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Sequence Stratigraphy of the Mishrif Formation, West Qurna 1 Field, Iraq

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SUMMARY

The Mishrif formation in southern Iraq is a world class reservoir with over 100 GBO in place. The West Qurna 1 field (WQ1) is part of large N-trending anticlinal structure located near the eastern margin of the Arabian Plate, in the foreland of the Zagros fold and thrust front. An integrated reservoir study of the Mishrif is underway in the West Qurna contract area as part of a Technical Services Agreement with the South Oil Company of Iraq. The Mishrif has been under primary depletion since 1999, with intermittent disruptions due to wars. A key component of the field re-development plan is to implement a waterflood to increase reservoir pressure and improve recovery. Planning the waterfood requires an understanding of the permeability structure within the reservoir, including flow unit geometry and connectivity.

A sequence-stratigraphic study of the Mishrif is underway to provide a foundation for reservoir characterization and modeling. The data currently available include data from 375+ wells (200 acre well spacing), 17 cored wells, and limited 2D seismic. PLTs and recent MDTs provide data on zonal pressures and contributions to flow, and information on scaling differences between core plug, whole core and well-test derived permeabilities.

The Mishrif is ~250m thick in the WQ1 area and was deposited on a low-angle carbonate ramp. The Mishrif is interpreted to be comprised of four (4) third-order depositional sequences (1-4, oldest to youngest), that span from the Lower Cenomanian to the Early to Middle Turonian (est. 5-7 Ma duration). The sequences are stacked into a second-order sequence that records an overall shoaling-upward pattern. Sequences 3 and 4 are each capped by major exposure surfaces that form tight “caprock” intervals. The sequence boundary at the top of the Mishrif (Sequence 4) corresponds to a plate wide unconformity (the 92 Ma SB of Sharland et al., 2002).

Reservoir quality variations within the Mishrif are closely tied to original depositional textures that vary predictably within the sequence framework. Grainstones, often with coarse Rudist debris, form high porosity, high permeability flow zones that will dominate flow within the reservoir. Grainstone distribution is predicable within the sequence-stratigraphic framework. Much of the reservoir is microporous with high porosity, but low permeability. The high permeability contrast within the Mishrif presents a significant challenge to waterflood management. Reservoir modeling is underway to determine the optimum development plan for the Mishrif, including waterflood. The development plan will need to be tailored to account for the observed geologic variability, using the sequence-stratigraphic framework as a guide.