would be no more than a pinhole in size, but would enlarge over time. The leakage rate from a ¼-inch diameter hole at a pressure of 172 psi would be 6 bph. If the leak occurred within the safety zone (i.e., discovered within 24 hours), spillage would be no more than 144 barrels. If the leak occurred in open water somewhere between terminal and shore (i.e., discovered within 72 hours), spillage would be no more than 432 barrels.

Total failure of a bolted connection (i.e., complete separation) is considered unlikely because of the number of bolts involved. More-likely are partial failures resulting in gasket or flange leaks; at normal working pressures, leakage rates are estimated to be 8 bph. All bolted pipeline connections are within the safety zone; therefore, leaks would be discovered within 24 hours. A leaking connection from a floating hose might spill 204 barrels before discovery. However, many of the bolted connections are on the tanker or pumping platform where leaked oil would be contained by spill coamings or troughs and discovered during normal watchkeeping rounds.

Another possible spill source would be from a floating hose if run over by a service craft or fishing vessel that slashes the hose with its propellers. The risk analysis determined that the steelreinforced wall construction of the hoses makes it unlikely that they could be fully severed by the propellers of service vessels. Rather, a slash might penetrate through the inner wall of the hose. Such a slash would leak only when the pipeline was pressurized; total leakage is estimated to be not more than 165 barrels.

The largest maintenance accident would be spillage of the entire contents of a floating hose and the SPM base (approximately 667 barrels).

13. Tanker Spill Analysis

OPA 90 relieves a deepwater port of any liability for tanker spills caused solely by the tanker. Thus, LOOP is not responsible for spills solely caused by malfunctioning tanker equipment (such as valves or seachests), or human error by tanker personnel (such as discharge of oily bilgewater), or from other accidents aboard the tanker (such as fire or explosion) which are not caused by LOOP.

For most of the time during its call at LOOP, a tanker is under sole command and control of its master and officers, who are responsible for safe operation and maintenance of their vessel and its equipment, and for compliance with all applicable Federal regulations. However, there are certain tanker spill scenarios for which LOOP might be liable (solely, or jointly with the tanker). These scenarios arise during those periods when the tanker is under joint navigational responsibility of LOOP and its own master, or joint transfer responsibility during discharge of the tanker's cargo oil. Because of these joint responsibility situations, LOOP's potential liability for a tanker spill must be reviewed as part of this rulemaking.

14. Navigation-Related Tanker Spill

Joint navigational responsibility exists when the tanker is maneuvering within the port's safety zone under direction of LOOP's Vessel Traffic Controller, or is maneuvering to or from the SPMs with the LOOP mooring master on board. (Although LOOP reports that the mooring masters are independent contractors to LOOP, OPA 90 does not limit or relieve the liability of a responsible party for acts or omissions by its agents or contractors.)

The most serious navigation-related accident that could occur at a deepwater port would be a collision between a tanker and another tanker or platform. A possible cause for such a collision could be mechanical failure of the tanker's steering system. In 1990, LOOP conducted a risk analysis that examined steering and propulsion failure scenarios of tankers maneuvering around the safety zone. As a result of this study, LOOP contracted a purposebuilt tractor tug that is specifically designed for controlling disabled tankers. This tractor tug, the LOOP **RESPONDER**, has been in service at LOOP since 1992.

Lesser navigation-related tanker spills, resulting from bona fide accidents where LOOP might be found solely or jointly liable, are more possible. One of these is a mooring overrun where the tanker runs over the SPM while maneuvering to or from the buoy. The risk analysis determined that the worst-case outcome for a mooring overrun would be severance of the two floating hoses, spilling a maximum of 209 barrels. Because of the slow tanker speeds during mooring and unmooring operations (less than 5 knots), and the heavy fendering arrangements on the SPM buoy, rupture of the tanker's hull (by impact with the SPM buoy) is not expected.

Another possible accident is a collision between a service vessel and a tanker. Once again, however, the tanker hull is not expected to be ruptured because of the slow relative speeds and fendering arrangements on the service vessels.

The risk analysis concluded that it was not possible to predict a maximum

spill size from an accident involving a tanker. This is because there are too many circumstances and variables that influence the outflow. However, it is unlikely that such accidents could occur without being in violation of Federal regulations, particularly those governing tanker movements within the safety zone. In such a case, the responsible party (LOOP or the tanker) would not be allowed to limit its liability, regardless of the limits established by this rulemaking.

15. Transfer-Related Tanker Spill

Joint transfer responsibility occurs when the tanker operates its cargo pumping system in response to directions from LOOP's Oil Movement Controller. A tanker spill during transfer operations is expected to be associated with the bolted connections where LOOP's floating hoses connect to the tanker's cargo manifold. Because LOOP furnishes the gaskets and bolts used in making the connection, and oversees the bolting and unbolting of the hoses, LOOP is potentially liable for any spillage from the connection.

The risk analysis determined that complete failure (separation) of the bolted connection was improbable because of the size and number of bolts used. It is more likely that spills would be caused by leaks resulting from a poorly-sealed connection. The risk analysis determined that such spills would be less than 10 barrels (the most serious being the result of a gasket failure).

16. Historical Spill Costs

At this time there is no economic model for projecting costs of an oil spill along the Louisiana Gulf coast. There have been some recent crude oil spills in those waters, but the final costs are not yet known. Accordingly, estimating the cost of a maximum credible spill must be done from broader historical data on U.S. spills.

The Coast Guard and Volpe National Transportation Systems Center (TSC) commissioned the Unisys Corporation and Mercer Management, Inc. to study and develop oil spill cleanup costs, third-party compensation, and natural resource damage data.

The results are presented in the draft Interim Report "OPA 90: Regulatory Impact Analysis Review—Spill Unit Values," dated September 15, 1992. The study researched all tank vessel oil spills of over 100,000 gallons (2,381 barrels) that occurred in U.S. waters between 1980 and 1990. The study's oil spill database contains cost information for some 59 incidents, representing 76 percent of the total volume spilled from