

STUP

METHODS

Freysinet

EKOFISK RESERVOIR

APRIL 1972



- CLIENT : PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, Oklahoma, U S A
- CONSULTING ENGINEER : C.G. D O R I S (Compagnie Générale pour les Développements
Opérationnels de Richesses Sous-Marines)
58, Rue du Dessous-des-Berges, PARIS 13ème, France
- CIVIL ENGINEERING DESIGN : EUROPE-ETUDES
66, Route de la Reine 92/ BOULOGNE-sur-SEINE, France
- CONTRACTOR : I/S F. SELMER / HØYER-ELLEFSEN
Postboks 3115 4031 HINNA, Stavanger, Norway
- SUB-CONTRACTOR FOR PRESTRESSING : S T U P
66, Route de la Reine 92/ BOULOGNE-sur-SEINE, France

.....
THE E K O F I S K PROJECT
.....

THE PROJECT -

Off-shore borings give a more and more important part of the crude oil world production and raise new working problems. The new oil-field of the Ekofisk Site in the North Sea, at 130 km from the Norwegian coast, is one of these rich fields, exploitation of which is carried out by the American Phillips Petroleum Company.

For loading and transportation of the oil, this company decided to place near the boaring a large reservoir from which the tankers can to be filled. In order to solve the problem consisting in creating a storage volume of 160,000 m³ on the sea bottom at - 70.00 m, Phillips called for competitive designs. A project presented by the French company DORIS (Compagnie Générale pour les Développements Opérationnels des Richesses Sous-Marines), with the prestressed concrete structure designed by Europe-Études, was chosen by the client. The design includes a large oil-tank, which will be constructed in a Norwegian fjord, floated to its final position and grounded onto the sea-bed, the top part of the reservoir emerging from the water level. This project was preferred to a project of under water steel tanks presented by the Chicago Bridge Co.

Europe-Études is in charge of the final design and of the supervision of work on behalf of the company DORIS. A call for tenders for the civil engineering enabled to entrust the two Norwegian contractors F. Selmer A/S and Høyer-Ellefsen with the construction work. This joint venture chose S.T.U.P. as sub-contractor for supplying all the prestressing materials and for carrying out all the operations concerning prestressing.

THE STRUCTURE -

The island-reservoir is a vertical cylindrical structure with a total height of 90 m, rising 20 m over the sea level. Its shape in plan is nearly circular and is inscribed in a circle of 95 m diameter. The tank has a perforated outer protection wall (breakwater wall) intended, in particular, to resist the wave shocks and to break down the swell effect (Jarlan patent) and an inner wall forming the reservoir itself. The two walls are fixed on a common floor.

The floor is a prestressed hollow box structure with a depth of 6.00 m, which has to be filled with sand or with mass concrete. The bottom slab has a depth of 0.60 m and the top slab a depth of 0.25m.

The outer breakwater wall is 1.35 m thick over the lower part and 1.83 m thick over the upper 32 m. The perforations, the purpose of which is to dissipate the energy of the waves, which can reach a height of 24 m, are of a diameter varying from 0.80 m to 1.30 m.

The walls of the reservoir itself are cylindrical walls 0.50 m thick. They are bearing on a pattern of four orthogonal diaphragms stiffening the whole structure. Two of these diaphragms are parallel in each direction and are extended out to the perforated outer wall. Their thickness is 0.65 m in the lower part and 0.50 m in the top part.

The reservoir is covered by a roof and thus allows for the oil to be under a slight pressure due to a small tank placed at the top of the main tank communicating with the base of this latter. During working, the tank is always full of crude oil (density 0.83) and/or sea water (density 1.03) with the crude oil occupying the space above the sea water. The filling is carried out by pumping in the oil, thus expelling the equivalent volume of water. Tankers are loaded by the inverse operation.

THE CONSTRUCTION -

The construction will start by the casting in a dry dock of the 6 m deep floor plus 8 m height of breakwater walls (holes temporarily closed). The temporary dry dock was excavated on shore of a fjord near the Norwegian harbour of Stavanger.

After completion of the floor, the dry dock will be filled with water and opened. The floor will then be floated into deep water in the fjord and the construction of the tank will continue using sliding forms for tank wall. The cellular floor will be progressively ballasted.

After completion, the reservoir will be floated to sea and grounded at the Ekofisk site on the sea bottom at - 70,00 m.

Planning -

- | | |
|-----------------------------------|-------------------|
| . Work order | May 1971 |
| . Start of reservoir construction | August 15th 1971 |
| . Completion of tank | April 1st 1972 |
| . Floating and grounding | Summer 1972 |
| . Commissioning | Early winter 1972 |

Quantity of materials -

- | | | |
|----------------------|-----------------------|-----------------|
| . Concrete | 80,000 m ³ | <i>Betong</i> |
| . High tensile steel | 2,570 tons | <i>Armering</i> |
| . Length of cables | 275,000 m | <i>— u —</i> |
| . Anchorages 12 T 15 | 12,270 | |

We certainly will have the occasion to speak again about this important work in a new field of construction, in which Europe-Etudes and S.T.U.P. are pioneers.

— oOo —

