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Application of multi-segment well approach: Dynamic modeling of hydraulic fractures

Song Du, Nozomu Yoshida, Baosheng Liang, Jianping Chen



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3 Application of Multi-Segment Well Approach: Dynamic Modeling of 4 Hydraulic Fractures

5 Song Du, Chevron Energy Technology Company; Nozomu Yoshida, Chevron Energy Technology Company;
6 Baosheng Liang, Chevron North America Upstream; Jianping Chen, Chevron Energy Technology Company

7 Highlights

- 8 • Dynamic simulation of fracture changing along simulation time is challenge, and can be benefit from
9 multi-segment well approach.
- 10 • This study demonstrated the flexibility and accuracy of using multisegment well approach against
11 the traditional methods.
- 12 • A shale oil field case from midland basin is presented to show the accuracy of using multi-segment
13 well approach.

16 Graphical Abstract – optional

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20 Abstract

21 Hydraulic fracturing is a stimulation treatment routinely performed to create fracture network on low
22 permeability reservoirs to enhance the productivity. Such induced fracture network has much higher
23 conductivity and generally is treated through either local grid refinement (LGR) to capture the transient
24 phenomenon or embedded discrete fracture model (EDFM). Both approaches require complex gridding
25 meshes, leading to heavy computational time. LGR also requires the orthogonal orientation of hydraulic
26 fracture with horizontal wellbore trajectory. Another challenge for LGR and EDFM comes from the
27 dynamic meshing over the time. Infill drilling and re-fracturing are common due to the nature of the fast
28 production decline in those hydraulically fractured wells. In the case of infill drilling or re-fracturing, the
29 grids for the well or completion stages have to be generated from the beginning of the simulation,
30 causing computational inefficiency. Also, sensitivity evaluation of well landing point, spacing, and
31 completion optimization needs easy preprocessing of model input and short simulation time.

32 In this paper, we overcome the above challenges through representing hydraulic fracture network with
33 multisegment well (MSW) concept. Multisegment wells (MSW) offer an improved description of the
34 wellbore physics over conventionally modeled wells and can be used in different situations like,
35 horizontal or multilateral wells, wells with inflow control devices (ICDs), and significantly varying flow
36 conditions along the wellbore. On the other hand, the conventional well model (CWM) represents a well
37 as a single pipe (single fluid) a MSW discretizes the well trajectory into several segments. Each segment
38 has its fluid conditions and solution variables, hence allowing for detailed modeling of changing
39 conditions along the wellbore.

40 Since MSW node system is independent of reservoir grid system, fracture orientation can be at any
41 angle freely with wellbore trajectory, which avoids the complex LGR or EDFM and reduces the number
42 of grids. Meanwhile, MSW provides a flexibility of fracture geometry representation, enabling easy
43 addition and alteration of fractures at any simulation time.

44 Our MSW approach has been validated by comparing with the LGR through several benchmarking
45 studies of a tight reservoir. A field case was demonstrated for infill drilling among existing vertical wells
46 and re-fracturing operations. While it is difficult to model infill drilling of a well with hydraulic
47 fractures through another modeling approach, the MSW option makes it easy by just opening the

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