# GOING BEYOND TRAINING

**Tibor Szabó, MOL Group, Hungary,** explains how operator training simulation is helping to optimise energy and process efficiency at the Danube Refinery.

An operator training simulation (OTS) using dynamic process models serves to familiarise control room operators with new control and safety systems by exposing them to typical operational scenarios they might face. Ensuring operational reliability and increasing both safety and energy efficiency are vital targets for any refinery, and an OTS can also play a crucial role in helping achieve these aims.

OTS is a dynamic solution that uses a process model of a production asset, integrated with a replica of the control and safety system to create a hands-on, process-specific learning environment. The traditional use of OTS has been to support operator training as confident and well-skilled operators with more training experience are generally more likely to run processes at optimal levels and more efficiently, as well as to make fewer errors. Using OTS helps upskill the workforce, accelerates operators' learning, and exposes them to the different scenarios they are likely to experience in the actual control room. This includes start-up and shutdown, recovery from malfunctions and dealing with abnormal situations.

Operators' ability to practise handling scenarios and potential incidents in an offline, non-intrusive environment is invaluable, but OTS can provide much more than just fundamental training. The MOL Group strives to leverage the opportunities provided by OTS as much as possible, including using it to help achieve process optimisation. By using OTS with a high fidelity process model, operators can test alternative process set-ups as well as different feeds and throughputs to see what effect these changes would have on process efficiency. If they find that certain changes would result in efficiency improvements, similar amendments can subsequently be made to the real system.

## OTS projects

The MOL Group launched its first OTS project in 2005, implementing simulators that modelled fluid catalytic cracking (FCC) and reforming units at the Danube Refinery in Százhalombatta, near Budapest, Hungary. The success of this project led to further high fidelity simulators being installed to model other units at the refinery. The simulations are located in training rooms close to their

**Figure 1.** MOL Group's Danube Refinery.

**Figure 2.** OTS has brought significant benefits in terms of process optimisation at MOL Group's Danube Refinery.

respective units, making it as convenient as possible for the operators to practise on them.

In 2016, MOL implemented a high fidelity OTS for the gasoil hydrodesulfurisation process unit at this refinery. In this unit, the main feed streams are gas oil from the crude and vacuum distillation units, delayed coker and FCC units. The cold properties – cloud point and cold filter plugging point – are improved in the first reactor catalyst bed, which processes the heavier feeds with the higher paraffin content. The second reactor is used for catalytic desulfurisation in the presence of hydrogen for both heavier and lighter feed. The reactors' product is then separated via a series of columns into gasoil, gasoline, LPG and fuel gas.

When implementing the OTS, the main goal was to help identify the optimum way of decreasing the sulfur content in the gasoil product to under the 5 ppm level required by European Union (EU) regulations. Another objective was keeping the product's cloud point low enough during the winter by selectively cracking paraffin components that have a high pour point. Within the scope of the project there were stipulations for feed rate and feed composition changes, as well as a requirement to simulate the relevant field devices, emergency shutdown functions, and control and sequence control packages. The accuracy of the model's critical parameters was required to be +/- 1%, with the accuracy of its yields, temperature, pressure, flow rate, composition, boiling point curve and paraffins, olefins, naphthenes and aromatics (PONA) stipulated at +/- 2%.

## An OTS system

Emerson Automation Solutions' DeltaV™ distributed control system (DCS) has been used to control the abovementioned unit for over 10 years. The company was also chosen to provide the OTS for the unit. Moreover, the new OTS could also be integrated into the existing DCS without the need for an additional interface, which helped reduce the complexity of the project, thus minimising potential for errors and creating greater project certainty.

Emerson was tasked with providing a high fidelity dynamic simulation model, and making both the human machine interface (HMI) hardware and the implemented software equal to the real plant's existing DCS. The process model of the unit was built using a third-party process simulation platform specifically for refinery processes.

## 'WHOM' training method

The MOL Group sees value in broadening its operators' skills though the creation of interesting and thought-provoking exercises for them to perform. This has led to the company implementing an OTS training method known as 'WHOM', standing for 'what if, happened, optimisation and maintain'.

The 'what if' aspect of the OTS training covers situations that happen rarely or have not previously occurred with the unit. Operators are, therefore, unlikely to have experienced them before and need to be taught how to respond to them should they occur in future.

The 'happened' section deals with incidents that have previously occurred with the unit, but it cannot be assumed that all operators will know how to respond to them if they happen again. Some operators may not have been involved in dealing with these incidents and they need to be well informed about making correct interventions.

The 'optimisation' training category is especially important. Reducing energy consumption and improving production efficiency are essential if a company is to meet the industry's ever more stringent requirements in these areas. As previously stated, an OTS provides an excellent opportunity for operators to test different process parameters on a process model. This enables them to see the difference that their interventions can make on the unit's various processes, and therefore identify ways of increasing efficiency within the real system. The transparency of such parameters represents a challenge to the traditional operator staff practices of 'stay on the safe side' or 'from father to son' training, which are present in many workplaces but do not always entail efficient operations. Optimisation training can be repeated as required and operators can then leverage the know-how they acquire during simulation training in real operational circumstances.

Finally, the 'maintain' element of the training refers to ensuring that the knowledge that has been acquired is maintained. This is achieved by operators attending

**Figure 3.** Using OTS enables operators to respond to process disturbances and upsets in a smoother way.

workshops and undergoing examinations, with aims of information conservation, continuous improvement and higher competencies. When considering what is vital in maintaining or improving a company's stability, efficiency and operability, components that are key to higher performance (such as properly trained, highly qualified personnel) must be treated as critical criteria. Therefore, tools such as OTS, which help employees to perform high standard work as quickly as possible, must also be regarded as critical.

## Results

The DeltaV operator training solution on the gasoil hydrodesulfurisation process unit at the Danube Refinery is enabling operators to acquaint themselves with DeltaV operating concepts while also learning the unit's actual processes. It is a key tool in the ongoing process of training future operators and reducing operator errors, as well as in refreshing the knowledge of current operators and providing them with more advanced training.

In terms of process optimisation, the OTS has already brought significant benefits. One benefit is teaching operators how to respond to process disturbances and upsets in a smoother way so that the amount of product stream sent off-specification is significantly reduced and product qualities remain in an economically viable range. Another advantage is that important process interlocks, such as the furnace and compressor, are activated much less thanks to the smoother operator response to disturbances, resulting in higher plant availability.

## Summary

Today's OTS solutions have evolved far beyond their traditional purpose of supporting operator training. They can also be used by control room operators to test different process set-ups and observe the effect these parameter changes have on process efficiency. Any beneficial changes can then also be made on the real system, resulting in process optimisation. Recognising the importance of operator training solutions, MOL Group has an ongoing plan to implement OTS throughout its plants. Several units at the group's Danube Refinery now have OTS. Since being implemented in December 2016, the solution on the gasoil hydrodesulfurisation process unit has helped to improve operator responses and reduce operator errors, which has led to reduced product loss, improved product quality and higher plant availability.