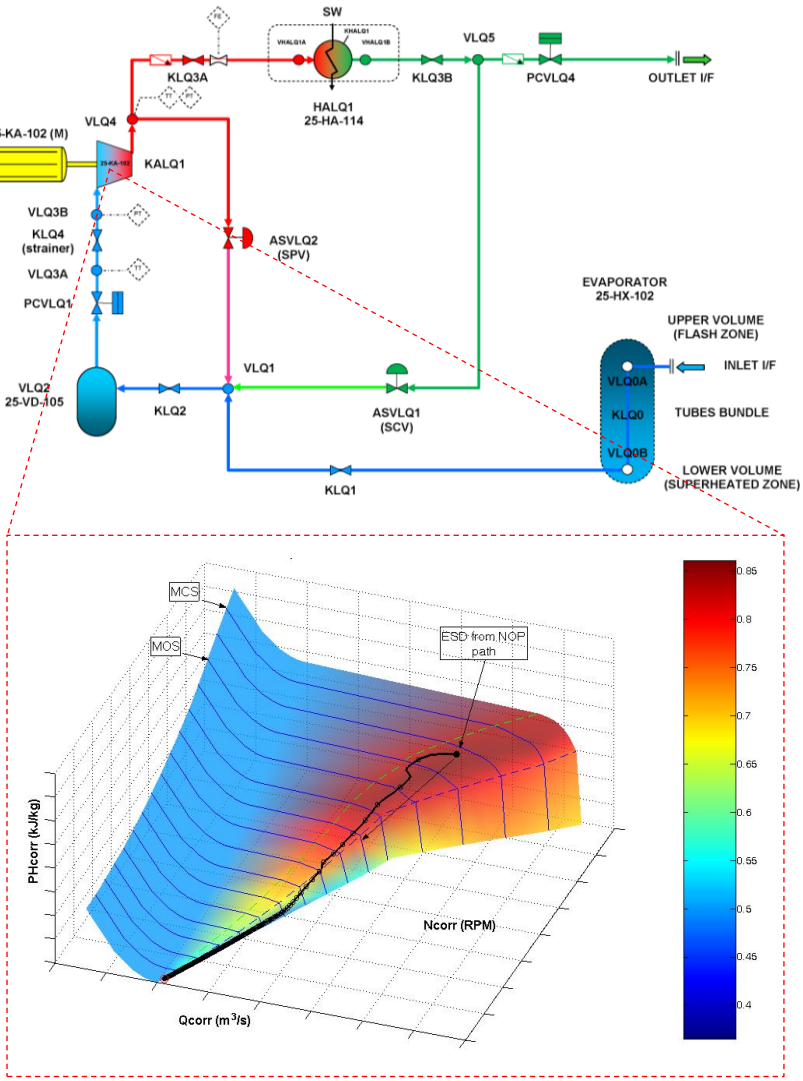
Systems & Advanced Technologies Engineering S.r.l.

MathWorks Partner

COMPSYS - DYNAMIC SIMULATION OF GAS COMPRESSION PLANTS



Plant equivalent scheme and operating point path on a ***COMPSYS*** 3D compressor map

OVERVIEW

Gas compression plants, typically to feed pipelines, distribution networks or underground storage systems must be controlled so that an optimum performance of each machine is achieved and safe management of transient conditions are assured.

This objective must be addressed since the system design phase, both to identify the best plant configuration and to specify and verify the control system strategy and components requirements.

SERVICE DESCRIPTION

Dynamic simulation services provide the analysis of the time history of plant's, compressors' and motors' parameters, which affect the design of the system and operations management.

Typically, the actual flow rate response of the whole system, stream characteristics (thermodynamic properties, velocity and flow rate), valves positions, machines speeds and power are plotted in comprehensible formats as function of time, for sets of pre-defined procedures or events (grid demand changes or back pressure variations, failure of assigned components, etc.).

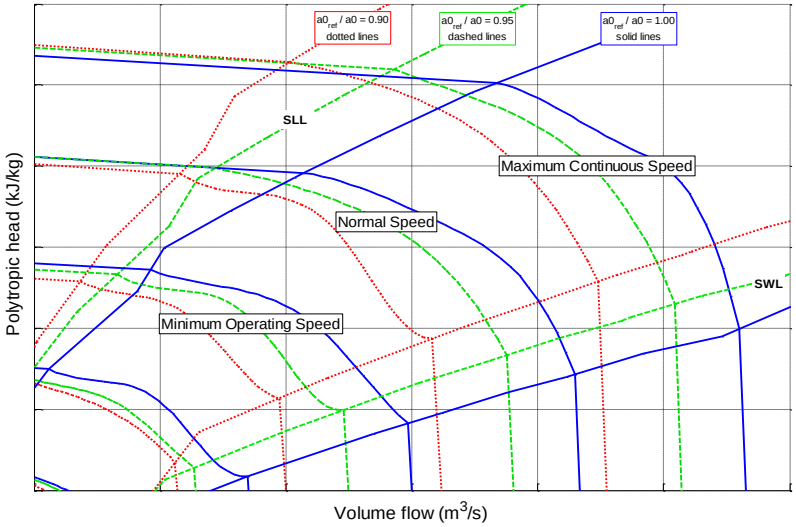
Machines operating conditions are also overlapped to the respective characteristic map to check the achievement of a suitable protection against anomalous conditions (surge, choking, runaway, etc.).

A comprehensive summary and commentary is provided to help system's designer to undertake proper corrective actions.

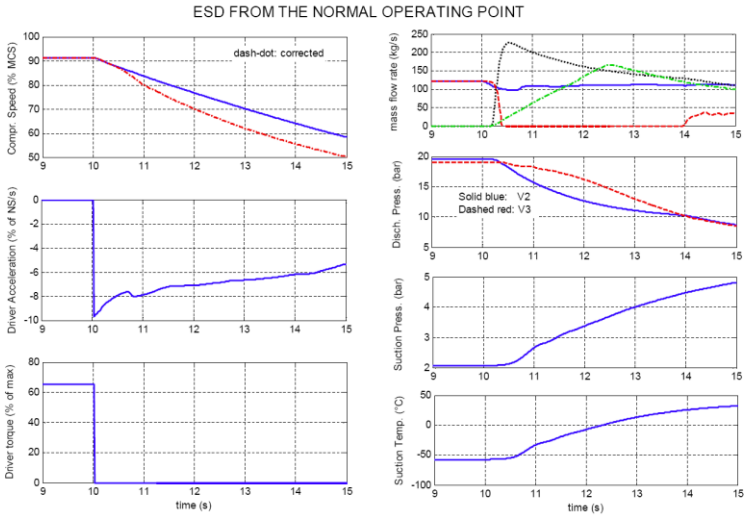
SCOPE OF THE SIMULATIONS

Multi compressor plants, configured in serial and/or parallel units, including heat exchangers, piping, manifolds, control and check valves, motors and controllers are subject to mutual influence during both stationary and transient conditions. Sometimes these interactions are not easy to identify and quantify. For instance quick valves operations may cause momentary surge conditions at one or more compressors, although the analysis of stationary conditions would exclude this occurrence.

Furthermore, when Single Input Single Output controllers are used, each controller may cause a disturbance to the other loops and cause undesired or too long transients. Finally, when a plant is to cope with a wide range of conditions by modules switching and/or recycling, the overall load management strategy and start-up/shut-down procedures must be verified.



Compressor map changing for different inlet conditions



An example of ***COMPSYS*** results plots

PROCEDURE OUTLINE

The process system and its control devices are modelled by a set of mathematical equations, including non linearities, and implemented using pre-defined and tailor made functional blocks in an object oriented mathematical environment, fully controllable during the numerical process.

The functional blocks performances are tested separately before integration over a wide range of conditions, to assure robustness of the model also under anomalous conditions (e.g. flow reversals).

Testing of the model or its components is performed under assigned stationary or dynamic conditions, derived from experiments or literature data. For poorly documented components sensitivity analyses are made to assure the overall model performance to conveniently describe the actual system.

During early design phases controllers are configured and preliminarily tuned, prior to undertake the required set of simulations. Upon necessity, the system or a few parts can be linearized at given operating conditions, to allow frequency response/stability analyses and identify the plants parameters which dominate transients.

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