

Pressure-driven Steady-State Simulation of Oilfield Infrastructure

Pascal Floquet^{(1)♦}, Xavier Joulia⁽¹⁾, Alain Vacher⁽²⁾,
Martin Gainville⁽³⁾, Michel Pons⁽⁴⁾

⁽¹⁾Laboratoire de Génie Chimique (LGC) UMR 5503 CNRS/INP/UPS
ENSIACET 118, route de Narbonne 31077 Toulouse Cedex 4 FRANCE

⁽²⁾ProSim Stratège Bâtiment A BP 2738 F-31312 Labège Cedex FRANCE

⁽³⁾IFP Direction Mécanique Appliquée

IFP-Rueil 1-4 avenue de Bois Préau 92852 Rueil-Malmaison Cedex FRANCE

⁽⁴⁾Michel Pons Technologie 32, rue Raulin, F-69007 Lyon, FRANCE

IFP is developing through *TINA* research Project (Transient Integrated Network Analysis) and in partnership with Total, a new generation of simulation tool for flow assurance studies. This integrated multiphase production software will be able to perform multiphase simulations from the wellbore to the surface facilities. Some steady state simulation tools are used at the early stages of a study for conceptual design, detailed engineering and at the initializing steps of dynamic simulations, then dynamic simulation tools are used for evaluating and better understanding the transient behaviour of the system. The purpose of this paper is to define, in a CAPE-OPEN compliant environment, a strategy to solve steady-state oil & gas problems, i.e. pure simulation and design problems in a context of hydrocarbon production and transport from wellbore to surface facilities.

Usually, a deep water production system produces a main field and sometimes it can be linked to satellite fields. The infrastructure of the system is mainly composed by subsea wellhead clusters, chokes, production lines, risers and separating units.

The first stage of this study includes the use of the process simulator ProSimPlus™ in a pressure driven environment (pressure equality is assumed at each manifold of the flowsheet) to solve simulation and design problems in two classical cases: flowsheet without recycle, recycle of gas from the separator's head to the riser (gas-lift). These two basic infrastructures are concerned with the life cycle of an production system; the first case corresponds to the beginning of a field exploitation, the second one to the case of the activation of “non-eruptive” wells with riser head pressure constraint. For each case, various strategies are exploited:

- flowrates/pressure strategy in which design variables (chokes (valves) opening, flowrates or well pressure) should be adjusted to verify pressure equality in each manifold and a fixed Riser's head pressure constraint.
- Pressures/pressure strategy in which only the well flowrates are free variables, for the same set of constraints.

In a second step of this study, the ProSimPlus SPEC module (design specification and recycle solver) is made CAPE-OPEN compliant and integrated in an INDISS™ environment. INDISS™ is the simulation platform chosen by *TINA* to provide a consistent set of data and model along the production flow from wellbore to export facilities and to solve a great number of problems from the simplest (design studies) to the more complex (shut-down, restart) oil & gas simulation.

In conclusion, this study pointed out two major elements: classical CAPE tools are able to solve efficiently, in a context of pressure-driven flowsheets, steady-state simulation encountered in oil & gas production problems and the CAPE-OPEN standards are the best way to “plug and play” a software component from a process simulator (i.e. ProSimPlus™) to another one (i.e. INDISS™). Future works concern multi-period optimization strategy in a modular sequential process simulator.

♦ Author to whom correspondence should be addressed Pascal.Floquet@ensiacet.fr