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Integrated Reservoir Modeling to Unlock Hidden Potential in Mature Peciko Field A Case Study of Advance Lithoseismic Attributes Interpretation and Paleo Channel Reconstruction in Complex Distributaries Channel Reservoir

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ABSTRACT

Peciko is a gas field located offshore in the Mahakam delta, on East Kalimantan, Indonesia. The field lies offshore in water depths of 30 - 50 metres, extends over 350 km2. The working permit is under Mahakam PSC, operated by Total (50%) with INPEX (50%). The field was discovered in 1983 with Peciko-1 and proved economic in 1991 with NWP-1. Since then, 19 delineation wells have been drilled and 3-D seismic was acquired in 1992-1993 and reprocessed in 2004 and 2012. The field was put on production in 1999 with peak production 1400 MMscfd reached in 2005.

Peciko structure is northward plunging anticline with multi-layered sand reservoirs of Late Miocene fluvial- deltaic deposit from the ancient Mahakam delta. The pay reservoirs have been grouped into 3 major intervals namely Main zone at 2100 – 4500 mSS depth, Fresh Water Sand (FWS) zone reservoirs at 1600 – 2100 mSS depth and Very Shallow Zone at 1600 to 500 mSS depth. The Main zone has been the major producing interval since early field development, now is declining. While FWS which was developed later under POD phase-7, become more important. Today the FWS reservoirs contribute around 40% of Peciko field production. This paper aims to present results of integrated geosciences studies to improve reservoir model of one of the biggest production contributor in FWS interval namely MF4 reservoir.

The MF4 is a complex multi storey channel reservoir which was thought to be well mapped and has been modeled based on seismic amplitude anomalies interpretation seismic cube and calibrated with 13 wells. However, recent drilled wells were penetrated some gas bearing channel outside the anomaly and/or in separated small anomaly objects. In line with static well data, the latest dynamic synthesis based on production data from those wells also indicate significantly higher connected gas in place (CGIP) compare to initial gas in place (IGIP) from previous static model. This issue raises some doubt on the reliability of the existing reservoir model and the accuracy of IGIP volume of FWS reservoir, which ultimately leaves a big uncertainty on mid and long term production forecast.

Triggered by that situation a simultaneous 3D elastic inversion was done on PSTM-2012 reprocessed data, followed by a detailed supervised seismic classification study in order to generate sand probability, lithology, and fluid attribute cubes. The litho-classification study provided very good quality results in terms of sand prediction and good correlations with well results. The litho-seismic image was then used as a trend to guide reservoir modeling; in first attempt, a stochastic object modeling method was applied. Unfortunately, with this approach the distribution of channel bodies were not realistic because we were not able to control the channel movement due to seismic resolution issue. The evolution of the channel needs to be modeled as realistic as possible, not only to get reliable IGIP, it is also crucial for accurate water break

through prediction during reservoir simulation. To better capture the channel bodies evolution, each channel fairway were drawn manually as polygons taking into consideration the 3D litho-seismic images and detailed reservoir correlation. This manual approach also allowed us to do some interpretation on area where there is some doubt on litho-seismic response. This integrated approach provided more reliable reservoir model and hopefully more accurate water break through prediction and better production forecast.

Learning from the successful updated of MF4 reservoir model, similar work will be continued on other layers in FWS interval to unlock some hidden remaining potential which was not fully explored by previous method and provide the keys to optimize strategy for future development of the field.