

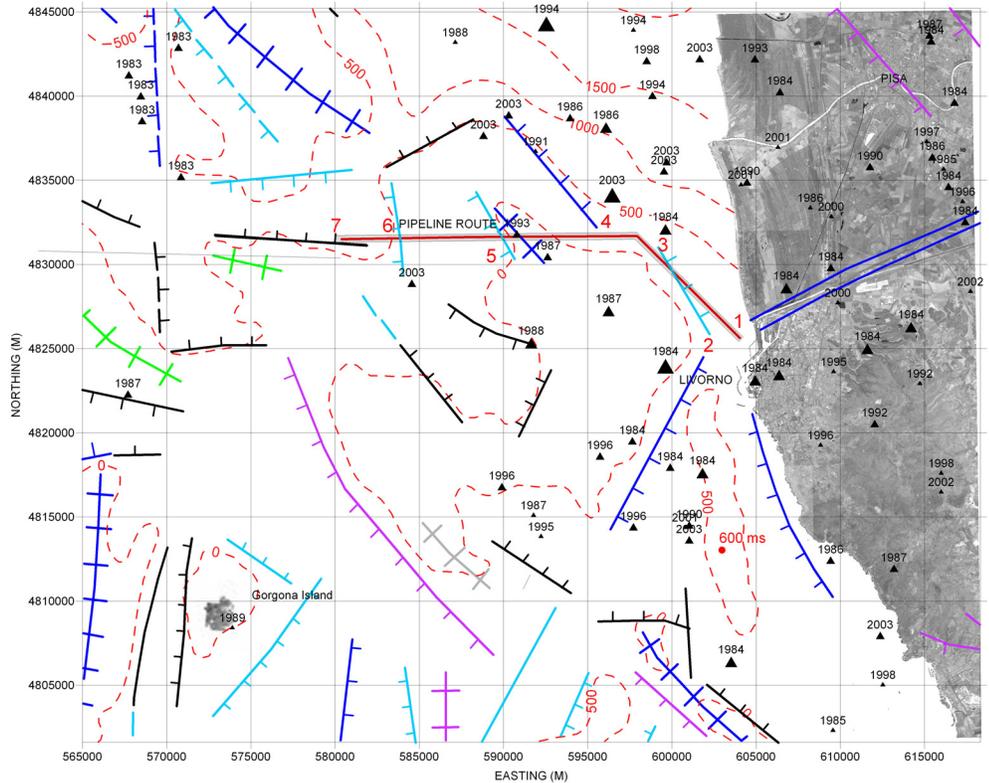
PROJECT PROFILE

DEVELOPMENT OF SEISMIC DESIGN CRITERIA FOR LNG TERMINAL PIPELINE

The proposed OLT Offshore LNG Project will require construction of a large pipeline from Livorno, Italy to a floating LNG storage terminal located approximately 12 kilometers offshore in water approximately 100 meters deep. D'Appolonia was retained in the pre-engineering phase of the project to develop seismic design criteria for the pipeline and also to determine the potential for sea floor displacement from active faulting.

Design ground motion was evaluated through a probabilistic seismic hazard assessment (PSHA). The components of the PSHA included identifying the main seismic sources that can affect the site, defining the seismic activity of these sources, and establishing the ground motion that could be caused at the site by earthquakes occurring in the various source zones. The hazard, expressed in terms of PGA, PGV and spectral acceleration at various return periods was then determined by numerical integration using the D'Appolonia in-house computer program ETQRISK.

The seismotectonic model was developed based on the ZS4 national zonation for Italy and the current work of

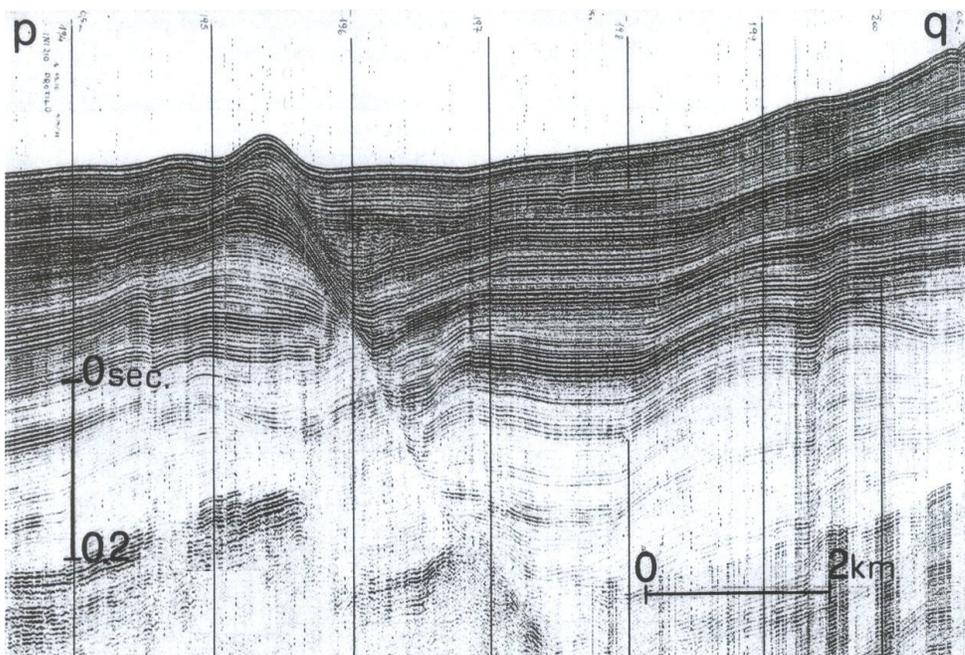


Interpretation of fault activity in the vicinity of the proposed LNG pipeline with instrumentally-determined earthquake epicenters.

national research groups (Gruppo Nazionale per la Difesa dai Terremoti and Istituto Nazionale di Geofisica). Historical records do not suggest that the Livorno area has a high seismic hazard, as confirmed by the results of the PSHA. Nevertheless, available pub-

lished data indicate that the pipeline route does cross faults with Quaternary activity. Furthermore, an anomalous swarm of small earthquakes occurred along the pipeline route in 2003, with the largest event causing some panic, but no significant damage in Livorno. The recent earthquakes confirmed that fault activity should be carefully evaluated, although the apparent lack of fault scarps from the available side-scan sonar data suggests that fault movements have not occurred recently. Based upon review of previously acquired seismic reflection data, it did not appear likely that fault movements have taken place during the Holocene. Nevertheless, additional data in the form of subbottom profiling and age-dating of sediments will be necessary for confirmation that the return periods of the fault movements are sufficiently long that they are not of an engineering concern.

Currently, this project is on hold pending resolution of political, environmental, regulatory and funding issues.



Sparker profile of fault in vicinity of pipeline route.