

PROVOKED DAMAGES IN THE DOMESTIC CRUDE OIL PIPELINE SYSTEM

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Abstract: Starting from the registration of the Evidence File of S.C. CONPET S.A. for all the damages occurred during the years 2000 and 2009 in The Domestic Crude Oil Pipeline System were emphasized the provoked damages, produced by artificial causes (unauthorized human intervention for stealing oil products). This kind of damage, which is concretized by provoked perforations, is very dangerous for the environment and for people's life in the region, total expenses generated by the effects of the provoked damages and needed for reparation being very high. This paper tries to present the evolution and characteristics of this phenomenon and the importance of prevention and monitoring.

Keywords: crude oil, illegal installation, perforation, orifice, provoked damage

1. A BRIEF INTRODUCTION IN THE DOMESTIC CRUDE OIL PIPELINE SYSTEM

S.C. CONPET S.A. Ploiesti is the National Crude Oil Common Carrier Company which operates a pipeline system and a railway system for the transport of the crude oil, the natural gas condensate and the liquid ethane to the domestic refineries in Romania.

The company operates a pipeline system of approximately 4500 km, with diameters ranging between 2 to 28 inches, several hundreds of railroad tankers, tanks for the storage of approximately 350000 tons of crude oil, pumping stations and related facilities, which are distributed among 25 operation and maintenance units.

The following subsystems are used for the transport of crude oil and petroleum products:

- domestic Pipeline Subsystem of approximately 2300 km total length, with diameters ranging between 2 to 14 inches;
- import and Offshore Pipeline Subsystem of approximately 1400 km total length, with diameters ranging between 12 to 28 inches;
- the Liquid Ethane Pipeline Subsystem of approximately 150 km length, with a diameter of 6 inches;
- the Natural Gas Condensate Pipeline Subsystem of approximately 550 km length, with a diameter of 6 inches;
- the Railway Transport Subsystem, which uses railroad tankers for the transport of crude oil and condensate.

2. TYPES OF DAMAGES IN PIPELINE SYSTEMS

As primary data, were retained the records from the each pipeline Evidence File, referring to all the damages occurred among the years 2000 and 2009. The respective damages occurred mainly either to the operation

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activity or because implying some accidental factors. The *exploitation factors* are the defects produced generally due to a long term operation that generates the material yielding by corrosion, erosion or as a result of an improper processing, like not synchronizing the pumping process, on-off operation systems, suddenly closing of valves etc., which, among others, produce supplementary pressure growths, resulting pipeline cracking or breaking. The *accidental factors* are the aleatory ones, following to some landslides and falling of ground phenomena in the pipeline proximity, because of floods, strong winds, earthquakes or as a result of unauthorized interventions on pipeline [1].

Considering the nature causes, the implied damages were grouped in two big categories, namely provoked and unprovoked damages.

Unprovoked damages, define those damages produced after a long exploitation under the corrosion-erosion phenomena.

Provoked damages are the damages produced by artificial causes (not authorized human intervention for stealing oil products). Therefore, as provoked damages could be mentioned illegal installations mounting or attempt of mounting on the pipelines system by practicing varied procedures (perforation and welding), in order to steal oil products from an operated or none operated pipeline.

In this paper are treated only the provoked damages to the oil ducts, which are characterized by the following parameters:

- the number of orifices caused by provoked perforations;
 - the diameters of the provoked orifices;
 - the county in which the provoked damage was occurred. Domestic Crude Oil Pipeline Subsystem crosses 24 counties in Romania;
 - the amount of oil drained from the pipeline because of the provoked damage. It represents the total quantity of the drained oil – due to a provoked damage – until reparation, in which is not included the amount of crude oil stolen over time by the help of hand-made equipment's;
 - the land area infested by the leakage of crude oil, due to the provoked damage. It represents the area of land contaminated with crude oil, due to a provoked damage to the pipeline. The land infested with crude oil shall be removed and stored in special arranged facilities or shall be treated by special procedures and given back to agriculture;
 - total expenses generated by the effects of the provoked damage occurrence and needed for reparation.
- It includes the cost of the crude oil amount lost due to the damage, the cost necessary to repair the provoked damage and the cost of giving back to agriculture of the infested land.

3. SOME INTERPRETATIONS AND DISCUSSIONS REGARDING THE PROVOKED DAMAGES IN THE DOMESTIC CRUDE OIL PIPELINE SYSTEM

In order to highlight the characteristics of the phenomena and processes of delivence, was developed the graphic representation of the registration data. Such representations contribute to a first and visually intuitive interpretation of the data and often they suggest law itself followed by the studied phenomenon. Graphics representations, for the quantitative characteristics have been designed in relation to a rectangular system of axes, the selection of measure units being arbitrary, depending on the data and parameters represented, so that the graph is proportional to the area represented, in order to facilitate conclusions obtaining. As a way of representing, according to data values and parameters concerned, histograms and/or representations in bars have been chosen.

During the period between the years 2000 - 2009 (Figure 1), in the Domestic Crude Oil Pipeline System was registered a total number of 1 366 provoked damages, corresponding to a number of 1 642 provoked orifices [2]. On abscissa axis were represented the years of provoked damages occurred, and on ordinate was represented the number of provoked damages/corresponding orifices, as a way of graphically illustrating, being preferred the histogram.

This unprovoked damages/corresponding orifices are assigned on each transporting pipeline subsystem, as is presented in Figure 2:

- Domestic Pipeline Subsystem: 453 provoked damages and 507 corresponding orifices;

- Import and Offshore Pipeline Subsystem: 478 provoked damages and 688 corresponding orifices;
- The Natural Gas Condensate and the Liquid Ethane Pipeline Subsystems: 435 provoked damages and 447 corresponding orifices.

On abscissa axis were represented the years of provoked damages occurred, and on ordinate was represented the number of provoked damages on each subsystem, as a way of graphically illustrating, being preferred the histogram.

Analyzing the resulting histograms (Figure 1 and Figure 2), the followings could be noticed [3]:

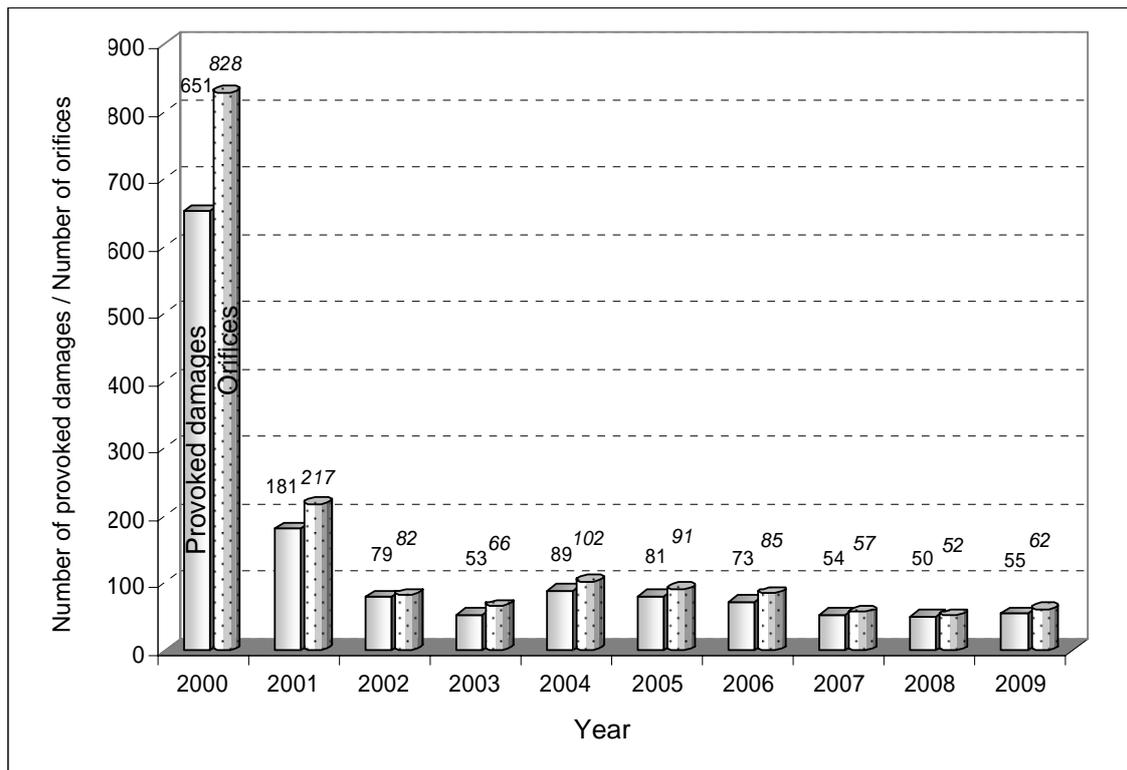


Fig. 1. Provoked damages and orifices situation during the years, for the Domestic Crude Oil Pipeline System.

In 2000 year, the number of provoked damages (651) and the number of corresponding orifices (828) are very high compared with the corresponding figures of the other years. This is explained on one hand, by the fact that delinquency phenomena was much diminished – since 2000 – as pipelines started to be in the custody of guard companies or police and, on the other hand, by legislation strengthening, which discouraged oil thefts attempts from pipelines.

In some counties like Constanta, Dambovita, Olt and Prahova, in the period of 2000 – 2009 years, occurred the most unprovoked damages, compared to the other counties. Explanation of damage occurrence mainly to certain areas crossed by the pipeline, in case of provoked damages, is given by the fact that in those areas, there are large urban agglomerations (prevailing in Constanța, respectively Bucharest), where the probability of existence of qualified personnel is higher.

In the sectors of activity of CONPET which contains dense pipelines networks, where the areas related to these pipelines are much more controlled, because of the near routes, the number of provoked damages attempting to the integrity of the pipeline is lower.

The number of perforations of the provoked damages varies between 1 and 2, for each fault in part and the orifices diameters varies between 4 and 72 mm.

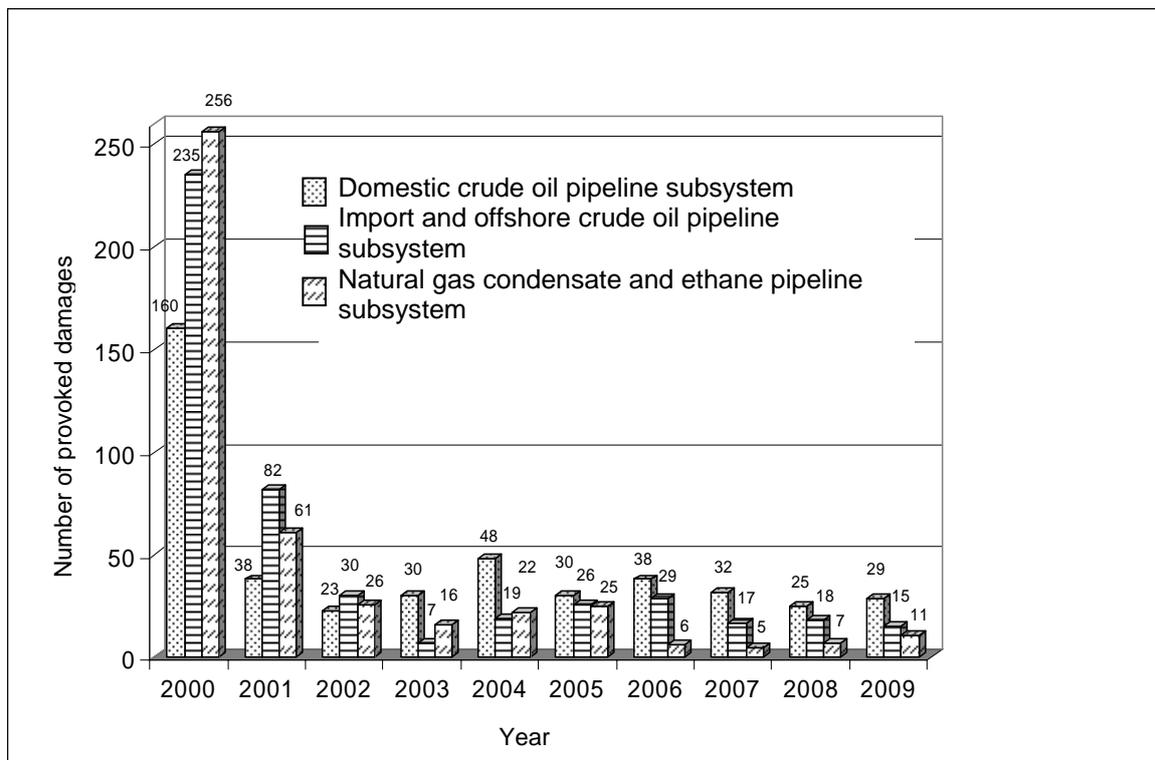


Fig. 2. Provoked damages situation during the years, for the Domestic Pipeline Subsystems.

4. CONCLUSIONS

Generally, in unauthorised interventions on the pipeline with the scope of stealing oil products, the thieves remove the visible signs in the region of the pipeline which could be discovered by the guard companies or monitoring personnel (crude oil traces, paths, tyres traces etc.).

The uncovering of illegal handmade installations, which are usually buried, is very difficult, the end of installation being localized at distance in the case of metallic illegal pipes. The variation of the flow and of the pressure in the piping system is very low at the moment of crude oil stealing, due to the small quantities relative with the transport capacity of the system and the monitoring instruments cannot register them. The methods used to discover these illegal handmade installations are the continuous monitoring (patrols and/or sensors) and the intelligent pig inspection.

In many cases, the mounting and operating of these kind of illegal installations occur accidents (explosions, fires, intoxications) which could provoke loss of life and could affect the environment. In all of these cases, the amount of oil drained from the pipeline, the land area infested by the leakage of crude oil and the total expenses generated by the effects of the provoked damage occurrence and needed for reparation depends also on the following factors:

- the value of the operating pressure in the affected section of the pipeline;
- the interval of time in which the provoked damage is observed and the pumping is stopped;
- the interval of time necessary for the maintenance team to move to the location, to localize the damage and to repair the pipeline;
- the soil composition and permeability;
- the geoclimate conditions and the geotectonic of the region etc.

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