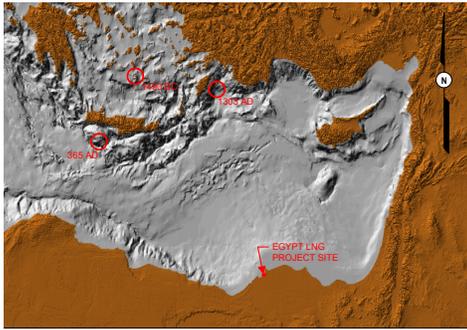


PROJECT PROFILE

GEOHAZARDS ASSESSMENT FOR LNG PROJECT IN NILE DELTA, EGYPT

Bechtel International was the prime contractor for a Front End Engineering Design (FEED) study for a Liquefied Natural Gas (LNG) export facility to be located near Idku, Egypt. In addition to gas treatment and liquefaction facilities, the plant was planned to have a number of large cryogenic LNG tanks designed to the National Fire Protection Association (NFPA) 59A code. D'Appolonia was retained to evaluate possible geohazards associated with the project, including the potential for tsunamis,



Location of historical earthquakes producing tsunamis along the Egyptian coast.

which are seldom considered as a significant threat along the Mediterranean coast of Egypt.

The Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE) were determined as part of a probabilistic seismic hazard assessment (PSHA). Seismotectonic source zones were identified from the regional geology. Source activity was determined by analysis of historical and instrumental earthquake catalogs. The induced ground motion at the site was modeled based upon attenuation relationships appropriate for the region. Uncertainty was addressed using a logic tree formulation.

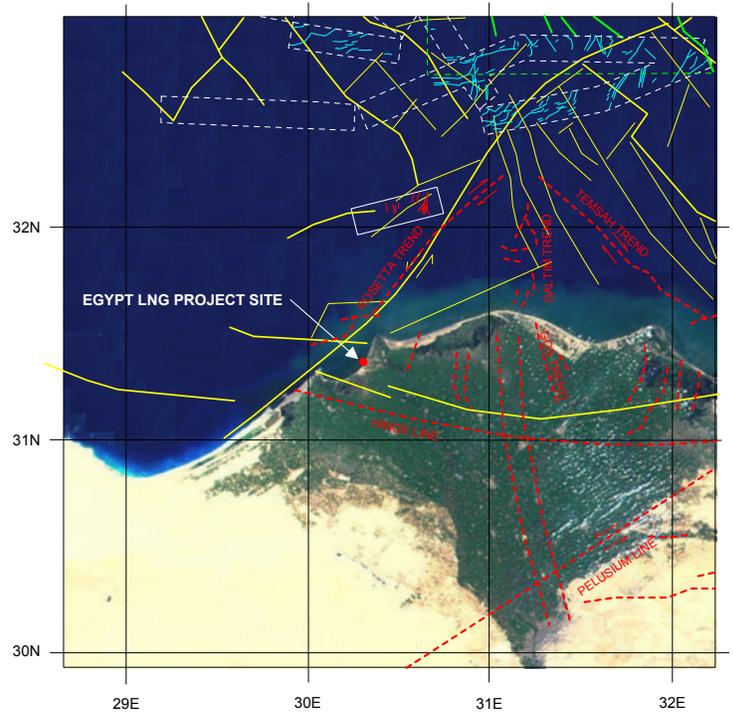
Numerous geologic faults have been mapped in the vicinity of the Nile Delta. D'Appolonia performed a lineament analysis of satellite imagery in order to screen for unidentified faults. Offshore and onshore geophysical data were examined for evidence of faults that displace recent sediments. The study showed that while geologically young faults are present in the region, no faults exhibiting Holocene dis-

placement are present near the site.

Our study identified tsunami as a significant hazard along the Egyptian coast. Three major tsunamis have affected the nearby city of Alexandria in the past 3,000 years. A review of the Mediterranean tsunami catalog was performed in order to identify the primary seismic source zones. Deterministic analysis was used to predict the area that would be flooded by a 5000-year recurrence interval tsunami.

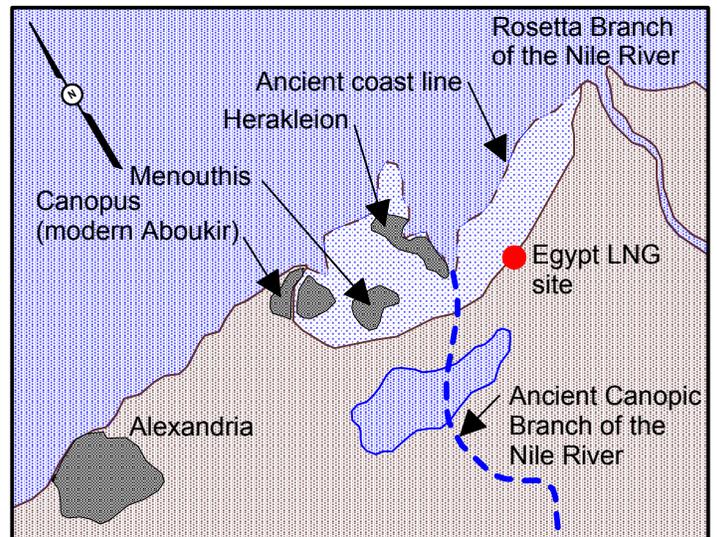
An interesting aspect of the fault study proved to be an evaluation of the cause of the submergence of the towns of Herakleion and Menouthis. Recent archaeological studies have found that these two towns, which are located northeast of Alexandria, suddenly disappeared beneath the sea more than one thousand years ago. Over the past several years there has been substantial public controversy regarding the possibility that an active fault could have been the reason that these recently discovered ancient towns became submerged.

However, offshore seismic reflection data compiled for another project in the region (the Scarab-Saffron project, where D'Appolonia was responsible for the inter-



Regional faults in the area of the Nile Delta. Note location of Egypt LNG project site.

pretation of the offshore geophysical data), demonstrate that an active fault was not the cause of the submergence of these two towns. Major catastrophic slope failure related to flooding subsequent to migration of the ancient Canopic Branch of the Nile River to its present Rosetta Branch position now appears to be the most likely cause of the submergence of the two towns.



Location of the ancient towns of Herakleion and Menouthis.