Dynamic simulation is becoming an increasingly mainstream design activity. Petrofac views dynamic simulation as critical to the success of our project delivery and has now included this discipline as part of the company’s technical integrity programme.

Steady state simulations give an idealised snapshot view of flow rates, pressures and temperatures which can be employed as a basis for process design. Dynamics, however, considers the behaviour of equipment over time, enabling the identification of equipment design constraints, hydraulic limitations, control system interactions or transient condition issues (during start-up, shutdown, turndown or equipment failure).

Applications can range from small studies of specific unit operations to high-fidelity detailed models of complete process plants.

Our services
Petrofac offers the highest level of expertise and experience in dynamic simulation. Using the latest industry standard engineering software, e.g. UniSim Design or HYSYS Dynamics, Petrofac can utilise dynamic simulation models to provide identification and elimination of design flaws, leading to lower risk, higher return on investment and tangible benefits across the project lifecycle.

Petrofac’s dynamic simulation consultants can deliver expertise in all aspects of dynamic simulation, from guidance in developing the scope and fidelity of required models, to development of the model itself using sound engineering principles and an understanding of the underlying principles of the simulation software, followed by detailed analysis of the generated results and their implications for the process design. In addition to highlighting potential design issues, recommended modifications can be tested using the same model and proposed solutions verified, all during the design stage and well in advance of actual start-up.

Typical applications of dynamic simulation are:

- Dynamic compressor studies, hot/cold gas bypass requirements, compressor control evaluations (single and multiple strings/trains)
- Control scheme design validation
- Start-up procedure development
- Analysing the transient response to process trips or equipment failures
- Depressurisation/relief studies
- Establishing process flexibility
- Novel design testing
- Utility system verification
- Commissioning assistance

These services extend across both onshore and offshore developments.

Our track record
Petrofac is a unique engineering, procurement and construction specialist with a reputation for quality and safe delivery of fast-track projects, providing all the resources for a successful project implementation.

Employing highly experienced dynamic simulation specialists, our track record includes many projects: from the Russian Arctic to the deserts of North Africa and the Middle East.
Rotating equipment and controls
Comprising up to 20 engineers globally, the Petrofac’s dynamic simulation team offers the highest level of expertise and experience in dynamic simulation married with detailed knowledge of compressor and turbo-expander control and operation amassed over many years of experience. Petrofac can provide the following modelling capabilities.

- high fidelity dynamic simulation of compression systems from simple single stage, to multi-stage parallel trains integrated within the surrounding process units
- simulation/emulation of load-sharing / load balancing, master performance and anti-surge controls
- compressor performance verification under transient conditions (e.g. varying molecular weight feed streams and the impact on the performance map)
- modelling of driver performance (gas turbines, motors, etc) with the appropriate inertia, constraints, and operating characteristics
- simulation of turbo-expander recompressor units within NGL recovery extraction process systems, including complex control schemes and sequencing for mode switching to from JT mode

Our experience and capabilities
Compressor types and drivers simulated
- axial and centrifugal compressors (single, multistage, multi-train)
- gas turbine drivers (aero derivatives and industrial)
- steam turbine drivers (extraction & condensing)
- motor drivers (fixed speed / variable speed)
- voith turbo Vorecon® drives
- turbo-expanders, recompressors

Recent projects
Recent dynamic simulation projects with a specific rotating equipment focus include:

**Algeria: gas compression plant**
Large scale plant level models covering a number of series/parallel train compression systems with CCC emulation for compressor controls scheme verification (master performance, loadshare, and anti-surge), along with NGL recovery unit with parallel turboexpander, recompressor strings (with complex control scheme).

**UAE: oil production facilities**
Modelling of multi-stage, multi-train Gas Lift Compression system with load sharing, anti-surge and master pressure controls for different compressors to guarantee performance over the field life. Development of a detailed automated start-up sequence.

**Tunisia: gas plant**
Full plant model including parallel trains of feed gas compressors (fixed speed motors with Vorecon® variable speed drives), NGL extraction unit (with turboexpander recompressor), and sales gas compression system. Scope included detailed analysis / revamp of the CCC expander start-up sequence.

**Oman: sour gas plant**
Analysis of a 4 stage fixed speed centrifugal compression system with varying molecular weight gas feeds, requiring CCC suction throttling, anti-surge, antichoke, and suction pressure limiting control scheme.
Our approach
The onset of any simulation project begins with the definition of the project objectives. This in turn dictates the scope and boundaries of the model, the fidelity required and the modelling approaches to be used.

Simulations are built using industry standard tools including AspenTech HYSYS Dynamics or UniSim Design, and are populated with actual equipment and instrument design data, an emulation of the control system, and are set-up to match various operating conditions. Where standard unit operations are insufficiently detailed to model particular process equipment, specialist techniques and custom-built models are employed to accurately simulate process behaviour.

Once a satisfactory match to the steady state heat and mass balance is made, dynamic testing and quality assurance is performed after which the model can be used to generate the required scenarios.

Petrofac employs various bespoke tools and approaches to both construct the models and process the results, which are then analysed in depth in order to verify the design or provide input into recommending modifications.

This approach enables us to rapidly and cost-effectively evaluate and validate the process and control system design, and verify the effectiveness of any proposed solutions in partnership with the customer.

Other services
In addition to the delivery of packaged dynamic simulation projects, Petrofac Engineering Services also offers the following services in the dynamic simulation field:

• Operator Training System (OTS) development support, advisory and technical assurance, provided as an advisory role in dealing with OTS vendors

• third party dynamic simulation management, verification and results reviews

• flow assurance linking to process dynamic models (e.g. OLGA-HYSYS links to determine pipeline transient effects on process performance)

• assistance in development of dynamic simulation and OTS scopes of work and project requirements

• development of bespoke dynamic models based on client requirements including where necessary embedded client proprietary software