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Direct Electrical Heating for Shallow Water Installations during Continuous Operation

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ABSTRACT

The interest in Direct Electrical Heating (DEH) is increasing and the system is being planned for flow assurance in development of oil fields on continental shelf around the world. The DEH system is selected due to several advantages:

- Allow production of fields that earlier is considered as not feasible
- Effective solution with high heat input
- Easy to install and operate
- Reliable components
- Can be retrofitted on pipelines in operation
- Implementation require minor modification
- The running costs are considerably reduced compared to traditional methods utilising chemicals

At present it is installed on several subsea pipelines in the North Sea and DEH is applied actively to prevent hydrate formation during shut downs for a total accumulated use of 1 year during the lifetime of the field.

For the new fields being planned with DEH there are several challenges due to extended design basis regarding:

- Continuously use of DEH during the lifetime of the field.
- Flow assurance of waxy unprocessed wellstream, requiring large heat input to the pipeline.
- Impact of steel armoured concrete pipe weight coating
- Use in shallow water
- Heating of risers and spool-pieces

As the pipeline is an active conductor in the heating system a special anode design is required, both to ensure sufficient grounding for the heating system and for corrosion protection regarding ac (alternating current). The design of the anode system is strongly related to time of use. This is one of the main challenges with continuous operation of DEH.

Furthermore the design of the electrical cables is important regarding mechanical and thermal stresses. The lifetime of the cable depends on several factors. The lifetime of the DEH installation decreases with increasing cable temperature and with frequent use.

It is necessary to obtain the electrical and magnetic characteristics of steel pipe materials. Both these characteristics determine the pipeline impedance. These data are required input for rating (electrical and thermal) of DEH and the anode design layout.

KEY WORDS

Pipelines; Flow assurance; Electrical Heating; Continuously operation; Ac Corrosion Protection; Steel Armoured Concrete Pipe Weight Coating; Electrical Power Requirements; Generated Heat.

INTRODUCTION

DEH at 60 Hz is evaluated for 12” carbon steel pipelines of 7 km length in shallow water (15 m – 50 m water depth) for continuous operation. The DEH system has to be terminated at least 30 m from the platform and template and spool pieces and the riser will the be unheated by DEH.

Compared to the presently installed systems, which are qualified for 1 year accumulated use of DEH, the main aspects that need clarifications related to continuous operation are:

- Corrosion protection due to ac
- DEH cable

Heating of spool-pieces and risers needs be studied. One possibility is to heat these parts by induction, which can be carried out by the DEH cables. This is considered in the paper.

Shallow water installations have not earlier been implemented and calculations of how water depth influences DEH system are carried out.

Depending of steel pipe material properties and DEH configuration, as