



Process simulators for safety and efficiency

Dr Vladimir Brusov, head of optimal control systems department for the R&D Institute of Urea (NIIK) in Russia discusses the role of computer process simulators in enhancing the safety and efficiency of industrial facilities.

Recent years have seen an increase in industrial- and technology-related accidents. This seems to be symptomatic of a serious imbalance between the growth of emergency-producing conditions and the countermeasures taken for their elimination. The increase in the number and significance of such accidents has both an objective and subjective cause. The need to increase competitiveness requires the construction and operation of more large-scale facilities. In order to reduce unit production cost, these plants also have to be operated under modes close to critical or upset conditions. A corresponding increase in operation time for equipment between turnarounds also contributes towards a significant increase in operational danger for industrial units.

These are the objective factors leading to the rise in emergency situations. As for the subjective ones, the human factor plays a significant role in this respect, as the cost of mistakes is high in present-day facilities.

With the implementation of distributed control systems (DCS) at the majority of industrial plants, the number of process start-ups and shutdowns has been reduced, as has the degree of direct interaction between operational personnel and the technical processes. Consequently, operational staff have less practical working experience both in normal operational conditions and in upset and emergency situations. Global statistics shows that the number of emergency situations caused by operational personnel, particularly in the hydrocarbon industry, is up to 80% of the total.

Computer process simulators - a highly efficient modern tool for personnel training/retraining - can be of valuable assistance in preparing personnel and reducing the influence of the human factor. The application of computer process simulators for personnel training at hazardous industrial facilities is obligatory in Russia. Such a process simulator was developed by the R&D Institute of Urea (NIIK) for explosion hazardous industrial facilities of chemical, petrochemical and oil refining industries.

Operational experience

In 2007 this simulator was put into operation at urea production plant 'Urea 2' at Eurochem, Russia, and NIIK is currently designing computer process simulators for two more

Russian urea plants: Eurochem's 'Urea-4' unit, and JSC FosAgro in Cherepovets.

The simulation developed by NIIK has several notable features; in particular it contains a full mathematical description of the process, simulating real operating conditions, including the calculation of numerous current values of parameters which are not controlled automatically. These properties of a computer process simulator guarantee more qualitative personnel preparation for real working conditions due to a more demonstrative visual image of a dynamic object. The computer process simulator is a part of the whole complex of an APC system. The advantages of a computer model and its influence on avoiding emergency situations make computer process simulators of the utmost importance for urea plants.

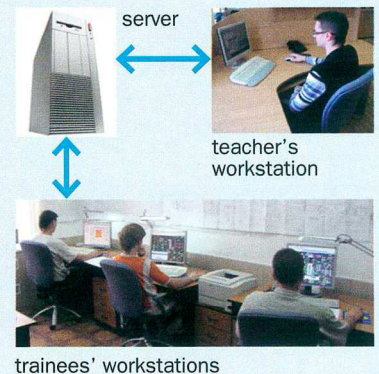
Other features include:

- Informational blocks of 'mnemo circuits' providing interpretation of large and complex equipment connection diagrams on the display;
- Training task formation using a special program module;
- A completely paperless electronic documentation library;
- A block of theoretical knowledge on the equipment;
- Adaptation of knowledge volume to different categories of users;
- A convenient simulator manual enabling users to quickly find any manual section.

Preparing operational personnel of industrial facilities via computer process simulators enables companies to solve the problem of training highly professional staff very quickly. The payback period for a computer process simulator is about one year; according to the American Petroleum Institute (API), the average profit from one operator undergoing training is about \$21,000. Experience shows that shutdowns of urea and ammonia units have become more frequent, connected with emergency situations. In many cases losses from a urea unit being out of operation for just one day ranges on average from \$270,000 to \$400,000, depending on plant capacity. That can be compared with the total cost of a computer simulator. One of the main reasons for emergency situations was a loss of the required skill level by operating personnel.

Therefore, staff preparation should be more intensive, with deep theoretical insight and qualitative practical training. For these purposes electronic training and certification systems should be used which include such state-of-the-art multimedia means as graphics, sound and animation. Specialists at NIIK believe the computer process simulator to be an indispensable and efficient tool in this respect. It gives an opportunity to exercise on this simulator, to 'walk' around the control system display, feel the reaction of the simulator to your operations. And it certainly helps an operator get rid

Fig 2: The structure of DCS



of any anxious feelings towards a new system. NIIK is ready to develop and put into operation computer process simulators for different technical processes, customising them according to the specific characteristics of this or that process.

Expert opinion

The ammonia units of JSC Cherepovestky Azot, part of the FosAgro group, have been using simulator complexes for three years. They were purchased almost immediately after replacement of the old board control system with a distributed control system. Chief engineer of JSC Cherepovestky Azot Mr. Schekoldin notes that as the leading role in plant technology is increasingly given to automatic systems, operators get used to them and gradually lose their own operational skills, and so can be at a loss in emergency situations. A computer process simulator helps them develop their skills in dealing with such situations.

"The simulator visually demonstrates the physical nature of the processes taking place in the equipment, their interconnections, and has other valuable features which we usually don't pay much attention to in practice. Trainees obtain not only practical skills but also theoretical knowledge. The scope of the training course is defined by the program once every four months and in case the trainee hasn't been working for more than 30 days. It is a very well proven tool for newcomers' training for the position of synthesis operators of ammonia units. Before operating the unit independently they have an opportunity to gather necessary experience and control skills."

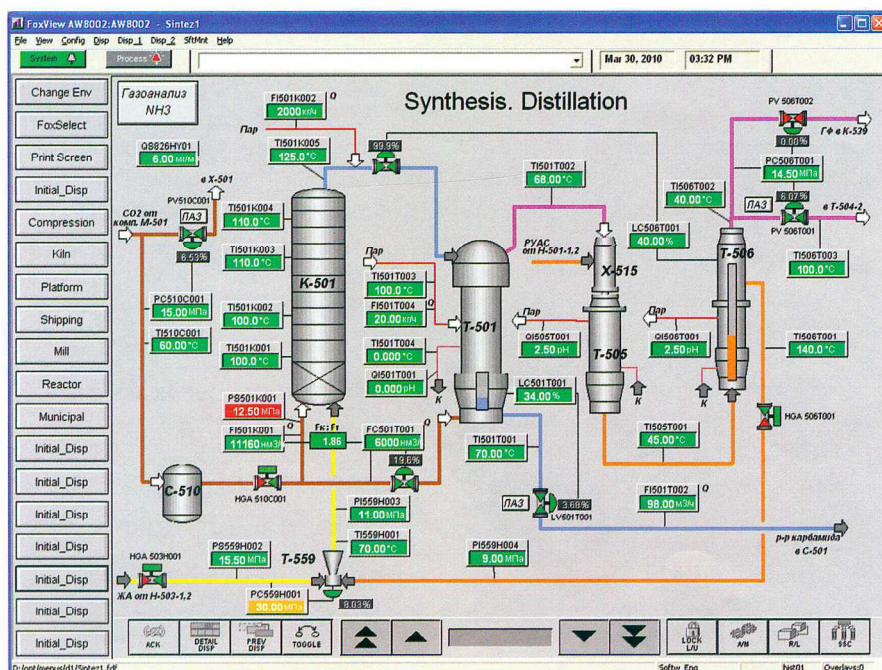


Fig1: Operator's workstation interface to DCS.