

Research and Development for monitoring and control system of Cryogenic Pilot Plant with “ virtual” simulation and data analyses process

CARMEN MARIA MORARU, IULIANA STEFAN, LIVIU STEFAN, CIPRIAN BUCUR,
OVIDIU BALTEANU, ANISIA BORNEA, IOAN STEFANESCU

Cryogenic Pilot Plant

National Institute of Research-Development for Cryogenic and Isotope Separation Technologies
CP 10, Str.Uzinei Nr.4, Rm. Valcea, Cod 240050

ROMANIA

<http://www.icsi.ro>

Abstract: - The software applications are executed with the support of the program packages dedicated to industrial processes and include acquisition and monitoring sub-modules, named “virtually” as well as the storage sub-module of the data analyses process, data later required for the software of simulation and optimization of the technological process for tritium removal. Research for monitoring and control of nuclear processes is also a major driving force for safety, economic and social development.

Key-Words: - control, monitoring, virtual simulation

1 Introduction

In this paper, state-of-the-art technologies are used along with worldwide developed software methods for the “ virtual” simulation and monitoring of nuclear processes relevant parameters, experiments being conducted on an already operating plant for tritium separation from tritiated heavy water. The implementation of new technologies, both software and hardware, for the tritium processing nuclear plants, and especially of those used for experimental purposes or for the development of new technologies, is rated as highly complex due to the problems implied by the implementation of state of the art apparatuses and equipments in a unit system which identifies the relevant parameters in a nuclear technological process of tritium separation.

To preserve the system flexibility stands for a requirement in experimental nuclear plants where it is common to change the configuration, the process and the monitored parameters. The large amount of data which needs being processed, stored and accessed for simulation and control requires the development of a support information structure for complex systems where the systems used for data acquisition and analysis of technological process be integrated into a technologically developed monitoring system.

The software development applications is created by way of the highly efficient equipments and software packages dedicated to industrial processes and incorporates dedicated sub-modules

for the acquisition of parameters together with the sub-module for process data storage, all used subsequently for the software application of optimizing and simulating the tritium separation technological process.

2 Research and development

2.1 Monitoring software system for cryogenic pilot plant

For accomplishing the monitoring and “ virtual” simulation system, the new and improvements LabView 8 software is used, with a very high complexity due to the issues raised by the integration of a great variety of instrumentation and equipment into a unitary control system. Integrated systems with mathematical simulations of the process are executed and simulated on software, all of which will be continued with the set up of the optimization system of the parameter monitoring system, by the methods adequate and applicable to the technological processes within the tritium removal plants.

The scanning of the measurement points on the plant is made with new Compact FieldPoint modules, and through the optimization of the monitoring system Real Time Module the process simulation system in case of emergency is set up; this system plays an important part in fighting the natural disasters and industrial accidents in normal operating and functioning.

We used the Labview 8 with Real Time Module for monitoring system which offers a friendly interface and many dialog windows with the operators from cryogenic installation. The instrumentation used for data acquisition system, realized in principal with Compact Field Point module is flexible with easy connection in data acquisition room from cryogenic pilot plant. In figure 1 is shown the cFP-AI-100 (Compact Field Point Module for voltage measurement).



Figure 1-Compact Field Point Module for data acquisition

The optimization and simulation will also include the control graphic part, which includes all the components monitored and surveyed during process, on-line in real time. Mainly, the process simulation is monitored in the detritiation units, where the isotopic exchange reaction and the tritium separation factor is defined, as well as the basic equations of isotope separation.

2.2 “Virtual” simulation of processes

A performed element in this monitoring system is the introduction into the data acquisition system of a simulation part in which the main elements in the process will be monitored, in order to optimize their functioning in case some faults appear, and to identify faulty field elements. For example we can simulate the functioning of the compressor with all components and valves. In figure 2 is shown the simulation system for compressor automation.

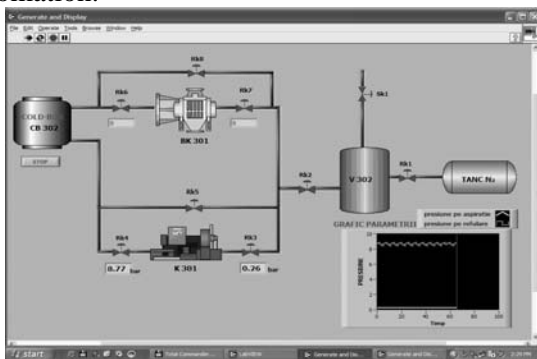


Figure 2 – Virtual simulation for compressor automation

We diagnose and solve control-related process performance problems, and monitor, improve and optimize industrial processes from cryogenic pilot plant by first gaining an in-depth process and operational understanding. Was applying various techniques, such as optimal controller tuning and controller performance monitoring, off-line or on-line multivariate statistical analysis, statistical process control, and plant historical data acquisition, analysis and reporting using high-level tools. In figure 3 is shown the capture screen of simulation system in LabView for isotopic exchange column from tritium removal plant with processes analysis.

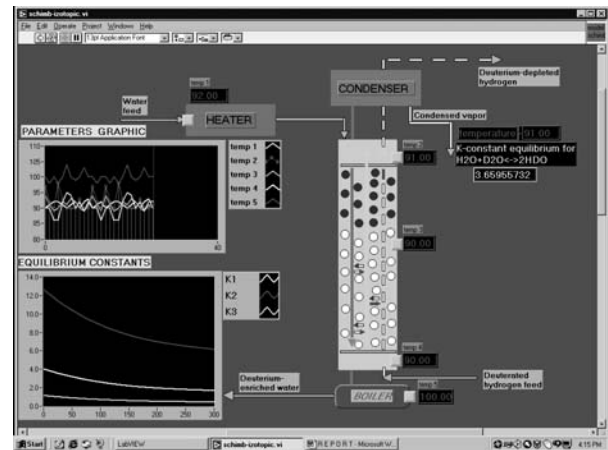


Figure 3. Simulation for isotopic exchange column – data analyses process

3 Futures Works - data analyses process in Labview 8

The system will also include the software developed for mathematical modeling with the monitoring of all parameters and process analysis software for the main modules in the tritium processing plant.

In Figure 4 is presented the starting of mathematical model for tritium removal process, which means the graphical representation of Entropy function by temperature for cryogenic distillation module from tritium removal installation.

The new software in LabView 8 with Real Time module and Compact Field Point modules will be effectively verified on an existing plant, by simultaneously checking the parameter values (classic system – optimizing software system of the process and of the relevant monitoring system). Security and monitoring system is connected to the controlling system from control

room in tritium removal pilot plant. The main function of this system is to monitor all parameters in installation.

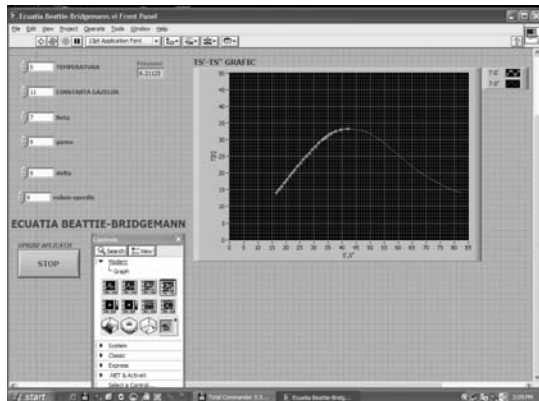


Figure 4. Mathematical model for tritium removal installation

In figure 5 is presented the diagram block with the virtual security system and monitoring system.

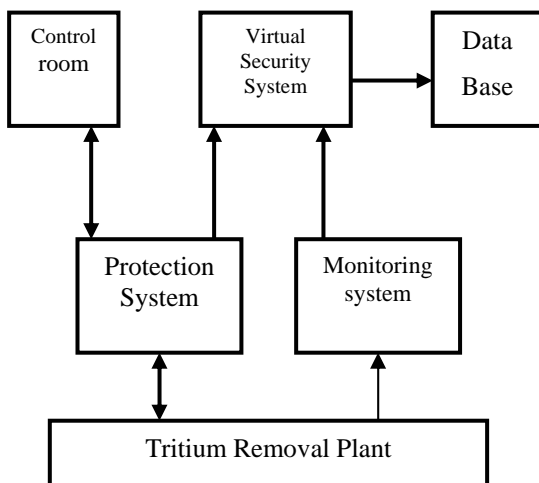


Figure 4: Block diagram with virtual security system (VSS)

4 Conclusion

The software monitoring system with data processing and the “virtual” simulation are of greatest importance for the operation under optimal conditions especially for the technological units that require a high degree of control and survey of processes, also having a significant role in the environmental protection and for increasing the safety degree of the operative staff of the nuclear plants and also of the people.

It proves very useful especially for those nuclear technological processes requiring the survey of the radioactive and toxic fluids, where the intervention of the human operator is minimal,

contributing to the diminution of the impact of nuclear plant functioning on the environment.

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