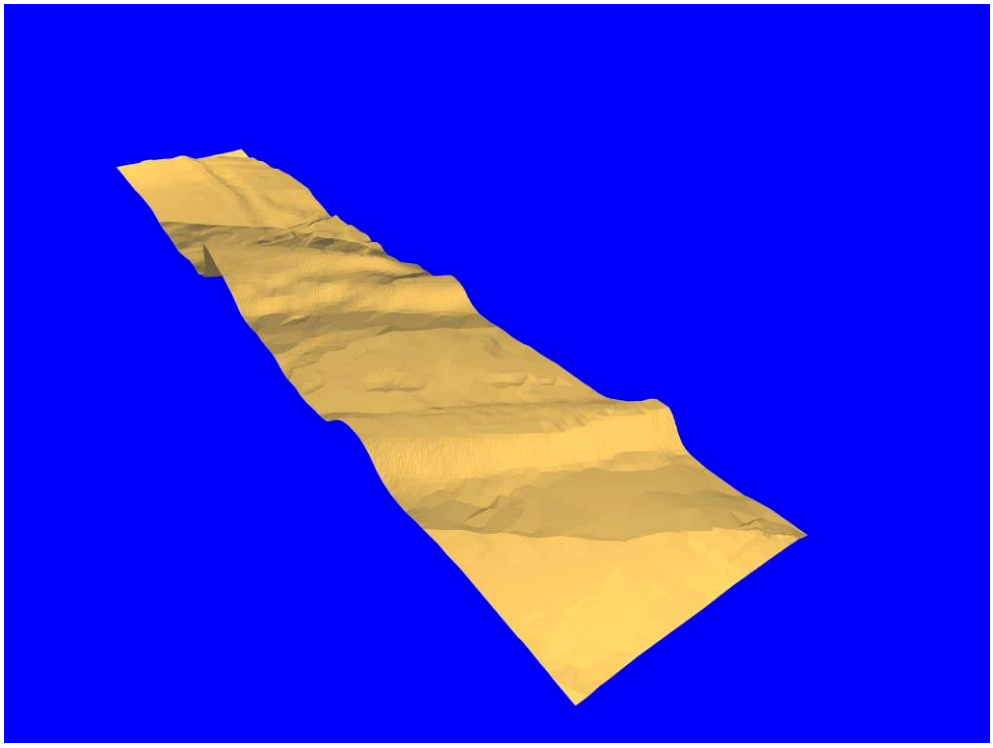
DF1-1 Pipelines
Dynamics of Sandwaves

China National Offshore Oil Limited Corporation (CNOOC) intends to develop the Dongfang 1-1 Gas Field for hydrocarbon production. The field is located in the South China Sea about 110 km to the west of Dongfang county on Hainan Island, in about 70 m of water. The selected route of the 22" export pipeline will pass through a sand wave / ridge area from KP 43.4 to KP 93.27 over a distance of about 50 km.

Seabed changes may occur as a result of migrations of the sand waves / ridges. Seabed rectification work may be required in the form of pre-sweep dredging and post-lay trenching. The design of these works is generally a major technical challenge and an important factor determining the cost-effectiveness and long term safety of the pipeline. Large scale movement of sand waves / ridges could result in pipe exposure and the generation of free spans. Potential large costs would be incurred if intervention is required. The purpose of this study was to specify a technically feasible, cost-effective definition of pre-sweeping cut lines and trench profiles while securing long term pipeline integrity.

Client: **CNOOC**

Carried out in: **2001**



Project description

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Introduction

To install a pipeline through a sand wave area, a large amount of seabed rectification is often required. The design of these works, i.e. pre-sweep dredging and post-lay trenching is generally a major technical challenge and has a significant effect on the cost-effectiveness and long term safety of the pipeline.

An important aspect of pipeline design through sand wave fields is the required burial depth. The burial depth is the result of an optimal balance between safety of the pipeline and trenching cost.

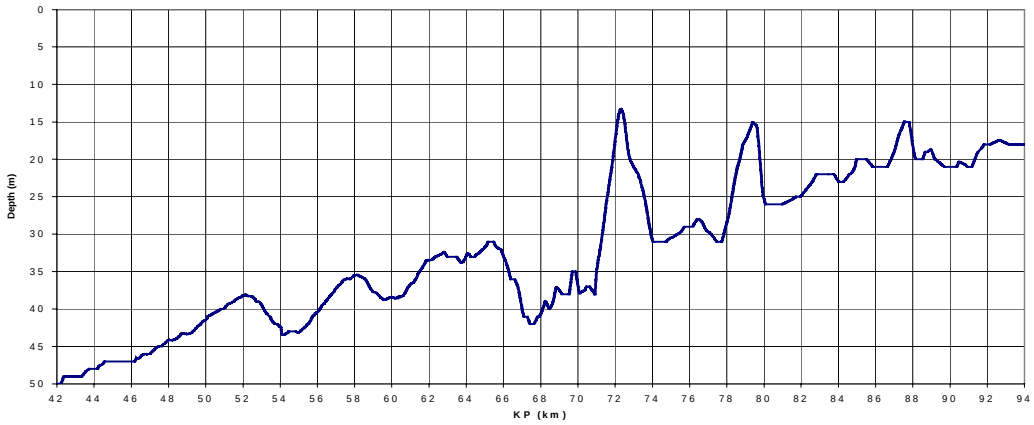
In this study, an integrated approach was taken to achieve a technically feasible, cost effective definition of pre-sweeping cut lines and trench profiles while securing long term pipeline integrity.

Study Approach

The following approach was applied:

- Determine the seabed variability along the pipeline route, consisting of:
  - short term (seasonal and yearly) variations and
  - long term variations (due to migrations of sand waves).
- Combine both short term and long term variations to obtain the lowest seabed level that may occur during the pipeline design life.
- Determine the required pre-sweeping
- cut lines and the burial depth (post-trenching) of the pipeline. This was based on the long term pipeline integrity. The following sources of risks were taken into account:
  - pipeline stability during installation and operation;
  - free span lengths within allowable maximum lengths during installation and operation.
- Cost estimation and optimisation.

The assessment of the sand wave dynamics and associated seabed variability along the pipeline route utilised historical survey data close to the pipeline route and experience from other similar projects. The short term variations are due to changes in the wave and current conditions from season to season and from year to year. These variations result in generation, migration and disappearance of small mega-ripples and sand waves superimposed on the large scale tidal sand banks. These small bed forms are likely to occur in the intermediate water depth (20 to 40 m) and on a sandy seabed. They are less likely to occur in deeper water and on a less erodible seabed. The magnitude of the short term variations is determined by the dimensions of the bed forms superimposed on the tidal banks. The long term seabed variations are due to changes in the long term environment and due to migrations / movement of large scale tidal banks. The tidal banks are expected to be stable and the migration rates, if any, will be small. This conclusion is supported by observations in other similar situations.



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