

## SC-DS01 - INTRODUCTION TO DYNAMIC PROCESS SIMULATION

### OBJECTIVES

The course content covers the basic needs of dynamics process simulation users. The attendees will learn the fundamentals of dynamic process modeling using commercial dynamic simulators and the main differences between steady state and dynamic modeling will be introduced. In addition, the necessary basic control theory will be reviewed briefly. To facilitate an efficient learning experience, all concepts will be studied based on simple and practical hands-on examples. The basic unit operations are introduced in a stepwise manner with the objective of being able to build dynamic process flowsheets by the end of the course.

Theory is used to introduce the objectives of every module in the course as well as to help attendees to understand how the underlying calculations are performed. The use of several software functionalities will show users how to explore operating alternatives for the processing plant units that are being studied.

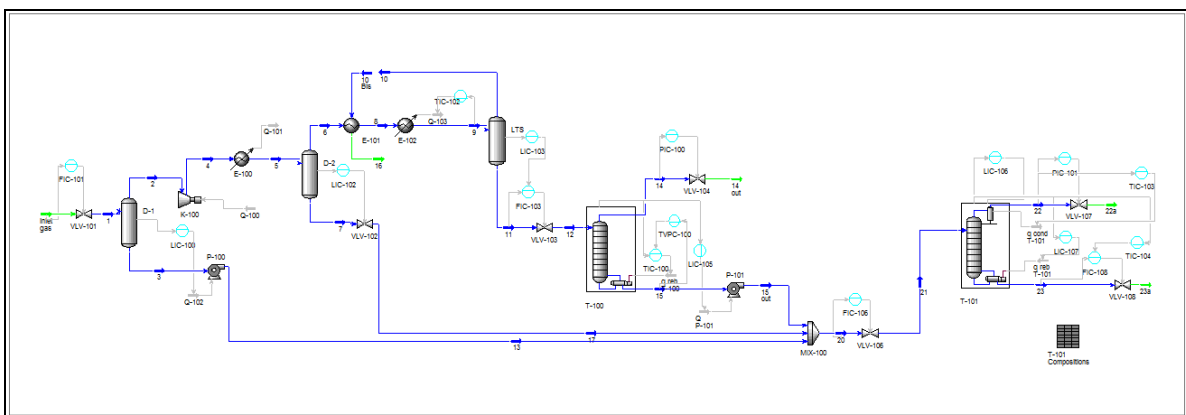
### PARTICIPANTS

This course is aimed at engineers who are involved in the design, control and operation of any processing facility. The workshops have been designed with an increasing complexity, in order to help in developing the attendees' learning curve. Although the workshop examples are taken from the Gas Processing industries, the acquired foundations on dynamic simulation can be applied to any process industry. Therefore, the course content is also applicable for process engineers, control engineers, safety, and environmental engineers in other industries, where dynamic process simulation is in use.

**Important Note:** Participants must be familiar with steady state process simulation to fully benefit from the subjects covered in this course.

### CONTENTS

The concepts acquired during the course will allow engineers to build their own process simulation cases to solve problems in their daily design studies. Basing decisions on rigorous simulation results will lead to better and quicker decision-making and furthermore improve confidence in the decisions taken. This course enables the attendees to use the dynamic modeling capabilities of dynamic process simulators to model and simulate typical processing facilities, showing the benefits that dynamic process simulation can bring in the day-to-day engineering and operating environment.



### THREE-DAYS COURSE AGENDA

MODULE	MODULE TITLE AND SHORT DESCRIPTION	TIME	DAY
1	<b>BASIC CONCEPTS OF DYNAMIC SIMULATION</b> Understanding the foundations of dynamic simulation using Process Simulators: The Pressure-Flow solver; Distributed and Lumped models; Pressure nodes and flow resistances.	2 hours	Day 1
2	<b>DIFFERENCES BETWEEN STEADY-STATE AND DYNAMIC MODELS</b> Discussion of the main differences between the two modelling modes concerning specifying equipment and flowsheet details. Rules for transitioning from a solved steady-state model to a dynamics one.	1 hour	
3	<b>FUNDAMENTALS OF PROCESS CONTROL</b> Open and closed loop. PID controllers and final control elements. Setup and modification of control strategies.	2 hours	
4	<b>DYNAMIC MODEL OF AN INLET SEPARATION PLANT</b> Development of an initial plant model in Steady State. Transition to Dynamics using equipment sizes, control valves, control loops, strip chart graphs, etc.	3 hours	
5	<b>ENHANCED DYNAMIC SIMULATION</b> Enhancement of previous model by incorporating additional details. Some of the defaulted values are modified and parts of the assumptions are revisited.	3 hours	Day 2
6	<b>GAS COMPRESSION SIMULATION IN DYNAMICS</b> Compressor maps, anti-surge control, bypass valves and other protection equipment is incorporated into the original model.	3 hours	
7	<b>OPERATIONAL PERFORMANCE (SCHEDULING OF EVENTS)</b> The Event Scheduler is a powerful tool that allows the dynamic modeller to plan and program several operational performance tests to monitor the response of the model in front of upsets and disturbances.	2 hours	
8	<b>UNITS TRIPS AND COMPRESSOR PRESSURE RELIEF</b> The robust dynamic model will be disturbed and upset by programming with the Event Scheduler unit trips and unexpected problems. The response of the protection equipment will be monitored.	2 hours	Day 3
9	<b>MODELLING A NGL EXTRACTION PLANT</b> Preparation of a new dynamic model of a NGL Extraction Plant. Transition from Steady State to Dynamics. Setup of level, flow and pressure PI control loops. On-off and cascade controllers are also introduced.	2 hours	
10	<b>DYNAMIC SIMULATION OF A DISTILLATION COLUMN</b> Expansion of the previous case by setting up a Stabilization column. A control strategy will be developed to meet the TVP specification for the NGL product	3 hours	

## ADDITIONAL OPTIONAL MODULES

MODULE	MODULE TITLE AND SHORT DESCRIPTION	TIME	DAY
Option	<b>BASIC CONTROL OF DISTILLATION COLUMNS</b> In this module, a fractionator is added to the model and a basic control scheme for level, temperature, pressure and composition is developed and discussed.	3 hours	
Option	<b>COLUMN PRESSURE RELIEF</b> The standard condenser unit of the fractionator is replaced by an expanded overhead system constituted by a cooler, a separator and a pump. The system is developed in dynamics mode. Finally, a pressure relief system is configured.	2 hours	
Option	<b>AMMONIA SYNTHESIS REACTOR</b> How to define reactions in dynamics mode. Different types of reactors. How to simulate dynamically a PFR for the ammonia reaction.	2 hours	
Option	<b>DYNAMIC MODELLING OF AN AMMINE CO<sub>2</sub> ABSORBER</b> Using simulation to model an ammonia absorber. Solving the case in Steady-State and moving it to Dynamics. Implementation of the control system.	3 hours	
Option	<b>MULTISTREAM HEAT EXCHANGER</b> How to use dynamic simulation to model LNG heat exchangers. Exploring the different parameters and features of this unit operation.	3 hours	