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AUTOMATIC SYSTEMS FOR SUPERVISING THE TECHNICAL MANAGERIAL ACT

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Abstract: Nowadays, the technological assistance of the manager by totally or partially automated systems (like SCADA), the automation, at least partial of dispatching (process management), the need for real-time cooperation, extended communication in networks of an always variable complexity, form and structure, multitasking activities define and determine the managerial capacity. At present, intelligent, redundant and programmable equipment communicates the necessary measure or decision to be taken before the person has taken note of all aspects of the problem. Currently, the well-known logic blocks of the "if"..."then" type extend the manager's capabilities beyond the natural human limits, lowering costs, optimizing processes and sometimes avoiding disasters. We all intuit the effects of launching an order to start the pumps and raise the pressure in a pipe that, from an unpredictable reason, is being sectioned by a valve... By automation we mean the use of a computer to perform a "critical time" task that a person would normally perform. In 1951 the psychologist Paul Fitts proposed the famous MABA-MABA list (Men Are Best At - Machines Are Best At). Dewhurst and Willmott (2014) observed that: "After years of promise and hope, machine learning has at last hit the vertical part of the exponential curve. Computers are replacing skilled practitioners in fields such as architecture, aviation, petroleum geology — and changing the nature of work in a broad range of other jobs and professions.

Keywords: complexity, human capacity, management, pipe, programmable devices, technological

1 INTRODUCTION

Consistently demonstrated, the transport of hydrocarbons through pipelines is the most economical, fast and fluent (uninterruptible) way of transporting such fluids between producers and processors or end users.

In our country, amid the downward trend in domestic oil production, we are witnessing, in a directly dependent relationship, the corresponding reduction in volumes from the exploitation of domestic deposits, transited through main pipelines, partially offset by the increase in volumes imported for refining.

But regardless of whether millions of tons or tens of thousands of tons are transported in a given time frame, the process itself (disregarding the negative connotations of the associated technical and economic performance) proceeds identically. The same hard work carried out 24 hours a day, the same just-in-time concept applied to the relationship with the beneficiaries of the services provided, the same process conditions generated by external factors, natural or technical-technological, objective or subjective, positive or negative the proper functioning of the transport system as a whole.

Obviously, the modern supervision and management of the process presupposes the existence and use of contemporary SCADA type technical means, capable, on the one hand, to ensure the optimal operation of the managed pipeline transport system, and on the other hand, to operatively identify irregularities and deviations. from the normal pumping regime by the inter-related interpretation of the specific own parameters and of the physical-rheological characteristics of the transported fluids, providing to the highly qualified personnel the information and the means necessary to adopt the most efficient and opportune decisions.

Not always, but fortunately, more and more rarely, the alterations of the normal state in the development of the pumping process are generated by technical failures. Human aggression, whether intentional or not, on the main pipeline transport system generates major negative consequences of an economic nature, sometimes affecting major environmental factors.

As a result, the in-depth knowledge of the manager and correct interpretation of the particularities of the system "transport pipelines / external factors / characteristics of transported fluids" can be a decisive element in limiting, if not eliminating both the causes and especially the effects generated by environmental aggressions. or human ones on an essential component of Romania's concept of energy security.

2 OBJECTIVES OF THE PAPER

From an overall view of what we call management today, human history shows us - although it only recently acquired this scientific name - the fact that the manager (no matter how they were referred to) was endowed with a number of clearly superior abilities that allowed them to achive more efficiently, faster and more accurately the proposed target, compared to the rest of the population. In a modern interpretation, they have the ability to achieve the intended goals with maximum efficiency, while saving financial, material and temporal resources.

From such a perspective, I propose to analyze the way in which the technology combines and determines definitively the technical management applied at the level of oil and natural gas transport companies through main pipelines in Romania, using as research methods the collection of data on statistical bases, the compilation of tables with historical records, respectively the quantitative-qualitative analysis of the information held.

Monitoring the evolution of phenomena, optimal operational decision requirements and qualified technological documentation can be ensured by a high-performance manager based on the use of the advantages offered by SCADA, Leak detection in dynamic or static mode and Intelligent Pipeline Pig.

In this paper are analyzed the components of a SCADA system that can be adapted to the proposed sector of activity, as well as the implementation algorithms and subsequently, the evaluation criteria of the obtained performances. The role of this implementation should allow for increased operational safety, higher quality parameters and a much lower cost than current implementations.

A project in which the management, control and automation of production infrastructure aim to optimize the operation of equipment in safe and reliable conditions involves the implementation of a centralized system for collecting and storing all production data, managing alarms in technological facilities, remote controls for automated field equipment and real-time reporting through:

- Single dispatching for Production Branches,
- Real-time monitoring, control and reporting,
- Increasing the quality of services, transparency in data transmission and retrieval for all categories of technology locations;
- Commercial optimization;
- Increasing the availability of production capacity.

Real-time monitoring and issuance of balances involves expanding the capacity of data networks; diversification of internal electronic services; modern concepts for monitoring the quality of data transmission; centralized configuration and cyber security; digital transformation by increasing security through hardware upgrades and implementation of new communication protocols as well as increasing electronic data flows compared to the classic ones.

In evaluating the architecture of an automation and management system, the competitive, immediate and future advantages must be taken into account, taking into account: operational safety; investment cost; installation cost; total cost including equipment maintenance and operation; the financial benefits obtained; the non-financial benefits obtained; system scalability; adoption by other companies; open architecture; compatibility with other systems; flexibility in choosing intelligent interfacing devices; staff maintenance and training costs; support for future application extensions; ease of changing configuration.

3 CASE STUDY - CONPET S.A.

In a first stage of the approached approach, it is necessary to expose the place and the role of CONPET S.A. in the global architecture of the domestic oil industry.

CONPET S.A. is the operator of the National Petroleum Transport System, as defined and regulated by Law no. 238 of June 7, 2004 - Petroleum Law, as well as the Methodological Norms for the application of the Petroleum Law approved by GD no. 2075/2004.

As a concessionaire of the National Crude Oil Transportation System, CONPET S.A. has a legal obligation to ensure that all applicants, legal entities, have free access to the available capacity of the system, on equal terms, in a non-discriminatory and transparent manner.

As a consequence of the specific distribution of oil fields in Romania, the National Transport System was built and operates so as to fully meet the transport needs of all these fields to refineries, the coordination and operation of the system being carried out by the Central Dispatch Office. of the Company, represented territorially, depending on the needs dictated by the configuration of the system, including in the form of local dispatchers.

In a sequential view, the distribution of the transport infrastructure by subsystem is as follows:

a. The country and condensate crude oil transport subsystem includes pipelines with a total length of 1,540 km, respectively storage capacities (related to pumping stations) of approximately 126,000 m^3;

b. the subsystem for the transport of gasoline and liquid ethane includes pipelines with a total length of 921 km, respectively storage capacities (related to pumping stations) of approximately 663 m^3;

c. the import crude oil transport subsystem includes pipes with a total length of 1,348 km, respectively storage capacities (related to pumping stations) of approximately 40,000 m^3;

d. the rail transport subsystem for the transport of crude oil and gasoline.

At present, CONPET S.A. operates on the basis of the oil concession agreement, a pipeline transport system with a length of 3,809 km, of which 3,161 km (83% of the total) are actually used to transport crude oil, gasoline, condensate and liquid ethane.

Against the background, the overall reduction of the activities carried out by the industrial operators within the national economy, respectively, in particular, those of the oil industry, today only three refineries operate [Petrobrazi, Petrotel-Lukoil and Petromidia, noting that in in the latter case, the quantities of crude oil transported are negligible, the refinery having its own offshore marine terminal] of the nine refineries previously served by CONPET SA [being closed Arpechim Refineries, Rafo Onești, Dărmănești, Suplacu de Barcău, Astra, Steaua Română which led, in turn, to the cancellation of the volume of transport services provided by the sole operator CONPET SA]), the degree of utilization of the transmission system shows a drastic decrease compared to the nominal capacity, being stabilized at 21.6%.

Consequently, the current pace of pipeline replacement is determined by the need to maintain, in optimal conditions, the sections with the highest degree of use, as amended by the technical conclusions drawn from their internal inspection activities, by statistics and the aggressiveness of technological and caused damage.

At the same time, the modernization of the system was carried out on the IT dimension. Thus, on an IT infrastructure built on the Microsoft platform, CONPET S.A. has implemented the ERP system, a platform that provides data exchanges in a unified framework, a unified interface for development, a high level of accessibility, high productivity through flexible adjustment of data updates and a wide range of data exchange interfaces.

At the same time, the automated assistance of the operation of the transport infrastructure is ensured by a SCADA system composed of a central dispatcher, 16 local dispatchers and 14 unmanned stations, being realized the real-time monitoring of the transport parameters, as well as the remote control of this trial. The existing SCADA system is MicroSCADA 8.4.3, produced and installed by ABB ENERGY INFORMATION SYSTEMS GMBH Germany. The hardware on which the SCADA System is installed in the Central Dispatch Office consists of five Base System 1 and 2 (redundant) servers, Frontend 1 and 2 (redundant) and a Remote Access Server.

In order to optimize the core business, within CONPET S.A. complex multi-annual modernization programs are underway, mainly aimed at:

- reducing operating costs and increasing operational safety (for example, by implementing a leak detection and leakage detection system; upgrading the cathode protection system; upgrading the SCADA system);
- reducing technological consumption in the storage and transport process (for example, by implementing a phased rehabilitation and resizing program for transit tanks in accordance with the quantities to be transported);
- increasing revenues by increasing the amount transported and identifying other related income-generating activities (eg, rental of storage space, maneuvers in the CF area, rental of railway infrastructure, atypical transport of crude oil and petroleum products).

In order to prevent further accidental pollution, an automatic pipeline leak detection system is being implemented, which will notify the Central Dispatcher in real time of the existence of an unauthorized damage or perforation of the pipeline and indicate its location, in the purpose of the operative movement of the intervention teams to stop the fluid losses.

To prevent the corrosion effect regardless of the type of fluid transported, the crude oil, ethane and gasoline pipelines are protected in combination, in the sense that the protective coatings (insulations) are doubled by the cathodic protection effect. CONPET S.A. has located on the route of the main and local pipelines, respectively, 218 cathodic protection stations.

As short-term effects are expected to increase the efficiency of the National Oil Transport System, highlighted by:

- improving the measurement of the quantity and quality of crude oil transported;
- reduction of crude oil and transported products;
- reduction of energy, fuel and lubricant consumption;
- reducing costs and operating problems;
- improving the reliability and flexibility of technological installations;
- minimizing the negative impact on the environment.

Continuing to expand the perspective from which we look at the company by considering the inputs received by CONPET S.A. from the national external environment, we notice, in a first phase, the advantage conferred by the position of natural monopoly. However, by operating a pipeline network isolated from that of neighboring States, CONPET S.A. it is effectively dependent on the evolution of the internal market (below the dimensions of hydrocarbon extraction and refining), being a captive service provider for a small number of customers. To this risk are added those of a political and regulatory nature, being similarly exposed to other state-owned companies.

The major dependence on a single large customer (OMV Petrom) is a considerable risk (revenues from the transportation of domestic crude oil have a share of about 75% of total revenues) but fortunately it is reciprocal, inducing at least relative stability, but which does not remove the instantaneous reflection, in the current activity indicators, of the evolutions of its clients.

Thus, CONPET S.A. recorded a decline in activity and revenue due to events in the sector:

- the closure of the Arpechim refinery, owned by OMV Petrom, a situation that eliminated the need for imported crude oil from the above-mentioned company, implicitly from crude oil transports, which led to the absence of pumping programs on the route Constanța - Călăreți - Arpechim;
- Petromidia refinery built its own marine terminal, which significantly reduced the quantities contracted with CONPET SA, and, as a result, the capacity utilization of the OIL Terminal - Petromidia pipeline decreased from 58.1% in 2008 to 2,24% in 2018, so that it is currently a subunit;
- the cessation of the activity of the RAFO Onești refinery, respectively the emptying of the dowry of the Ø 20” Bărăganu-Onești pipeline, brought the respective section into disuse, simultaneously with the cancellation of the utility, on this dimension, of the Bărăganu pumping station activity.

Currently, PETROTEL LUKOIL S.A. is the main user of the import crude oil transport subsystem, with modest requests from OMV Petrom and Petromidia. However, the steady increase in the quantities transported for the benefit of OMV Petrom over the last two years should be noted, but unfortunately this increase does not add up to a constant increase in the quantities transported in the domestic, country, This is a permanent and perennial decline - with about 200,000 tons of crude oil / year - mainly due to the non-compensation, by specific methods, of the natural decline of the hydrocarbon deposits, almost entirely mature, of Romania. investment effort estimated at 20-35 billion euros by 2030).

In conclusion, CONPET S.A. it is dependent on the level of crude oil processing in Romania, not being interconnected externally. The significant risk is a reduction in the amount of crude oil transported as a result of a reduction in the amount of crude oil imported from refineries, which makes the utilization of the import subsystem below 10%. Consequently, in the absence of an interconnection of the National Transport System to other transport networks outside Romania, there is a dependence on the realization of the programmed revenues compared to the decisions of the companies involved in crude oil processing in Romania.

The same negative estimate can be associated with the evolution of the transport of crude oil products from the country (gasoline and ethane) which, as a result of the restructuring of the petrochemical industry in Romania, decreased sharply, without any indication of a possible revival, which influences negatively the degree of utilization of the subsystem related to these products.

Under the conditions - estimated - of maintaining or moderately increasing the consumption of crude oil in the medium term, respectively, taking into account the fact that, at a current share of imports of 20-30% of domestic demand for hydrocarbons, Romania's relative energy independence is likely to decline, forecasting a 40-50% increase in imports by 2030 due to higher primary energy demand and the natural decline in domestic hydrocarbon production, which can be a real advantage for the lines. (at least on the route Constanța - Călăreți - Ploiești), whose degree of use will increase in direct proportion.

4 AUTOMATION SYSTEM AND SCADA

Objectives and means of implementing the Automation and SCADA (Supervisory Control and Data Acquisition) System within CONPET S.A. are specific to the general rationale behind the adoption of a decision accordingly, namely:

Objectives:

- optimizing system performance;
- achieving a maximum level of process control;
- minimization of operating errors;
- minimizing losses;
- ensuring the intervention of the coordinating operator;
- providing a high degree of security and flexibility;
- minimizing effort and billing time;
- optimization of transport costs.

Means:

- operation of the pipeline network as closed as possible, at maximum hydraulic efficiency;
- creating adequate support to increase the ability to identify and correct unsafe and abnormal operating conditions;
- preventive maintenance of the system by identifying the inaccuracies of the equipment and the erroneous operation of the equipment;
- issuing comprehensive and flexible reports for operational, engineering planning and management needs.

The overall configuration of the SCADA system supported the following steps:

- establishing the location of the main station and the central processing unit (Central Dispatch Office of CONPET S.A.);
- determining the location and number of main substations;
- establishing the location and number of remote terminal units (RTUs) related to the location points;
- setting the interfaces (MODEM) and the type of telecommunications network, transmission medium, channels;
- elaboration of the block diagram of the SCADA system;
- preparation of specifications and data sheets for equipment (hardware) and programs (software);
- drawing up specifications for remote terminal units (RTUs).

The local automation system has been installed at certain points in the crude oil and gas pipeline network, namely in:

- pumping stations;
- measuring installations;
- line tap stations;
- reception stations (delivery points at refineries);
- loading and unloading ramps.

The Local Automation System permanently communicates with the Control and Command System and transmits operating data from local devices through the SCADA system, using the related two-way telecommunications network.

The control system operating mode for each station has been designed to operate in three ways:

- manual remote monitoring (central dispatching station). Manual remote monitoring ensures:
- commands to close a station with line valves;
- station stop / start commands;
- flow and flow pressure setpoint adjustment commands;
- emergency stop command.

In this mode of supervision, no local command can be executed except for emergency closure under critical conditions.

- local automatic. In Local Automatic mode, all setpoint and control adjustments are made through the local control system. With the exception of shutdown commands in response to critical conditions, the station control system does not accept any commands from the central station via SCADA. Local emergency shutdown (ESD) remains operational.
- local manual. In Local Manual mode, the commands are made exclusively by the operators, in the installation, from the control buttons, the manual wheels of the valves, etc. Local emergency shutdown (ESD) remains operational.

Their selection is made locally, the three modes being mutually exclusive, the chosen mode being communicated to the central dispatching station, at any time.

The main tasks of the Local Automation System are: measurement; digital control; adjustment; calculation-processing; monitoring; reports / database organization.

The measurement consists in adapting and processing the signals from the flow, temperature, pressure, etc. transducers. installed on the piping system. The devices have been chosen for easy operation, maximum accuracy, minimal maintenance and modern verification technologies.

Basically, the direct flow measurement systems of crude oil quantities consist of the metering skid. It is a set of tools mounted on a platform (skid), with the role of giving as little error as possible to the final indication of the quantity delivered to the beneficiary of transport services. This requires certain technical performance, in particular as regards the accuracy of the measurement that these instruments must meet, in order to be able to use the data indicated for the tax return.

These tools are spread over one, two or even three runs (branches representing flow paths) of the same skid. Measurement, adjustment and execution elements, already largely supplied, are of the following categories:

- valves with / without signaling contacts;
- protection valves;
- flow control valves;
- isolation valves;
- volumetric meters and flow measuring turbines;
- temperature and pressure indicators and transmitters;
- impurity analyzers ("crude oil" type);
- densimeter;
- sample extractors;
- electronic cabinets for collecting and processing the values measured by the components of the skid;
- flow computers and logical interfaces.

The Remote Terminal Units (RTU) form the first interface for connecting the Local Automation Systems with the Control and Command System in the main dispatching station, through the telecommunications network.

The first objective of the Remote Terminal Unit of a station is to receive data for process equipment through the Local Automation System, form data to be transmitted through the telecommunications network to the central dispatcher, data that are interpreted, resulting in commands to be transmitted from the central dispatcher to equipment in the operating field.

Operators have access to the process through process displays, which allow them, for example, to start or stop the pumps in the pumping stations.

As a matter of principle, if the number of input / output (I / O) signals allows, a single RTU fully performs the necessary control functions. Additional RTUs have been installed in stations where input / output signals and logic control requirements exceed the capacity of a single RTU. These secondary, subordinate RTUs can collect data and control a single object or group of objects, so that the data acquisition and control functions can be distributed within a particular station, as follows:

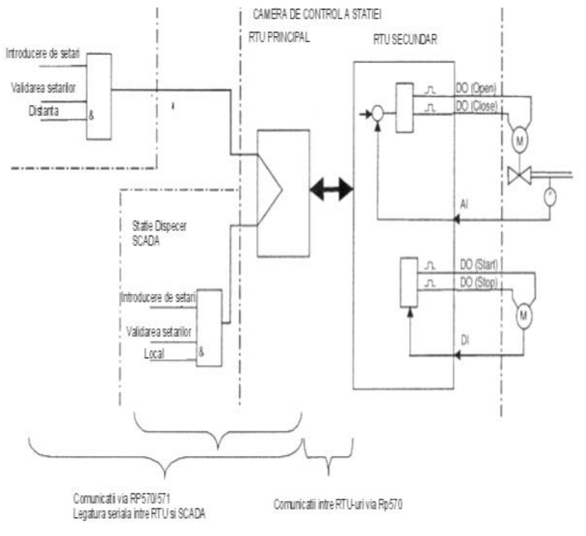

Figure 1. Data acquisition and control functions specific to a complex SCADA station

Overall, the Management and Control System includes functions of:

- data acquisition;
- warning and driving in case of alarm situations and events;
- data validation;
- display of parameters;
- trends of parameters / situations;
- provision;
- system surveillance;
- maintenance;
- control of the statistical process;
- execution of application programs;
- system configuration;
- process management;
- archiving.

The Management and Command System has the following hierarchical control architecture:

1. Dispatcher Central Station - Central Dispatcher;
2. Dispatcher substations - local dispatchers;
3. Local automation - local automation stations.

If the station has operational staff and is equipped to provide all monitoring and complete control operations, it is considered a substitute dispatcher.

If the staffed station provides all its own full monitoring and control operations, as well as those of other nearby stations without staff, the station is considered the main substation dispatcher.

The important stations or installations in the crude oil, gasoline, ethane or condensate transmission network are equipped with RTU, and the control and monitoring of the process is done through the local automation stations.

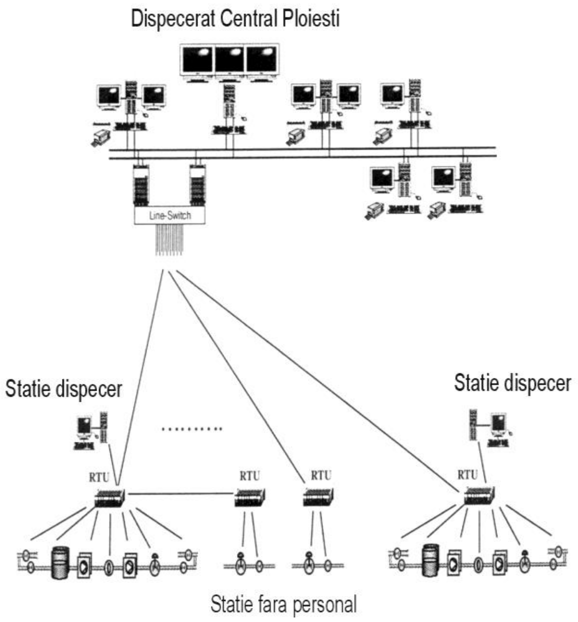

Figure 2. The hierarchical structure of principle for SCADA CONPET

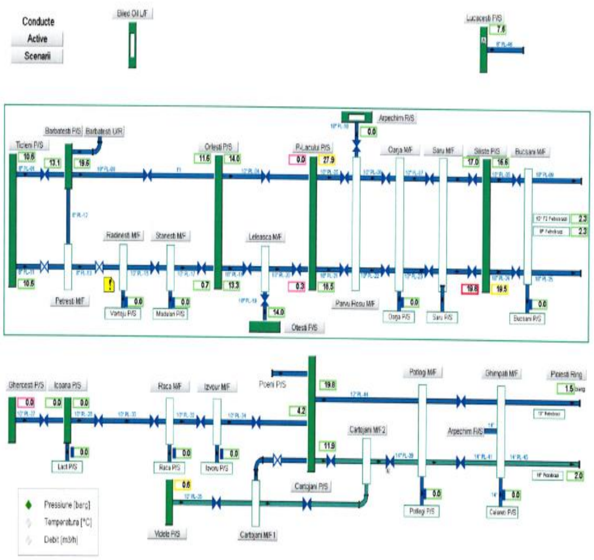

Figure 3. SCADA CONPET system – country

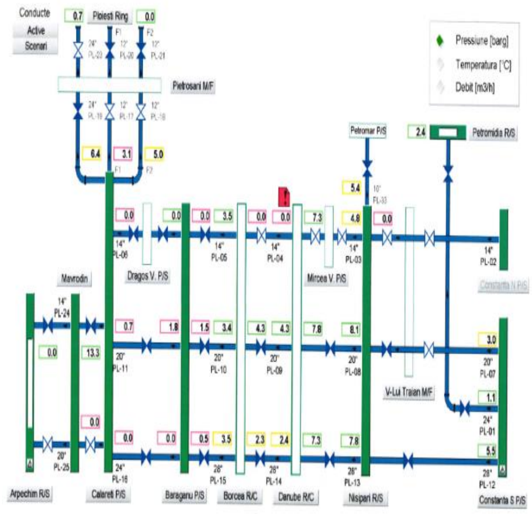

Figure 4. SCADA CONPET system - import

As a subcomponent of the Management and Command System, the Management of the Control System consists of two main parts: the Supervision, Control and Data Acquisition (SCADA) system and the Support and Process Optimization functions, the latter allowing, among others, through Pipeline Application Software, operative processing of events and alarms.

The realization of the project "Optimization of the SCADA system, hardware and software upgrade of the data transmission and automation system" aims to:

- Safe and stable operation of the oil transport system, without blockages and delays;
- Updating the SCADA monitoring and control system with the optimized technological schemes of the pumping stations (pipes and tanks);
- Updating process and instrumentation documentation (PFD, P&ID);
- Optimization of maintenance and subsequent configurations due to the hardware components available on the market, as well as the possibility of remote diagnosis and configuration;

- Implementation of a Historian type recording and reporting system that allows obtaining detailed information regarding process data, for an extended period of time;
- Improving the training of dispatch operators by creating a cabinet dedicated to this process;
- Increasing the security against the penetration of the SCADA system.

4.1 Leak detection in dynamic mode

Leak detection is based on the Dynamic Response Averaging and Persistence Compensation (DRAP) method. Pipeline modeling, together with process measurements, forms the basis for calculating leak detection. It uses the following methods based on a dynamic model: unexpected flow rate (UF), unexpected pressure UP.

Leak detection results, events/ alarms from dynamic modeling are transferred to the MicroSCADA database to be presented to the operator.

The data is accompanied by a status definition and a time label:

- alarm system indicator;
- leak alarm level;
- estimated size of leaks;
- estimated location of leaks (minimum / maximum distance from pumping / receiving points).

4.2 Static leak detection

This module detects leakage from isolated pipe sections without flow and is used for small leaks, which depend directly on the mass estimated to be in the pipe and on the modeling of the mass in that section.

The detection of leakage produced in static regime presupposes that the analyzed pipe section is closed and the immobilized crude oil supports a stabilization period. After the stabilization period, the static leak detection module may initiate the calculation of the initial reference mass based on:

- real-time pressure measurement in the pipe section;
- simulated temperature profile in the pipe section;
- the equation of state for liquids.

5 INTELLIGENT PIPELINE PIG

In the background, but without giving it less importance, we find the widespread use of non-destructive control techniques - in-line inspections of oil pipelines, a technique that can provide the network manager with the most important information that indicates the status and the ability of the system to meet the demands at the designed level, namely the integrity of the pipelines.

CONPET SA promoted the internal inspection for the first time in 1998 for the pipes that cross the Danube and the Borcea arm. In the following years, the internal inspection was extended to almost all main pipelines belonging to the import crude oil transport subsystem and to main pipelines belonging to the internal crude oil transport subsystem, accumulating a total of 1913 km.

In table 1 is the history of the internal inspections carried out so far.

Following the inspections, several types of defects were identified, mostly typical of long-lasting transport pipes and whose original exterior insulation (bitumen + fiberboard / PVC tape) lost adhesion for various reasons. Thus, following the field verifications, corrosions with singular / pitting or generalized metal loss / corrosion groups were visualized.

In addition, both anomalies of the inner diameter (blows; wrinkles, ovalizations), defects assimilated to cracks - laminations and combined defects were identified and visualized.

Table 1 - History of internal inspections carried out by CONPET SA

Pipe	Length [km]	Inspection period	Pipe age at inspection date [years]	Instrument/ Technique
12” Dunare & Borcea	36	1998-1999	30 / 20	UT
10” Barbatesti - Ploiesti	248	2001-2002	32	MFL
12” Dunare & Borcea	36	2008	40/30	UT (re-inspection)
20” CT-Pitesti	318	2008-2009	39	MFL
14” CT- Pitesti	278	2009-2010	40	MFL
28” CT-Baraganu	89	2011-2012	22	MFL
24” Baraganu-Calareti	89	2011-2012	25	MFL
12” Calareti-Ploiesti x2	144	2011-2012		MFL
10” Barbatesti-Ploiesti x 2	361	2013-2014	45	MFL (re-inspection)
12” Dunare & Borcea	36	2015-2016	47/37	MFL+UT (re-inspection)
14” CT-Pitesti	278	2015-2016	46	MFL+UT (re-inspection)
12 ¾” F1 și Ø 12 ¾” F2 Călărești PETROTEL	144	2019-2021	35	MFL+UT (re-inspection)

In addition to replacing the affected pipe segment, some of the structural repair methods were used (according to PRCI Industrial Recommendations Pipe Repair Manual, Catalog No. L52047, PR-186-0324, August 8, 2008): cutting, type A sleeve, compression sleeve, type B sleeve, composite sleeve, welding filler, screw clamp and gasket, hot cut.

Image 1 - Generalized pitting located in the upper part of the pipe - totally destroyed external insulation (temporary repair)

Image 2 - Pitting insulated in the lower part (6 o'clock), apparently good insulation (brittle with light mechanical action)

Image 3 - Corrosion group, on the whole circumference, partially destroyed insulation (repair with composite sleeve)

Image 4 - Rolling with extension to the outer surface 30 mm + corrosion (removed)

Image 5 - 2-plane deformation (mechanical stress) – removed

Image 6 - Generalized corrosion with helical bead damage (removed by replacement)

Evaluation of the corrosion growth rate based on multiformat data:

- Successive interior inspections
- Soil resistivity
- Positioning of cathodic protection stations

Following successive interior inspections can be determined by complex analysis and comparison:

- corrosion growth rates (indoor and outdoor)
- fit for purpose assessment (fit for purpose assessment)
- future integrity management / pipeline maintenance

Below are relevant data of the evaluation of the 10” Barbatesti-Orlesti oil transport pipeline, inspected in 2011 with MFL instrument - standard resolution and in 2018 with high resolution MFL instrument.

The synthetic results are presented in the table 2.

In the interval between the 2 inspections, 47.9 km of the total length of 72 km of the pipeline were replaced.

During the 2018 inspection, 23,742 individual defects with metal loss were reported compared to 51,778 defects with metal loss at the previous inspection in 2011. The significant decrease in the number of reported defects is considered to be associated with extensive replacement works that were performed on this pipeline after the 2011 inspection.

Table 2 - Synthetic results of the 2 inspections

Event 2011	**Reported Number**	**The Deepest Defect**	**Event 2018**	**Reported Number**	**The Deepest Defect**
Internal Corrosion	not	-	Internal Corrosion	208	63% wt
External Corrosion	51000	94% wt	External Corrosion	20,639	85% wt
Metal Loss - Manufacturing Defect	778	94% wt	Manufacturing Anomaly	115	35% wt
Constructive Defect	19	-	Manufacturing defect (cutting)	8	-
ID anomalies	1	-	Longitudinal Weld Anomaly	9	13% wt
Rolling	96	-	Irregularity of Longitudinal Welding	4	-
Patch repair	3	-	Circumference Welding Anomalies	108	68% wt
Total	**51,897**		Irregularity Circumferential Welding	92	-
			Coup	760	9.90%
			ID Anomalies	4	12.37%
			Rolling	160	-
			Gather	32	6.79%
			Repaired anomaly	13	-
			Patch repair	6	-
			Near Metal Obj	30	-
			Eccentric protector	12	-

From the point of view of internal corrosion, in the pipelines carrying liquid hydrocarbons are typically expected to be distributed at the bottom of the pipeline where it is possible to separate the free water from the water-in-oil emulsion. The distribution of internal corrosion does not suggest an active internal corrosion in the pipe associated with the accumulation of water, as long as all defects are randomly distributed on the circumference and along the entire length of the pipe.

The control of external corrosion is obtained, mainly, by the external insulations applied to the pipes, applied both in the factory and in the field (bitumen + PVC or HDPE strips, and for welding cold applied strips or heat-shrink sleeves). Field welded joints are insulated with cold-applied strips or heat-shrink sleeves, and cold-applied strips are used for local repairs.

5.1 Cathodic Protection System

The pipe is additionally protected with a Cathodic Protection System - Printed Current. CONPET uses the -850 mV / 100mV protection criterion changed to evaluate its performance. It is mentioned that the system has been malfunctioning for various periods of time.

Soil resistivity measurements are between 2.77 Ωm and 675.46 Ωm along the entire pipe; these values indicate that the aggressiveness of the soil, in the sense of corrosivity, ranges from low to extremely aggressive.

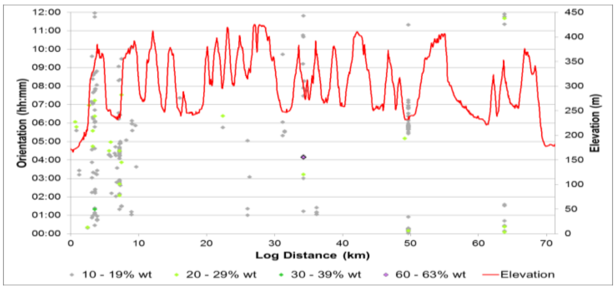

Figure 5. Distribution of orientation internal corrosion

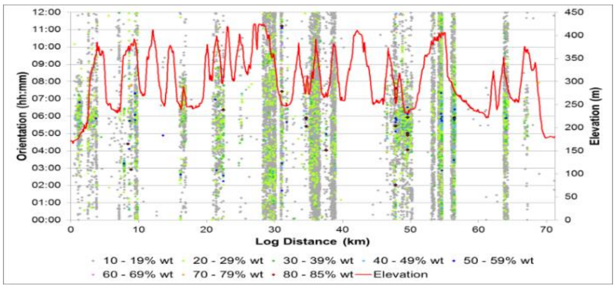

Figure 6 - Distribution of orientation external corrosion

The evaluation of the corrosion growth rates included 3 stages:

- Overlapping the defects identified by the 2 inspections and calculating the growth rate (apparent);
- Comparing the inspection signal and selecting the key reference defects;
- Resizing following data evaluation and inconsistency review (equalization and validation)

5.2 The conclusions were as follows:

For internal corrosion: it is within normal limits, not being an active phenomenon in this pipe. The areas with the maximum growth rate correspond to the topographic areas with sudden variations in height in which the stagnation of water contained in the transported product is presumed. Maximum growth rate of internal corrosion: 0.15 mm / year

For external corrosion: The corrosion rate assessment identified corrosion increases in several areas of the pipeline, both for existing defects and new corrosion defects with variable growth rates reaching a maximum of 0.56 mm / year.

It is noteworthy that the high growth rates of corrosion correspond to areas where soil resistivity measurements show high or very high aggressiveness.

Table 3. Soil resistivity km 15+400 – 15+800

Station no.	**Cumulative distance (m)**	**Apparent**	**Station no.**
308	15400,53	37,23	Normal
309	15446,97	23,56	Normal
310	15504,66	17,56	High
311	15559,69	11,57	High
312	15610,12	10,13	High
313	15657,62	8,70	very high
314	15702,28	8,24	very high
315	15750,10	7,79	very high
316	15796,73	9,28	very high

As such, we can conclude that internal inspection is the key method / technology currently widely used to maintain the integrity and safety of pipelines in the oil and gas industry. Repeating internal inspections at regular intervals provides pipeline operators with the information necessary to allocate effective resources to prevent new anomalies, and in the case of existing ones to detect and limit their extent, with direct results in reducing the number of technical accidents.

The inspection database, supplemented with complex reference data (soil and specific cathodic protection investigations, non-destructive / destructive field investigations, etc.) provides support to define safe and efficient operation, as well as a short-term plan. medium and long pipeline rehabilitation and repair.

6 CONCLUSIONS

Let us now consider, knowingly, what it would have meant to manage such a system without the advantages offered by SCADA and intelligent development. First of all, it would have required an army of personnel, well trained and constantly at every valve and every pump, ready to maneuver and start or stop them ... without mistake. Regardless of the season or the time of day. The same staff inflation must also establish, in the conditions of an accuracy that distinguishes between hydraulic efficiency and inefficiency (with direct influences on operating energy costs, therefore, on profit) the pressures - implicitly, the optimal flows. Without knowing the condition of the pipes, the degree of corrosion, the thickness of the wall, this is impossible.

By risking our predictions, it would become downright dangerous. A closed valve in the pump wire, a pressure above the resistance limit of the pipe wall, an incorrectly configured steering keypad would be nothing but a safe path to disaster, with all the negative technical, economic and environmental effects that result from this scenario. Nothing in line with the notion of efficient management.

However, fortunately, we are not in this situation, but in which automated and redundant systems exclude error, never get tired, allow the system to operate in the area of maximum hydraulic efficiency and, moreover, anticipate the investment work needed to increase degree of operational safety. We are in the age of human-machine coexistence, both intelligent in a compensatory and convergent way.

Despite all the progress made, not all activities can be fully automated yet, the chance of a certain unwanted event occurring and the severity of the consequences of the event must also be assessed by man, being necessary to have management schemes with "man in the loop", and human decisions must be evaluated.

The benefits of implementing a SCADA system prove to be:

- a stable industrial solution and fast technical support;
- flexibility in the further development of the system;
- centralized or remote control and monitoring;
- providing an easy mode of operation to users;
- rapid diagnosis of alarms and breakdowns;
- preventive maintenance (proactive actions);
- increasing the service life of equipment and machinery through proper operation (automatic operating mode);
- Optimization of consumption/ operational costs.

Given the fact that equipment and software in the IT industry have had and continue to evolve rapidly over the years of work in the oil sector, we know how crucial it is to respond quickly to system failures and potential failures to secure ourselves. assets. Being proactive rather than reactive is essential to maintaining our SCADA systems and making sure they work successfully. The life of the system must be at least 15 years. Thus, the chosen components must each have an estimated lifespan, under normal working conditions, of at least 15 years.

Once a SCADA system is implemented, operations can be monitored and controlled, and the system will provide information to maximize profit. Because SCADA is the center of opening, transmission, and distribution operations, people who use the information system can benefit from an overview of the site, system installation, and operation.

Because the implementation of a large-scale SCADA system involves very large investments, the problem of implementing such a system must be gradually conceived, the implementation of each phase must lead to a cash-translating benefit. Also, from the design phase, the possibility of extending the system must be taken into account, both in terms of increasing the number of measuring points and expanding the functionality of the system.

I appreciate that the management of the companies in the oil and gas industry must be convinced of the usefulness of introducing such a system by demonstrating the material advantages and the possibility of gradual implementation. Users may be reluctant to use a completely new system that they are not used to working with, so they need to be educated in advance of putting the system into operation. Also, with the introduction of new items, users need to know in advance what they are and what their role is. In a word: management and user education is the basis of the success of any SCADA implementation project.

Being one of the strategic objectives for ensuring energy security, sustainable development and competitiveness, the implementation of the SCADA system allows increasing economic efficiency in the operational management of the National Natural Gas Transmission System in Romania and the National Petroleum Transport System.

The digital transformation of oil and gas companies and the support of innovations to enable new ways to interact with customers, increase efficiency and support new directions of development will facilitate long-term and equally profitable relationships with the market and the social environment.

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