

PROJECT SHEET

MUMBAI HIGH FIELDS TO URAN TRUNKLINE PROJECT

BOSKALIS OFFSHORE: SKILLS, RESOURCES, EXPERIENCE

Boskalis Offshore brings together the offshore skills, resources and experience of Royal Boskalis Westminster. The group's offshore capabilities include seabed rectification works for pipeline/cable and platform installation, construction of pipeline shore approaches and landfalls, offshore mineral mining, offshore supply and support services and decommissioning services. Boskalis provides clients with tailored, project-specific solutions for above dredge related offshore services, as illustrated by the following project summary.

MUMBAI HIGH FIELDS TO URAN TRUNK-LINE PROJECT (MUT)

The Mumbai High Fields to Uran Trunkline Project is situated near Mumbai (Bombay) in India. ONGC Ltd (Oil & Natural Gas Corporation) has constructed two new pipeline connections from the Mumbai High Fields to Uran over a total length of 204 kilometres. These new pipelines have been constructed in order to replace the existing Bombay High Fields to Uran Trunkline, which has already completed more than 25 years of successful operation and has surpassed its design life. The new pipelines are a 30" oil pipeline and a 28" gas pipeline.

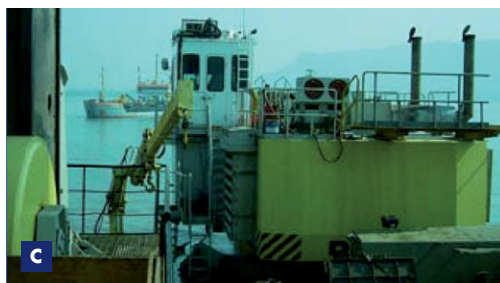
The pipe laying has been executed by Hyundai Heavy Industries Co. Ltd (HHI). Boskalis was

FEATURES

Client	ONGC Ltd.
Location	Mumbai, India
Period	August 2004 - June 2005
Main contractor	Hyundai Heavy Industries Co. Ltd.
Contractor	Boskalis Offshore Boskalis Westminster Middle East



- A** Location map
- B** Backhoe Dredger "Colbart" equipped with a hydrohammer
- C** Backhoe Dredger "Colbart" & TSHD "Flevo" in operations
- D** TSHD "WD Fairway" in the Port of Mumbai



awarded a subcontract to execute the pre-trenching, backfilling and landfall works from the Landfall Point to 19.5 kilometres offshore (from Port Limits). Project preparations commenced in August 2004 and all operations were completed in May 2005 well before the start of the monsoon season. Upon completion of the operations within the Port Limits Boskalis was requested to use their expertise for the post-trenching of both pipelines until 130 kilometres offshore.

PRE-TRENCHING OPERATIONS

A trench was dredged to a width of 8 metres in the near-shore section (1.6 kilometres) and to a width of 10 metres further offshore. Soil conditions in the area vary between very soft silty clay and weathered basalt. In the case of



hard material, a cover of 1 metre on top of the pipeline was required, in the case of soft material a cover of 3 metres. Three dredging units, each with its own specific features, were mobilized for the operations.

The backhoe dredger "Colbart" dredged the near-shore part of the trench, where the water depth limited the activities of the hopper dredgers, and the sections where hard material was encountered. To pre-handle sections with hard material, the "Colbart" was fitted out with a S35 hydrohammer.

The trailing suction hopper dredgers "Flevo" and "Seaway" were mobilized to dredge the shallow parts of the trench and the offshore section respectively. The dredged material was deposited in a temporary storage area at 1 kilometre distance from the trench to be re-used for backfilling.

To allow HHI's lay barge to approach the shore close enough an access channel was dredged

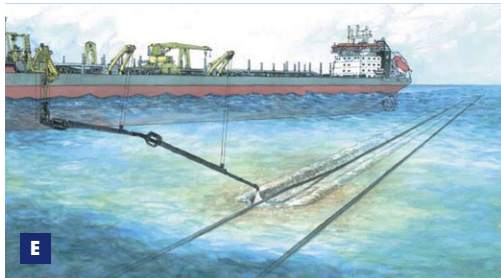
with a width of 60 metres and a guaranteed sufficient water depth to enable the lay barge to work at all times. At the shore land-based equipment was used for the excavation of the tidal area. To provide the vessels with accurate and up-to-date progress data a multibeam survey launch performed surveys. The constant provision of adequate data enabled the vessels to perform optimally and to adjust their day-to-day planning as per the requirements for achieving the design profile.

BACKFILLING OPERATIONS

Immediately upon completion of the shore pipe-pull, backfilling operations were started in the available areas. Combining backfilling in the near-shore sections with pipe laying in deeper water resulted in an optimal process, which was required for completion within ten weeks. A part of the backfilling works, by "Seaway" and "Flevo", was done by discharging through the suction pipe. To enable the "Flevo" to perform this action its pipe layout was converted. The remaining part was backfilled by means of discharging through the bottom doors, and that by "Flevo" only. The vessel's small size and ability to position itself exactly above the trench made the "Flevo" very suitable for this kind of operations. This cautious way of discharging resulted in a controlled rising of the backfill level.

POST-TRENCHING OPERATIONS

In addition to the "Seaway" the "WD Fairway" was mobilized to Mumbai for the post-trenching operations. Both vessels were equipped with a purpose-built jet nozzle instead of a draghead. This nozzle created a jet stream which penetrated and eroded the seabed around and underneath the pipelines, which were gradually lowered to the required level. Giving the distance offshore and the water depth in the working area, a multi-beam echosounder was installed on the suction pipe allowing the vessels to perform their own surveys. To ensure the integrity of the pipelines a profiler was fixed on the suction pipe, providing the operator with online information on the position of the jet nozzle with respect to the pipeline. Post-trenching of 420 kilometres was successfully completed in a period of one month.



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- E** Post-trenching system as used on TSHD "WD Fairway" and on TSHD "Seaway"
- F** Jet nozzle of TSHD "WD Fairway"
- G** Land-based equipment excavating at the Landfall Point at Uran.
- H** TSHD "Seaway" during post-trenching works

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