ABSTRAK

PEMODELAN STATIS DAN VOLUMETRIK FORMASI BATURAJA BERBASIS FASIES UNTUK PENGEMBANGAN LAPANGAN "NORSE", SUB-CEKUNGAN CIPUNEGARA

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Lapangan "NORSE" merupakan lapangan karbonat Formasi Baturaja di Sub-Cekungan Cipunegara, Cekungan Jawa Barat Utara, yang dicirikan oleh heterogenitas reservoir tinggi dan keterbatasan sebaran data sumur sehingga estimasi cadangannya menyimpan ketidakpastian besar. Penelitian ini bertujuan membangun model geologi statis tiga dimensi berbasis fasies dan mengevaluasi ketidakpastian volumetrik sebagai dasar pengembangan lapangan tersebut. Penelitian mengintegrasikan data *wireline log* dari tujuh sumur, seismik tiga dimensi *pre-stack depth migration*, Routine Core Analysis, petrografi, mudlog, dan biostratigrafi. Analisis fasies mengidentifikasi evolusi vertikal pendangkalan ke atas dari *Argillaceous Deep Shelf* menuju *Open Marine Platform* yang berakhir pada *Platform-margin sand shoals* sebagai fasies reservoir terbaik pada interval Top Baturaja. Evaluasi petrofisika menggunakan metode persentil gamma ray, kombinasi density–neutron, Timur, dan *Archie* menghasilkan porositas efektif rata-rata 13,5% tergolong kelas cukup/*fair*, saturasi air rata-rata 58,1%, serta kontak minyak–air pada kedalaman −2.322,51 meter di bawah muka laut. Atribut seismik *root mean square amplitude* dikonfirmasi sebagai pengontrol lateral porositas dengan koefisien determinasi 0,6298, sedangkan penentuan tipe batuan berbasis *flow zone indicator* mengklasifikasikan reservoir menjadi empat tipe batuan yang mengontrol pemodelan permeabilitas tiga dimensi, dengan permeabilitas rata-rata net reservoir sekitar 30 *milidarcy* (rentang 0,12–186,5 *milidarcy*). Kerangka struktur Lapangan "NORSE" dikontrol oleh sebelas sesar normal berarah barat laut–tenggara yang membentuk jebakan antiklin tersesarkan. Perhitungan volumetrik probabilistik menggunakan simulasi Monte Carlo menghasilkan estimasi volume minyak awal di tempat sebesar 7,245 juta barel pada persentil ke-90, 10,508 juta barel pada persentil ke-50, dan 14,847 juta barel pada persentil ke-10, dengan rasio persentil ke-10 terhadap ke-90 sebesar 2,05 yang sesuai dengan standar *Petroleum Resources Management System* (2018). Volume batuan kotor (*Gross Rock Volume*) dan perbandingan *net* terhadap *gross* merupakan parameter yang paling sensitif. Berdasarkan integrasi peta porositas, volume pori hidrokarbon, dan saturasi air, direkomendasikan tiga sweet spot sebagai usulan sumur sisipan, yaitu Spot 1 (X = 818.956,63; Y = 9.305.047,50; Z = −2.252,02 m), Spot 2 (X = 818.362,61; Y = 9.307.069,70; Z = −2.248,27 m), dan Spot 3 (X = 818.767,02; Y = 9.308.307,10; Z = −2.248,11 m).

Kata kunci: Fasies; Karbonat; Pemodelan statis; Petrofisika; Volumetrik

ABSTRACT

FACIES-BASED STATIC AND VOLUMETRIC MODELING OF THE BATURAJA FORMATION FOR FIELD DEVELOPMENT IN THE "NORSE" FIELD, CIPUNEGARA SUB-BASIN

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The "NORSE" Field is a Baturaja Formation carbonate field in the Cipunegara Sub-basin of the Northwest Java Basin, characterised by high reservoir heterogeneity and sparse well control, leaving substantial uncertainty in its reserve estimates. This study aims to construct a facies-based three-dimensional static geological model and to evaluate volumetric uncertainty as a basis for field development. The study integrates wireline logs from seven wells, three-dimensional pre-stack depth migration seismic, Routine Core Analysis, petrography, mudlogs, and biostratigraphy. Facies analysis identifies a vertical shallowing-upward succession from the Argillaceous Deep Shelf through the Open Marine Platform, culminating in Platform-margin sand shoals as the best reservoir facies at the Top Baturaja interval. Petrophysical evaluation using the gamma ray percentile, density–neutron combination, Timur, and Archie methods yields an average effective porosity of 13.5% classified as fair, an average water saturation of 58.1%, and an oil–water contact at −2,322.51 metres below sea level. The root mean square amplitude seismic attribute is confirmed as a lateral control on porosity with a coefficient of determination of 0.6298, while flow zone indicator rock typing classifies the reservoir into four rock types that govern three-dimensional permeability modelling, with an average net-reservoir permeability of about 30 millidarcy (range 0.12–186.5 millidarcy). The structural framework of the "NORSE" Field is controlled by eleven northwest–southeast normal faults forming a faulted anticline trap. Probabilistic volumetric calculation using Monte Carlo simulation yields a stock-tank oil initially in place of 7.245 million barrels at the ninetieth percentile, 10.508 million barrels at the fiftieth percentile, and 14.847 million barrels at the tenth percentile, with a tenth-to-ninetieth percentile ratio of 2.05, consistent with the Petroleum Resources Management System (2018) standard. Gross Rock Volume and net-to-gross are the most sensitive parameters. Based on the integration of porosity, hydrocarbon pore volume, and water saturation maps, three sweet spots are recommended as proposed infill wells, namely Spot 1 (X = 818,956.63; Y = 9,305,047.50; Z = −2,252.02 m), Spot 2 (X = 818,362.61; Y = 9,307,069.70; Z = −2,248.27 m), and Spot 3 (X = 818,767.02; Y = 9,308,307.10; Z = −2,248.11 m).

Keywords: *carbonate; facies; petrophysics; static modeling; volumetric*