Evaluation of Stress and Strain Induced by the Rock Compaction on a Hydrocarbon Well Completion Using Contact Interfaces with Abaqus

G. Capasso and G. Musso*

eni E&P, S. Donato Milanese, MI, Italy

*now Politecnico di Torino, Italy

Abstract: The development plan of a hydrocarbon field includes the design of all the production/injection wells forecasted for the scenario considered. The pressure depletion occurring during the hydrocarbon reservoir exploitation induces rock compaction in the near wellbore area, which may result in mechanical actions transmitted to the well completions, that alter the stress regime in some of their sections. This phenomenon can possibly bring to the failure of the casing and of the cement, eventually leading to the well shutdown and to significant economic loss. By making reference to a case of industrial interest, the paper describes a procedure to evaluate stresses and strains in the completion structure induced by the rock deformation by using Abaqus.

Keywords: Well stability, Geomechanics, Failure criteria, Contact Interface.

1. Introduction

The well completion design represents one section of the field development plan for the exploitation of a hydrocarbon reservoir. The most basic completion type is represented by the open-hole: in this case the wellbore is left open in correspondence to the producing layers, without any protective structure. However, this completion type does not prevent well instability induced by rock failures, possibly generated as a consequence of the rock stress regime modified by the production process.

More often, the completion design includes the casing, i.e. a steel pipe that is inserted into the drilled hole, which is then connected with the surrounding rock by the cement introduced in the annulus between the formation and the steel casing.

According to the routine procedures for well design, the structural elements of the completion system are dimensioned with regard to the actions developing during the completion phase itself; however, the pressure depletion occurring in the near-wellbore area during the production period may induce rock compaction and, as a consequence, mechanical actions on the cement and the steel casing transferred through the rock/cement/casing interfaces.

The magnitude of the stress and strains transmitted to the completion system is mainly dependant on the drawdown occurring at the well and on the compressibility of the rock formation interested by the phenomenon. However, the assessment of the stability of the completion system in the