



## APPLICATION NOTE

Oil & Gas

### Flow measurement for high pressure water injection in oil fields

- Monitoring the performance of waterflooding to increase offshore oil production
- Reliable and accurate flow measurement to control high-pressure water injection
- Use of rugged electromagnetic flowmeters designed to Norsok standards

#### 1. Background

Exploration in oil fields with declining natural pressure requires enhanced oil recovery (EOR) techniques to maintain efficient production rates. The most effective recovery techniques include well water injection and waterflooding.

The operator of an offshore platform in Norway uses waterflooding by injecting highly pressurized water into the surrounding formation of its oil fields. The increase in pressure exerts a force that moves oil from hard-to-reach areas of the reservoir towards the production well, allowing oil production to increase.

#### 2. Measurement requirements

To effectively utilize and control the injected water, the operator was looking for a reliable and accurate flow measurement that could withstand the extremely harsh process and environmental conditions on the offshore platform. Well water injection involves elevated process conditions of up to 300 bar / 4351 psi. The operator was searching for a flow technology able to provide stable readings at the given process conditions, even if valves or pumps cause an impact on the pipeline.

The flowmeter had to be designed in accordance with standards like Norsok and TR-2000 for offshore operation. It was also required to be approved for use in hazardous areas in accordance with ATEX (zone 1, with intrinsically safe outputs). Only flowmeters from manufacturers with a long track record in the offshore oil and gas business were to be considered.

## 3. KROHNE solution

The customer preferred the electromagnetic flow measuring principle since other flow technologies had not always provided reliable readings under the prevalent conditions, especially in the vicinity of valves or pumps. The pressurized water injection is now therefore monitored with a dedicated offshore version of the OPTIFLUX 4300 electromagnetic flowmeter (EMF).

The scope of supply included several flowmeters designed in accordance with Norsok and TR-2000 specifications. The majority of instruments were supplied in sizes of 4", 6" and 8". These flowmeters have extremely robust 6Mo alloy tubing and hub connectors with pressure ratings of up to Cl2500#. Larger versions of the OPTIFLUX 4300 in sizes up to 24" with high pressure flanges (ASME Cl900) were also part of the delivery.

The flowmeters were equipped with either ETFE or polyurethane liners. They were supplied as compact versions or with remote field-mounted flow converter in stainless steel (316L). The sensor body of the OPTIFLUX 4300 meters was painted in accordance with Norsok M-501. The EMF design has no external cables that would need special protection or could cause safety issues. All flowmeters were calibrated with water in one of KROHNE's own calibration facility prior to delivery and were therefore ready for immediate use.



OPTIFLUX 4300 on calibration rig



Production of KROHNE 24" flow sensor with high pressure flanges



EMF with hub and clamp connectors

## 4. Customer benefits

The OPTIFLUX 4300 assists the oil producer in optimizing the control of water injection, thereby increasing oil production. The mag meters have become an important component in the oil recovery process, helping the operator increase its ROI in the long term. The EMF proved to be the perfect fit for the given conditions as it maintains operation in the event of process effects caused by pumps and valves. Its rugged stainless-steel housing also protects the meter against the harsh offshore environment and provides extended safety. There are no external transducers and cables which could be damaged. The EMF also comes calibrated, enabling very accurate and long-term stable flow measurement.

As an experienced supplier of process instrumentation for offshore applications, KROHNE offers a wide range of specialized flowmeters, including mag meters, ultrasonic inline and clamp-on flowmeters or Coriolis mass flowmeters. The customer benefits from a comprehensive flow portfolio that is not limited to one specific measuring principle. This enables KROHNE to offer tailor-made advice and the right choice of device, always considering the prevailing conditions. In addition, KROHNE also offers the associated offshore services for commissioning and field verification of the meters from a single source.

## 5. Product used

### OPTIFLUX 4300

- Electromagnetic flowmeter for advanced offshore applications
- Designed in accordance with Norsok and TR-2000
- Flange: DN2.5...3000 / 1/16...120", also available as high pressure versions



### Contact

Would you like further information about these or other applications?  
Do you require technical advice for your application?  
application@krohne.com

Please visit our website for a current list of all KROHNE contacts and addresses.

