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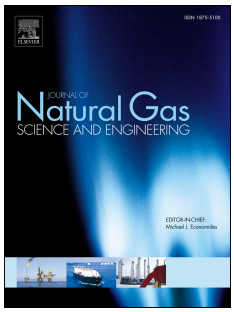

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A Study of Mechanical Extending Limits for Three-section Directional Wells

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Abstract

With the increase of vertical and lateral extensions of directional wells in recent decades, extending limits of rotary drilling have attracted much attention. In this paper, mechanical extending limits in directional drilling, which mean the maximum well depth for a certain rotary drilling system to drill under certain mechanical ground and underground constraint conditions, are systematically studied. Firstly, the integral mechanical results of down-hole tubular strings on holding wellbores of different holding angles are deduced on the basis of integral mechanical model. Secondly, the prediction model of mechanical extending limits is built by introducing the objective function, constraint conditions, operation conditions and integral mechanical results. Thirdly, the mechanical extending limits for three-section directional wells under pick up and slack off operations in the sliding and rotary modes are respectively deduced and the charts of extending limits for kinds of directional wells are drawn. At last, the theoretical and statistical mechanical extending limits are compared and the laws of extending limits in shallow, mid-deep and deep wells are analyzed. The results indicate that distributions of buckling state on tubular strings are different for different well trajectory parameters, so mechanical extending limits are also different. From shallow, mid-deep to deep wells, the limit operation conditions, constraint conditions and measures to increase extending limits are different correspondingly. The studies in this paper enrich the theories of extending limits in directional drilling and provide important guidance for design & control in actual drilling process.

Keywords: directional drilling; mechanical extending limit; down-hole tubular string; helical buckling; constraint optimization

1 Introduction

With the increase of exploration and development of unconventional and deep-water oil & gas resources, the objective conditions in drilling engineering become more complex. More and more deep and extended-reach wells are drilled under complex ground and underground conditions. Correspondingly, drilling