : défaut détecté dans un fourreau métallique 4 : défaut détecté dans un fourreau isolant ou métallique revêtu 5 : présence de contact dans un fourreau métallique (présumé ou confirmé)	2
PS4	Traversée ou parallélisme (d < 100 m) SNCF	Risque de corrosion	0 : aucune situation de ce type 2 : traversé d'une voie ferrée non électrifiée 5 : traversé ou parallélisme d'une voie ferrée électrifiée	0 : aucune situation de ce type 2 : défaut détecté sous une voie ferrée non électrifiée 5 : défaut détecté sous une voie ferrée électrifiée ou à moins de 100 m	3

A data-processing tool allows to collect the pipeline information and to carry out the notation used for the trace of the "risk curve" all along the pipeline.





It results from this a global notation of corrosion risk which is determined by the sum of notation of the risk parameters along the pipeline. The areas which are the most exposed to the corrosion risk can thus easily be identified.



Selection of areas to be inspected

The cutting of the pipeline in areas to be inspected is based on the evaluation of the risk of metal loss.

Two categories of areas are selected: “sensitive areas” which are metal loss risk area and “low risk areas”.

The coating defects detection is not systematically done over the entire length of the pipeline. The areas to be inspected by ESM are selected among the sensitive areas and on adjacent “low risk areas”, by maintaining an inspected length from 30 to 40% overall length of the pipeline.

3 Search of coating defects

Detection of coating defects

The search of coating defects is carried out by one of the techniques generally used (Attenuation, Pearson, DCVG.). In case of doubt about the precise localization of defects, two techniques can be used jointly.

The initial coating defect search can be combined with measurements of gradient and/or measurements of potential at the of coating defects location.

Notation detected coating defects

The detected defects are the subject of a second notation which, added to the first notation of the areas at the risks of the pipeline (cf.3.1), allow:

- to refine the global notation of the risk areas of the pipeline,
- to rank the defects to be excavated according to this global note.

Examples of risk parameters “inspection” , using

N°	Paramètre de risque	Risque	Note du paramètre de risque pour la sélection des zones à risques	Note du paramètre de risque pour la hiérarchisation des défauts localisés	Coefficient du paramètre de risque
ECI 2	Pertes de signal par la méthode d'atténuation	Localisation d'une zone de défauts	0 : défaut situé dans une zone avec aucune perte de signal significative 3 : défaut situé dans une zone avec une perte de signal significative	0 : défaut situé dans une zone avec aucune perte de signal significative 3 : défaut situé dans une zone avec une perte de signal significative	1
ECI 3	DCVG	Localisation de défaut	Pas de notation	0 : aucun gradient relevé 1 : entre 10 et 80% de la valeur maximale enregistrée 3 : valeur < 10% ou > 80 % de la valeur maximale 5 : si la valeur est égale à la valeur maximale ou minimale à proximité immédiate d'une valeur maximale	1

4 Determination of the coating defects to excavate

The ranking of the defects to be excavated is carried out on the basis of evaluation of the “second risk notation”. The evaluation of the status of the detected defects can be refined by the CIPS method.
On a portion of inspected pipeline of 15 to 20 km, it is recommended to excavate the following defects:

- 4 to 5 the most important risk defects (highest notations) in order to verify the presence or not of loss of metal in these areas
- 2 to 3 of the less important risk defects (lowest notations) in order to confirm the limits of the sensitive areas.

5 Checking of excavations

Visual observation and CP electrical measurements

For each excavation, the defects affecting the steel of the pipeline and the coating are the subject of a checking report.
The whole of the data collected during the checking gathers information relative to the:

- pipeline and its environment,
- identification and characteristics of coating defects,
- state of the steel at the location of coating defects,
- level of cathodic protection of the pipeline in the excavation.

Characterization, analyses and repair of the steel loss

The whole of the operations of characterization and analysis are carried out according to GRTgaz procedures.
The analysis of the acceptability of the loss of steel is done starting from the recorded dimensions and according to a calculation code used at GRTgaz (code ARD).

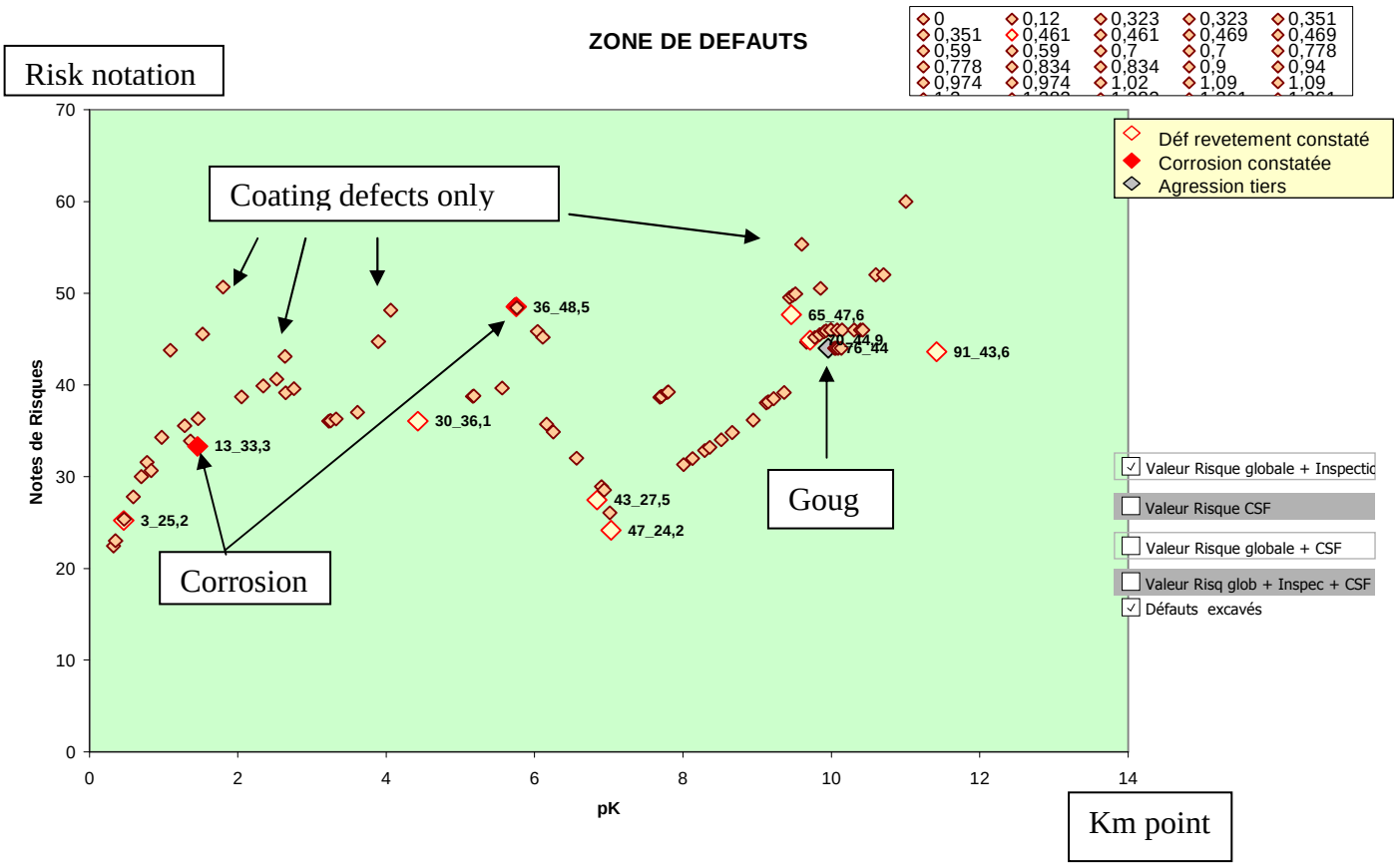
The classification of the loos of metal is the following:

- unacceptable
- temporary acceptable
- acceptable

6 Validation of the assumptions and the limits of the sensitive areas

The results of the checking make it possible to establish a third notation, linked to the data collected during the excavations, and to be ensured of the coherence between the forecast and the real state of the pipeline. The absence of metal loss on the defects excavated out of the sensitive areas must be checked.

In the event of contradiction with the estimate of the risk of the global notation, the causes of incoherence are analysed. If necessary, the evaluation of the risks is taken again and new excavations are programmed.
If loss of metal are identified in “low risk” areas , the length of the pipeline to be inspected (see 3.1) is extended to these areas, which are then considered as “sensitive areas”.



7 Evaluation of the preserving state of the pipeline

The assessment of conservation state of the pipeline allows the:

- identification of the causes of the loss of metal,
- determination of the activity/not activity of eventual corrosion at the date of the excavation,
- assessment, if required, of the corrosion kinetic in the event of active corrosion,
- ranking of the whole of the indications of coating defects detected by ESM, according to their estimated level of metal loss risk.

8 Arranging follow up

At the end of the investigations, a decision must be taken concerning the arranging follow up of the inspection and the acts of maintenance to envisage (e.g.: CP reinforcement, earthing system when presence of a.c. tension…).

1) In the event of an acceptable lack of metal and coherence with the forecast on all the selected defects, it can be decided to stop the ESM inspection.

2) In the event of an unacceptable lack of metal, a study is led in order to determine whether it is convenient to consider the use of intelligent pig or if the perennially of the pipeline can be maintained by iteration of the ESM inspection either immediate or in long term.

3) If no coherence is established between the forecast state and the real state of the pipeline and in the presence of unacceptable lack of metal, the method ESM can be called into question and it can be decided to use an intelligent pig.

9 Conclusion and prospects

The methodology of the ESM inspection is an alternative solution to the pig inspection.

It allows, by several successive notations of the risk parameters , to select areas to be inspected and coating defects to be excavated in order to evaluate, by excavations, the state of the steel in various points of the pipeline.

In all cases, coherence between the forecast and the real state must be checked.

If no coherence is established, the methodology of ESM inspection can be called into question and it can be decided to use a pig inspection.

GRTgaz will evaluate the relevance of its ESM methodology according to the results of checking excavation reports and pig inspections, by analysing the probability of false indication in terms of coating defects and lack of metal.

This approach will make it possible to refine the data-processing tool and to identify the operational limits.

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