

Dynamic simulation benefits ACROSS THE PLANT LIFECYCLE

Miquel Angel Alós explains how dynamic simulation can help maximise plant performance and deliver cost savings on new plant projects.

The oil and gas industry has witnessed seismic downward shifts in barrel prices and uplifts in market competitiveness which has challenged owner-operators to squeeze more out of their operations. Engineering, procurement and construction companies (EPC) are also under more pressure to reduce project risk and achieve better alignment with owner-operators to ensure effective management of their client's capital.

The use of rigorous dynamic simulation can help to maximise operating performance while achieving better quality products more quickly. Analysing operating scenarios using dynamic process modelling gives confidence that new plants will start-up safely, meet budget and perform to plan. Dynamic simulation is also vital to successful plant design and operation. Designs can be improved by incorporating a system's dynamic response to changes within the design model. To accommodate and study scenarios such as shutdowns and emergency situations, dynamic process simulation of the 'real world' can deliver effective results.

Lost production overshadows installation costs in the oil & gas and refinery sector, so it is vital that plant designs are robust. Dynamic simulation can show transient responses that are not determined during traditional steady-state design methods, providing engineers with a deeper understanding of plant operational behaviour, which can be crucial in safety-related equipment sizing. As a process simulation knowledge provider, Inprocess conducts dynamic simulation studies to confirm safe and efficient

design. The net result of this for a project is significant time and cost savings.

The pillars of effective use of steady-state and dynamic simulation to support best engineering design practice are based upon good communications, efficient knowledge transfer and comprehensive support training. Tailoring training programmes to maximise process simulation knowledge will help to ensure a better understanding of the plant lifecycle and will maximise project return on investment.

Dynamic simulation benefits

Unlike steady-state simulation, dynamic models factor time, which helps model complex transient behaviour such as changes of temperature and pressure. This type of simulation reproduces the real behaviour of a process plant, providing values that correspond to process variables at a given time. These simulations have an interactive interface that helps the engineer understand what it would be like with a real plant and with solutions becoming more precise, fast and easy-to-use. The main benefit of dynamic simulation is the deeper knowledge it provides about the process as a result of improvements in system control design, plant operations and staff training. It enables the verification of the appropriate size of equipment used to determine design constraints covering the plant's normal operation. As the plant goes through many modifications during its lifetime, dynamic simulation provides a means of continuous assessment of the operability of the proposed design solution.

Better design decisions through detailed analysis enable engineers to



make the necessary trade-offs and optimise the design. Dynamic simulation makes it possible to simulate a realistic understanding and behaviour of the plant and to help improve decision support and safety.

Best practice

A recent case study based in Central America required Inprocess to provide consultancy to a large owner-operator. We were asked to verify and perform a feasibility study on engineering design models supplied by an international EPC. Verification of the EPC's design formed the project's first phase while its second involved verification of the multiphase pipeline behaviour, assessing plant start-up and support plant operability to reach production targets.

The project involved analysis of all operating variables, including safety analysis, process dynamics and units interactions. Applying simulation models helped the client across different phases of the facilities' lifecycle.

For example phase one, using AspenTech's Aspen HYSYS simulation platform, first-principle models (steady-state and dynamics) provided a significantly better understanding of the process dynamics and its interactions and enabled Inprocess engineers to evaluate and fine-tune strategies before implementation. Using dynamic simulation early in the design phase

allowed the engineers to identify important operability and control issues, along with equipment sizing adjustments, which led us to improve the design.

Through the second phase, the simulation platform integrated everything into one simulation environment, reducing the time required for 'what-if' studies. During start-up operations, a holistic simulation model, incorporating both the pipelines and the structure of the platform (topside), determined the correct sequence of steps to adopt when starting up the initial wells and to reach the early production rate.

Designing pipeline systems requires complex considerations, such as the pipeline flow path, terrain profiles, expected volumes to be received and delivered over the pipeline, along with the physical properties of products to flow through the pipe. Dynamic simulation of pipelines with updated compositions from the wells was invaluable to gain crucial information about the development of liquid holdup profiles, as well as pressure and temperature data. This information determined predicted hydrate formation risk and slug sizes. Crucially, dynamic modelling results helped to keep the flow going, which consequently prevented interruptions to the plant and avoided reduced profits.

Big savings were achieved on the project through improved and faster start-up procedures with capital cost savings through the avoidance over-design of relief systems. The topside model was tuned and calibrated by reconciling discrepancies with plant data, by adjusting certain values and parameters to ensure the model corresponded to actual unit operation before proceeding with further development.

The availability of the upgraded model helped the client to troubleshoot operability issues and to reach targets earlier. In addition, using a common platform facilitated the effective communication between all

stakeholders, which was essential for the transfer of knowledge. Collaboration and information sharing became the lifeblood for determining accurate outcomes and analysing plant behaviour.

Inprocess also delivered a Process Trainer of the plant – a dynamic model containing real plant data, combined with a user-friendly interface, identical to the HMI of the plant which is able to facilitate the execution of pre-programmed scenarios of different operational conditions to troubleshoot detected problems. In the early field production phase, this operational support yielded a database of operational cases, which are cumulative during the plant life cycle. Consequently, new engineers at the plant are able to learn how it operates by following the simulation cases, helping to minimise the impact of personnel turnover in plant operability and safety.

Understanding

An effective design and control strategy requires a comprehensive understanding of the process in order to avoid unplanned downtime. Process

simulation experts are now able to quickly create robust models that can validate EPC design and increase confidence that projects will run on time, to standard and be maintained easily to help ensure optimised operations. Dynamic models of the plant give companies the assurance that they can achieve faster and safer plant start-ups while maximising productivity.

Dynamic simulation helps to avoid disruptions and minimises the impact of unnecessary costs on real plant operations. For example, using a reliable dynamic model, owner-operators can ensure production goals are achieved according to already signed contracts, avoiding penalties for not meeting agreed production or product quality. Similarly, it is possible to plan for sub-optimal plant operating points, preventing full plant shutdowns and keeping the plant in operation, when partial power failures occur in remote locations or where power supply can be unstable.

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Bosch Rexroth adopts augmented reality for service support

Augmented reality software and smart glasses from XMReality has enabled Bosch Rexroth to roll out a new service and support programme with remote assistance.

The first Rexroth solution launched for industrial hydraulics involves the client company's own maintenance team, who carry out adjustments, troubleshooting and emergency work, with remote guidance from Bosch Rexroth's systems specialists, using XMReality software on a smart handheld device, along with optional smart glasses.

The augmented reality smart glasses enable hands-free operation during interaction with the service experts. However, the software can also be used with just an ordinary smartphone.

The service expert sees on his screen what the operator sees through the lens. The software transfers video and audio streams between the service expert and the operator with perfect synchronisation, even when the bandwidth is low. Gestures, drawings or instructions can be overlaid by the instructor on the live image.

The XMReality software is compatible with Windows and Android operating systems. The optional smart glasses can be used with prescription glasses or protective smart glasses. A 40° field of vision enables the instructor to see the periphery of the image. The smart glasses are powered by the tablet or laptop computer and battery life is usually around two hours, depending on battery size.