МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ

МАЛА АКАДЕМІЯ НАУК УКРАЇНИ

НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
“ПОЛТАВСЬКА ПОЛІТЕХНІКА
ІМЕНІ ЮРІЯ КОНДРАТЮКА”

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НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ 1918

МУЗЕЙ інтерактивний простір НАУКИ

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Мала академія наук України під егідою ЮНЕСКО

ЗБІРНИК НАУКОВИХ ПРАЦЬ

XVII МІЖНАРОДНОЇ НАУКОВО-ПРАКТИЧНОЇ КОНФЕРЕНЦІЇ “АКАДЕМІЧНА Й УНІВЕРСИТЕТСЬКА НАУКА: РЕЗУЛЬТАТИ ТА ПЕРСПЕКТИВИ”

12-13 ГРУДНЯ 2024 РОКУ

SUBSURFACE FLOW-TO NETWORKS FLOW SIMULATION THREE BROWN OFFSHORE FIELDS DEVELOPMENT STUDY

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In today's rapidly evolving landscape, integrating advanced technology and enhanced computing capabilities has made modelling and simulation indispensable to the core business processes of oil and gas assets. At every phase of asset development and production, simulation is beneficial and essential for informed strategic, tactical, and operational decisions. Effectively managing the development of an asset presents significant technical and economic challenges, underscoring the need for an asset management tool that facilitates comprehensive simulations of the entire operation—integrating the reservoir, production, surface facilities, processing platforms, and economic models to foster interdisciplinary collaboration.

Nowadays, with continuously developing technologies and vastly improved computing capability, modelling and simulation are part of oil and gas assets inevitable core business processes. Most Noth See Offshore companies operate an asset, so Oil and Gas Companies involved in an asset operation elect the most experienced company to manage the assets. The company engaged in the asset operation that operates finance, which is all involved in asset operation and according to the percentage of the assets' property. The overall activities motivate each participant to control the asset operator interactively. Hence, the whole asset production optimization has a remarkable control in which companies aim to reduce operational costs. All companies share the assets value in the way that the company have the same data, and each interactively controls and motivates whit their individual studies the operator with the latest state of technology operational solutions, which means that the overall project developing study is cost-effective.

This paper presents three field development studies: All are brown development study with horizontal and deviated vertical wells production or injection wells positioned within

each offshore field. The study considers three assets with full-field operation, including three static and dynamic sub-surface flow simulation models. Each model is coupled in parallel to the network simulation models.

In the full field modelling and flow simulation study we present hydrocarbon production results.

In the study we used the software SLB-ECLIPSE and E300 coupled with Network simulation software METTE. METTE is an integrated production management solution that provides operators with flow performance calculations for wells and flow lines, integrated field modeling for life of field simulation and optimization, and virtual metering for the allocation of production to wells. Key benefits to operators include flexible production performance calculations, fast network simulation and improved life of field integrated flow assurance.

The combination of data from predictive reservoir models, production modeling and field instrumentation enables operators to monitor production continuously and use information from the field when forecasting future reservoir performance and making operational decisions. The result is an integrated production management solution. METTE focuses on the maximum reuse of input files across application modes. This reuse ensures consistency and efficiency in data management with minimum file maintenance. The commonality in input data simplifies the sharing of data/files between disciplines performing different flow assurance tasks.

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With coupled METTE reservoir simulation, METTE acts as a master process generating reservoir simulations and ensuring time synchronicity during simulation. Flow rates from a

converged network solution are fed to the reservoir processes as target rates for the next step as in Fig. below (*Ref. Emerson Process Management – Production Management Solution*).

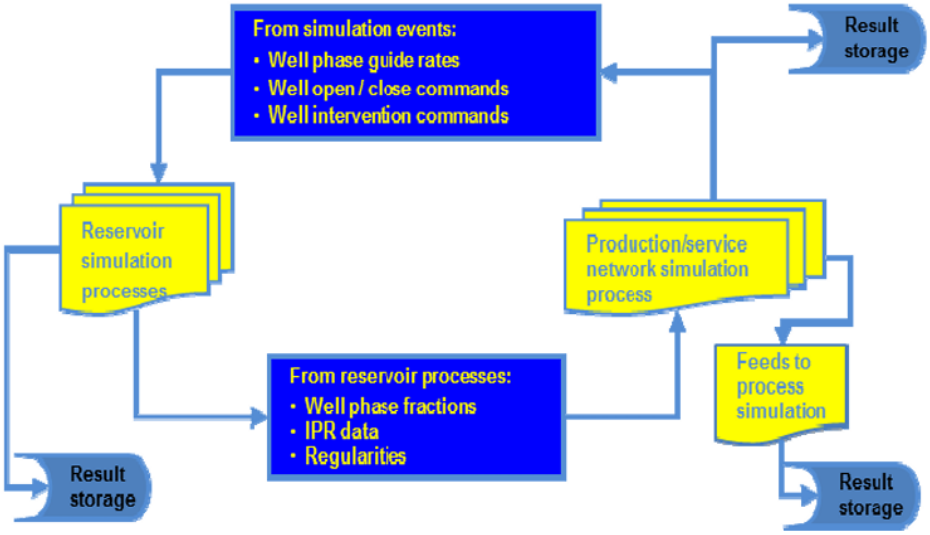


Fig. Emerson Process Management – Production Management Solution

Brown Fields Study Sate of Technology Workflows

National University "Yuri Kondratyuk Poltava Polytechnic" and our Department and Institute have all the necessary software for field operations. We completed the project presented here using ECLIPSE and METTE software for a comprehensive field study.

We selected three fields with water well injections and hydrocarbon horizontal well producers. We combined the flow simulation of the three fields with the network simulations within each time step of the three producing assets. Each field production profile defines one Geophysical and Geology model. Each file has Seismic time-depth maps and the filed velocity model. All well-logging data on each field is integrated into the G and G model. With special MDT and RFT data, we create gas, oil, and water-oil contacts.

The selected wells have Build-up and Draw-down data from which we generate near wellbore parameters, which we use in the final model verifications. Each well's data is continuously measured, so each well has high-frequency BHP, Well Head data, and Separator Data. For most well production data, we may record it on the separator, and we use the workflow to reallocate data to each well from the separator in the most precise way.

Fluid data are crucial, so we have the best possible laboratory data. We also extensively interpret internal PVT data. These data are essential for all reservoir and Production engineering operations.

Finally, we calibrate Static and Dynamic models with high-frequency rate pressure time data and extend the study with versatile risking procedures.

The main goal of the modern development of hydrocarbon deposits is the complete extraction of recoverable reserves under maximum economic profitability. Advanced technologies we use to achieve this and enhance the oil recovery ratio. One key technology is computer modelling.

• Field development history match and its forecast allow optimal development of hydrocarbon deposits with the least costs.

• The main problem when drawing up project documents is due to discrepancies between static (geological) and hydrodynamic models

• 3D modelling solves the following tasks: calculating hydrocarbon reserves, planning (designing) wells, assessing uncertainties and risks and preparing the basis for hydrodynamic modelling.

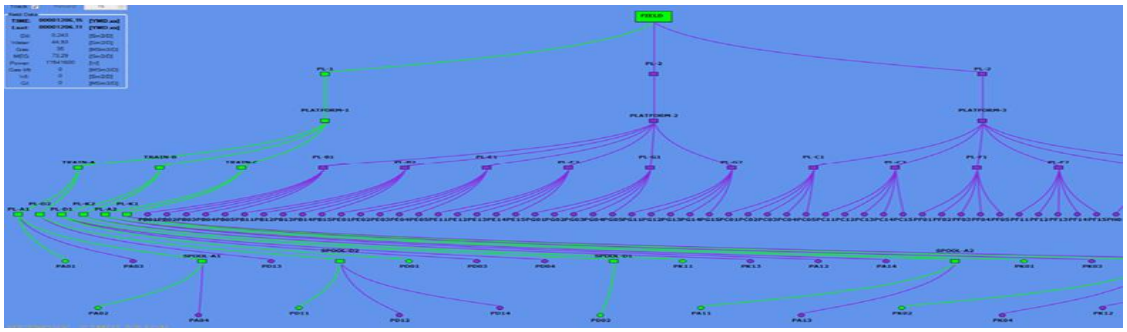
• Constructing three-dimensional geological models has already become a central component of technological processes for justifying well drillings and drawing development plans for hydrocarbon deposits, including the efficiency of proposed geological and technological measures. We mainly use field flow simulations due to the increasing complexity of the fields and new production technologies, such as drilling horizontal, multi-fracture horizontal, and multilateral wells.

• This flow simulation technology is now a leading approach in fossil energy exploration and field development studies. It also proves beneficial for secondary and tertiary recovery efforts, EOR-IOR as well as unconventional field studies. Additionally, we utilize comprehensive knowledge and software tools for transition energy applications, including storage solutions for CO2, methane, and hydrogen, as well as studies related to coal bed

methane and geothermal energy. We are continually enhancing the technical capabilities of flow dynamics in subsurface and network flow simulation studies.

• From traditional numerical models to deep learning approaches, from experts' system neural network, machine learning to artificial intelligence, Ai studies we follow and integrate in scope of activities of modelling in theory of filtration in porous media.

Keywords: Eclipse; METTE, water injection; reservoir; modeling; subsurface-to-network pipes simulation; oil saturation; hydrocarbon production; multiple reservoir study.



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