

Phylosopy rehabilitation of Danube Croasing Pipelines

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Abstract— After 100 years of exploitation of crude oil deposits in Romania, in 1967, the communist government decides to supply fuel demand by importing crude oil from Iran. The imported crude oil was wanted to be petrochemically processed in two refineries, Arpechim Pitesti and Petrotel Ploiesti. In order to ensure the transport of crude oil from the port of Constanta to the two refineries, a pipe with a diameter of 350 mm was built. As Iran had entered into an embargo and crude oil could no longer be imported from that area, it was decided to import REBCO crude oil (Rusian export blend crude oil). The most difficult stage in the pipeline installation program was the crossing of the Danube.

The Danube River and the Borcea Branch had a length of 2 km and 1.6 km, respectively, and a depth between 2 m and 8 m.

Also the speed of the water made it impossible to deposit sand and alluvium on the bottom of the water (which consisted of limestone and stratified sands).

The crossing of the Danube river represented at that time an exceptional technical achievement, the chosen solution being the location of some pipes on the bottom of the water.

The paper describes the rehabilitation program of this sub-crossing, 50 years after its commissioning.

Keywords—Danube, croasing, oil, pipelines

I. Introduction

The oil transport system from the port of Constanta to the Refineries in Pitesti and Ploiesti was built in three stages:

- 1967, oil pipeline by 350 mm pipe diameter,
- 1974, oil pipeline by 500 mm pipe diameter,
- 1979, oil pipeline by 700 mm pipe diameter.

The underpass of the Danube river and the Borcea arm was made in 1967 (4 oil pipeline by 300 mm pipes diameter) and 1979 (6 oil pipeline by 300 mm pipes diameter).

transport capacity was set at 20 million tons of crude oil annually.

At this moment, Romania still transports through these pipelines a maximum quantity of 4 million tons of crude oil annually.

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Romania extracts approximately 3 million tonnes oil, but necessary of finished products is located somewhere at 10 million tonnes (6 million tons refined in two refineries in Ploiesti and 4 million tons refined at the Midia refinery, Constanta).

That is why the import of crude oil is absolutely necessary to ensure the quantities of fuel for Romania and the countries around it.

As the crude oil transport system is very old (over 50 years old) and because a new pipeline system cannot be installed (due to the reduction in the quantities of finished products used in the future and the switch to the use of green cars), it was decided to maintain the system. transport of crude oil by its rehabilitation.

The solution chosen at that time for pipe installation consisted of:

- dredging the bottom of the water (figure 1),
- treatment of pipes on the water surface (10 pipes of 300 mm) (figure 2),
- their ballast on the bottom of the water (figure 3).

Starting with the year 2000, these pipes have entered a complex program of rehabilitation and maintenance.



Figure 1. Danube croasing pipeline install

II. Oil pipeline croasing rehabilitation pylosophy

Considering that the crude oil transport system under the Danube and the Borcea Branch cannot be stopped for complex repairs, we chose a complex program to rehabilitate it and keep it in operation until the placement of two new pipes (this time installed by horixontally drilling).

The rehabilitation program consisted of:

- a. performing a risk analysis,
- b. detecting the condition of the pipe insulation in the non-flooded area,
- c. cleaning the pipes inside and determining their minimum diameter,
- c. checking the water bottom in the pipe mounting area and detecting any suspensions of the pipes,
- d. inspection with MLF pipes and determination of the state of internal and external corrosion,
- e. repair of defect points larger than 30%, located in the land area,
- f. cleaning and abandoning pipes that have defects greater than 50% and that are in the flood zone.
- g. horizontal drilling for the new pipe.



Figure 2. Danube crossing pipeline install

A. *Performing a risk analysis*

The probability of a spill occurring along a pipeline lies at the core of risk management for pipeline operator.

I proposed a methodology to risk evaluation based to the formula:

Risk=frecvency (number of accident per year)* vulnerability (environment and population) *consequences (deads or tones per event).

B. *Detecting the condition of the pipe insulation in the non-flooded area*

The inspection of the bottom of the water in the area of the pipes was done with the autonomous divers, because the speed

of the water in the area did not allow a good visibility and therefore the use of autonomous inspection vehicles.

The exposed pipes were found and one was suspended for about 2 m.

It was decided that the suspended one should be abandoned (oil was evacuated, oil products were cleaned and inerted with nitrogen until its decommissioning was approved).



Figure 3. Danube crossing pipeline install

C. *Cleaning the pipes inside and determining their minimum diameter and internal defect detection*

I decided to use intelligent inspection tools based on the principle of magnetic flux leakage useful in the detection of pipeline corrosion.

Before to Internal Corrosion Detection has been carried out a calibration program by using aluminum gauge plates, attached to bi-di high density polyurethane cleaning pigs.

D. *Reducing pipeline pressure based to ANSI/ ASME B31G criteria calculation for corroded pipes line*

After running the inspection tools I decided to reduce pipeline pressure based to ANSI/ASME B 31G.

ASME B31.4 and B31 G code are procedures for analyzing flow in pipe and for repairing them.

Both codes also provide analysis of interconnected pitting, taking into account the lonitudinal length of these pitted areas.

A given corroded region in a pipeline is evaluated on the basis of its maximum length (L) and maximum depth (c).

Sound engineering judgement requires that corrosion should not be allowed to reach a size (L and c) so large that the

predicted failure stress level is at or below the maximum operating stress.

Therefore a factor of safety was applied.

Above philosophy in conjunction with calculation programmed were developed in order to cover needs (proving result listing and graphs) for each type and size of pipe.

The use of graphs (or result listing) is an effective and easy way for pipe line inspectors to determine the extent of external corrosion zones that require repair, replacement or/and compute the derated operating pressure.

Computer program was validated by hand calculations.

E. Coating replacement and defect repair

All the defects that could be intervened (in the non-floodable area) were repaired and also the pipe insulation in the non-floodable area was repaired.

F. Writing pipeline revalidation documentation and presented to the governmental agency to approve new system pipeline working condition and a new oil pipeline horizontally drilling install

Documentation necessary for the Governmental Agency is:

- New GIS information.
- Modification of the Pipe System.

In accordance with Romanian Law, Agency decides to operating system or application on new rehabilitation procedures.

After analyzing the defects (maximum 3 on each pipe with over 30% reduced wall thickness) the decision was made to repair them.

The defects were detected in the floodable area (the area of taking over the high flows of the Danube).

It was found that only three pipes should be abandoned (having defects in the river area).

Conclusion

The rehabilitation of the Danube underpass was carried out in a program financed by the World Bank and aimed at maintaining in operation until the location of two new pipelines.

At this moment, the necessary documentation for the approval of the drillings was made (the work was estimated at a value of 50 million Euros) [1,2].

References

- [1]
- [2]

References

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