Case: RotaChoke-Applications Offshore

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There are studies showing that an offshore production rig in the North Sea has energy available for regeneration which represents 12 MW installed power. This case study will look into some of the processes which can be regenerated, and also do some economical considerations.

Business Drivers

5 MW of the 12 MW identified are located subsea and 7 MW topside.

Setting a conservative goal of regenerating 2MW topside, this will lead to a saving of 26 million Norwegian Kroner (26 MNOK) yearly (including reduced CO2/NOX- taxation). The calculations behind this are described further down the article. Correspondingly, CO2 emission is reduced by 12.700 tons and NOX emission by 240 tons yearly, given the alternative is to generate electricity from gas og diesel generators.

For hydro power, the rule-of-thumb is that below ”break-even” CAPEX of 3 NOK per yearly, the investment will be profitable. 2MW installed effect is 17,5 million kWh, giving a break-even CAPEX of 52,5 MNOK, which is definitely within reach. For this price, the investment is paid in a few years. However, the cost of electricity offshore is far higher than onshore, and there is "room" for higher investments, if necessary. In a 10 year perspective, the total savings are 260 MNOK's.

Applications for RotaChoke

Possible applications of the RotaChoke on a production rig is listed below:

- **Cooling water over bord**. This is the simplest and least critical application. The head is 30 meters and the flowrate is stable and high (appr. 1 m3/s). Based on this, there is a potential of installing 300kW here, giving 2,5GWh. Possible problems with the turbine will not influence production of safety, as there will be bypass piping.
- **Produced water**. Given that the CTOUR technology is used to purify the produced water, there is 30 bars with maybe 500 liters/s available, resulting in 1,5MW installed effect. Possible problems with the turbine will not influence production of safety, as there will be bypass piping. Possible problems with the turbine will not influence production of safety, as there will be bypass piping.
- **Process Train**. These turbines are more exposed to the ”prime time” processing of hydrocarbons, and stability and durability are important

parameters. Given 20 bar pressure with 1000 l/s, the installed effect is 2MW.

- **Well head chokes**. Some fields have excess reservoir pressure also after it initial production phase. RotaChoke can the replace traditional chokes, with some important advantages
  - It is not subject to erosion and wash-outs to the same degree as traditional chokes, due to the low velocity through the RotaChoke
  - It regerates energy from the reservoir pressure
  - Each individual RotaChoke can be dynamically controlled to balance pressures between the wellheads.
- **Local power generation**. Injection water, or other high pressure flow lines, can be utilised to generate energy where the consumption is higher than available supply (satellites, sub-sea templates, etc). The injection water is thus becoming the energy carrier.

Behind the Figures

It is assumed 2MW installed effect, giving 2.000kW x 24 x 365 = 17.500.000 kWh = 17,5 GWh

To generate this electricity from diesel, will require 4.000.000 kg diesel (efficiency factor 37%), with corresponding emssion of 3.17 kg CO2 pr. kg diesel = 12.680.000 kg. CO2.

- CO2-tax for diesel is 0,8 NOK/liter.
- 4.000.000 kg diesel equals 4.850.000 liter.
- CO2-tax= 4.850.000 x 0,8 = 3.880.000 NOK yearly.

Nox-tax is 15 NOK pr kilo NOx. It is produced 55-100 kg NOx pr ton diesel, depending on the RPM.

4.000 ton diesel => 240 ton NOx, resulting in a yearly NOx tax of 3.600.000 NOK

On top of that is the cost of diesel – assumed 4 NOK/liter in large bulks. Diesel cost is thus 19.400.000 NOK yearly.

Energy cost	19.400.000
CO2-tax	3.880.000
NOX-tax	3.600.000
Total savings	26.880.000

The 2MW installed effect has a potential of saving 26,8 MNOK yearly, which is 13,4 MNOK yearly saving per MW installed effect.