Wellbore Safety and Integrity during Hydrocarbon Production

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Abstract

Wellbore safety and integrity pertaining to production of oil and gas are critical for sustained production within the regulatory guidelines. Potential integrity issues originate from various sources. The purpose of this talk is to identify some of these sources and outline the state-of-the-art approach to modeling en route to mitigating these hazards. Specifically, we discuss annular-pressure buildup (APB), sustained-casing pressure (SCP), and leaks in gas-lift valves triggering unwanted backflow during well shut-in.

APB is induced by heat transfer from the tubing to other annuli containing fluids. The resultant pressure increase in confined annular space may be contained by simple reduction in the production rate and/or by proper design of the concentric annuli to minimize heat transfer. SCP is defined as any measurable casing pressure that rebuilds after being bled down. Unlike APB, SCP is not induced by heat transfer; rather, by leakage of fluids into the annulus. For instance, gas leakage, leading to SCP, may occur through the poor cement bond between the casing and the formation, packer, and/or the casing itself. Gas-lift valves (GLV) are designed to allow an influx of annular gas into the tubing and prevent backflow, even when a pressure differential exists toward the annulus. However, elements such as erosion, corrosion, scale, fatigue, vibration and temperature and pressure effects may cause the GLV to leak, causing a serious safety issue.

The common thread to all three processes involves fluid and heat flow modeling of fluids in tubing and annulus of interest. Tests specific to each process are explored and methods proposed for identifying the safety hazards that various tubular elements present. Field examples for each case are used to illustrate applications of these models and hazard mitigation steps that are taken.