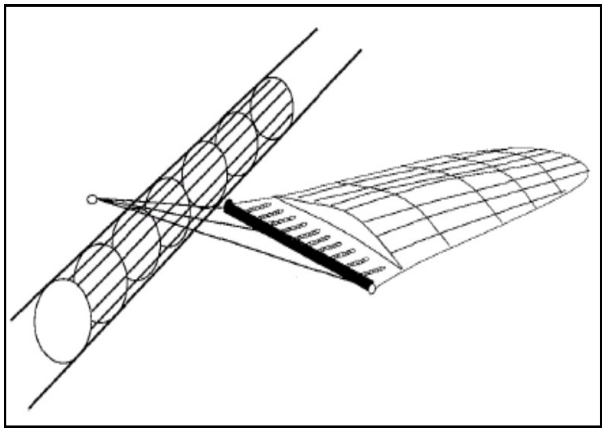
The increasing need to develop marginal fields has resulted in a prime need for minimum installed capital cost. The elimination of trenching by engineered protection of the submarine pipelines can form an integral part of the solution.

The cost of trenching and gravel bund protection of submarine pipelines can be much greater than that of the installed cost of the pipeline. Where seabed soils are very stiff or contain boulders, trenching can be very difficult if not impossible.

Legislation changes, on pipeline abandonment, have forced operators to re-evaluate the approach to trenching protection and the problems, of buckle upheaval.

In the granting of a Works Authorisation, the authorities are now taking a more pragmatic approach, as long as the operator can demonstrate that the pipelines will not pose a risk to human life or the environment, nor will they become a hazard to other users of the sea.



In support of an application for a dispensation not to trench and for protection of small diameter pipelines, a rigorous investigation must be carried out. The following method has been utilised in support of two successful applications for the non-trenching of 6, 8 and 10 inch diameter pipelines.

Risk and Consequence Analysis

For the majority of hazards, such as fishing gear and dragged anchors, the probability of an occurrence happening is quantified and the extent of possible damage together with its expected consequences is known. The risk due to fishing is based on an historical data base established for each block. This enables trend analysis to be carried out for differing categories of equipment. The trends can then be related to low, medium and high projections of EEC fish quotas to derive predictions over the expected life of the pipelines. A comprehensive statistical data bank has been developed to support this work.

Impact Analysis

The prime requirement of this analysis is to demonstrate that there is no danger of the integrity of the steel pipeline being comprised following an impact. This is achieved by modelling the pipeline as a compliant structure, and analysing its behaviour during the two distinct time domain phases of a trawl board interaction. These are 1) the initial impact when the energy is absorbed by the shell of the pipeline as its inherent inertia prevents its movement. 2) the pullover load where energy in the tow system is transferred into the pipeline and is deflected until the over-turning moment results in the release of the trawl board. The contribution of the pipelines mass, flexural rigidity and its added mass and other hydrodynamic forces are all determined within the model.

Coatings

The coatings applied to the external surface of a pipeline act to dissipate Hertzian stresses local to the point of impact. The behaviour of both concrete and thermal insulation coatings are modelled for known contact characteristics. Thermal insulation coatings are modelled as either a visco elastic or consolidated material.

Mechanical properties including compression and shear strain correlation's are built into the model for a range of operating temperature.

Works Authorisation and Liaison

A very important aspect in achieving a works authorisation is the preparation of the application and the subsequent liaison with regulatory and other interested parties such as the fishermen's associations.

Impact Testing

In support of the analytical work considerable full scale impact tests have been carried out on both coated and uncoated pipe. Instrumented tests were also carried out to verify time domain history.