RISK ASSESSMENT

OFFSHORE OIL AND GAS OPERATIONS

The combination of hostile environments, uncertain technological methods, and large-scale operations increases the likelihood of accidents and the potential severity of the consequences for workers, the environment, and investors

FLOYD R. TULER
Associate Professor, Mechanical Engineering
Worcester Polytechnic Institute
Worcester, Massachusetts

Oil and gas production offshore has become an increasingly important component of total world petroleum production. At present, over 26 percent of the world's oil is produced from offshore wells, up from approximately 20 percent in 1979. And notwithstanding currently stabilized demand and price for oil, more than 3700 exploration and development wells are expected to be completed offshore in 1984—about a 6 percent increase over 1983.

Varied and complex technologies and human activities are involved in the exploration, development, and production of oil and gas offshore. Failure to provide for the safety of these operations can result in a wide range of undesirable consequences to people, the environment, property, and to continued production. Major accidents have already occurred—most notably the collapse of the Alexander Kielland and the sinking of the Ocean Ranger and the Glomar Java Sea, as well as several helicopter crashes, and the Ekofisk and Ixtoc-I blowouts—with large loss of life.

In earlier phases of the offshore industry, development of the necessary technology and methods was for the most part an evolutionary process that grew out of techniques for drilling on land. However, offshore installations are among the largest structures constructed by man. They must be fabricated in drydock or sheltered water, towed over open sea, and installed at a precise location. In addition, new and unproven technological methods have been required as exploration and production have moved into more hostile regions where weather is more severe and less predictable, waves are higher, water depths are greater, temperatures are lower, onshore facilities are less accessible, and formation pressures are less predictable. Installations in these more hostile regions are generally much larger and more costly than those used in regions such as the Gulf of Mexico. Thus, the combination of hostile environments, uncertain technological methods, and large-scale operations increases the likelihood of accidents and the potential severity of the consequences for workers, the environment, and investors.

Risk, which combines the probability of occurrence of an event and its consequences, can be used to compare large potential hazards (e.g., to pipeline risers) and high-probability events (e.g., pump or compressor leakage). Thus, risk analysis techniques provide a framework for a better understanding of risks, for improving designs, and evaluating the effectiveness of proposed improvements. Increasingly, formal risk analysis is being used in planning, designing, managing, and regulating offshore activities worldwide.

Details of formal risk analyses on specific installations, operations, or systems are not generally available in the open literature, most studies having been done by industry for internal use or for submission to a govern-