Energy storage systems russia

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Energy storage systems (ESS) are an important component of the energy transition that is currently happening worldwide, including Russia: Over the last 10 years, the sector has grown 48-fold with an average annual increase rate of 47% (Kholkin, et al. 2019). According to various forecasts, by 2024-2025, the global market for energy storage systems will reach 50-100 GW, which equals USD 80 billion. Over the recent years, development of ESS has been driven by development of non-conventional renewable energy sources (RES) (Zhdaneev 2020). The maximum capacity of the Russian ESS market is 10-15 GW up until 2030 (Kholkin, et al. 2019).

Currently, five energy storage technologies have been commercially developed: mechanical, electrochemical, thermal, electrical, and chemical (Andrey et al. 2020). According to the technology development report (Andrey et al. 2020) of the European Energy Commission, electrochemical ESS is the second most developed and used technology of production after pumped-storage units. ESS installed for end-consumers (prosumers) (Brown et al. 2020) downstream of the power meters, i.e., on the prosumer side, plays an increasingly important role, including in the oil and gas industry.

The first example of practical use of an ESS in the oil and gas industry was a joint project of Woodside Energy and ABB Ability (Baccino et al. 2018)--a PowerStore system with a rated capacity of 1 MW and a storage capacity of 1 MWh, installed at the Australian Goodwyn Alpha offshore platform in 2017. The platform production capacity is up to 36 and 11 kTpD of gas and gas condensate, respectively. The platform is equipped with four 3.2 MW gas turbine power units, a total of 12.8 MW. Confirmed ESS operation results in 2019: saving 3,000 tons of diesel fuel and reducing CO_2 emissions by 7,500 tons. Thus, ESS replaced 1 out of 4 existing gas turbine generators and reduced the emergency diesel generator operating time.

The next offshore ESS project was developed by Seadrill/Northern Drilling, Siemens, Kongsberg Maritime, and DNV GL (Northern Drilling''s West Mira first rig to receive DNV GL Battery (Power) 2019), and commissioned on the West Mira semi-submersible rig in the North Sea in 2018. This ESS consisted of four 1.5 MW modules, with total capacity of 6 MW. The rig power unit consisted of six 5.5 MW DPSs. As a result, 42% saving of diesel fuel and 12% reduction in CO_2 emissions are currently reported.

In 2020, Maersk (Energy and delivers energy storage, 2021) implemented the world''s third project of using an ESS in offshore oil and gas production on a Maersk Intrepid CJ70 jack-up drilling rig, also operating in the North Sea. The total capacity of the rig power unit is 11.6 MW. The monthly saving of diesel fuel was 25%, and CO_2 emissions were reduced by 25%. In its basic specifications, this ESS was similar to the Australian Woodside Energy and ABB Ability ESS project.

In the beginning of the article, feasibility of wide use of ESS on drilling rigs is substantiated. Conclusions are then made following 2017-2019 hands-on studies of power modes on a number of rigs. Results of these studies laid a foundation for development of an experimental ESS unit with a control system based on a 3-level invertor. Explanation is given for the optimum way to integrate the ESS into a rig power circuit. After field testing, feasibility of using ESS in drilling is proven, and bare-bone specifications for a serial-produced ESS are calculated.

If certain pricing rates are achieved, ESS may provide extremely effective solutions for the following power supply objectives for the Russian oil and gas industry:

Improving the power quality. Despite the lack of RES, the majority of Russian consumers experience the same problems with power dips as networks with a large share of RES do due to the length and bad state of lines. ESS provides reliable power supply and postpones investments in upgrades of the existing networks and building new ones;

Using ESS as storage systems downstream of the power meter to optimize energy supply costs. There are several reasons to install a storage system, ranging from the requirements for uninterrupted supply to the possibility of reducing costs by lowering the consumption peaks.

In Russia, deep drilling rigs (Zhdaneev and Frolov 2020) are among the most energy-intensive facilities with an installed total capacity of 3-5 MW.

Extensive experience in designing and maintaining rig control and power supply systems has shown that the load pattern is characterized by a short-term high energy consumption with a high-power rise rate, which requires a larger number of simultaneously operating diesel power stations (DPS), or gas piston or gas turbine units (Pavkovi? et al. 2016). As for the rigs, this energy consumption mode is most typical of run-in-hole/put-out-of-hole operations (RIH/POOH).

Based on average daily power consumption statistics and load diagrams for various rig operating modes at more than fifty pads equipped with DPS, it was proposed to improve the energy efficiency of individual DPS-powered rigs by introducing energy storage systems (Fig. 1).

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