pumping platform (approximately one and a half miles) is not directly computer-monitored. A major pipeline rupture along this section will create an abnormal pressure drop at the suction side of the booster pumps on the pumping platform, detectable by the SCADA sensors. Such a pressure drop would also be apparent to personnel on watch in the tanker's cargo control room, who would initiate a shutdown of the tanker's cargo pumps. A minor leak will create a surface slick, visually detectable from the tanker, pumping platform, or service vessels always operating around the Marine terminal. Whenever a tanker is discharging at an SPM, a LOOP service vessel also conducts sunrise and sunset inspections each day along the SPM pipeline and around the tanker.

## 11. Major Pipeline Spill Scenarios

Major pipeline spill scenarios are based upon total severance of the pipeline during a full-capacity transfer operation at 100,000 bph flow rate. There are two points in the pipeline system where maximum spills could occur: Severance of the main oil pipeline (which connects the terminal to shore), and severance of a floating hose (that connects the tanker to the SPM).

(a) Severance of main oil pipeline: The scenario assumed complete severance and offset of the pipeline by 48 inches, allowing full, unimpeded discharge from the severed end. This severance was assumed to occur at the midway point (56,000 feet) between the marine terminal and the Fourchon booster station, which is the furthest distance (10.6 miles) from any of the SCADA sensors. This represents the longest time delay (16 seconds) before the transient pressure wave would reach a sensor. The water depth at that point is 50 to 60 feet, well within the working range of divers to effect repairs.

The failure analysis determined that, within 24 seconds of the rupture, the SCADA computer would identify abnormal pressure data at both the marine terminal and Fourchon booster station sensors and trigger alarms at the LOOP Operation Control Center. Full system shutdown (tripping booster pumps off-line, hydraulically closing control valves, and depressurization of the pipeline) would be accomplished in 3 minutes from rupture. The estimated spillage during this shutdown period would be 2,785 barrels.

After shutdown, and because its density is heavier than crude oil, seawater will begin to flow into the "offshore" ruptured pipemouth, displacing an equal volume of crude oil

out of the pipe. Because the seafloor gradient is nearly flat (110 feet of water depth over 18 miles of pipeline length), this will be a low-energy displacement process. For the first few minutes after rupture the displacement rate will be approximately 1,366 bph, but will slow down rapidly as the seawater intrudes deeper into the pipeline and must overcome the increasing resistance (viscosity and other frictional losses) of displacing oil back out of the pipe. After 14 minutes the displacement rate would be approximately 877 bph, and after 5 hours it would be approximately 367 bph. Over a 5-hour period it is estimated that the seawater will intrude approximately 2,150 feet into the pipeline, displacing 2,409 barrels of crude oil.

Depressurization of the "onshore" pipeline (from rupture to Clovelly Dome 33 miles away) would take 51 seconds, during which time approximately 500 barrels of seawater will be sucked into the ruptured pipemouth. LOOP would keep the shoreside pumps on line in order to maintain suction on the pipeline and continue drawing in seawater; 30 minutes of this suction would assure a full water plug in the pipeline, precluding any oil backflow out of that ruptured pipemouth (a full water plug would be approximately 3,868 barrels).

In the meantime, LOOP will also activate its response plan for locating and plugging a pipeline rupture. LOOP maintains a service vessel and a team of divers continuously on-duty at the marine terminal. The service vessel can transit the 18-mile offshore distance in less than 2 hours, following the pipeline and searching for the surface slick. Once located, divers would be able to temporarily seal off the open pipemouth within 3 hours. Complete repairs to the pipeline would be accomplished without further spillage, using pipe stoppling and repair techniques already developed by industry.

Therefore, the maximum spillage expected from severance of the main oil pipeline is not more than 5,194 barrels.

(b) Severance of a floating hose: Two 24-inch ID floating hoses connect the tanker to the pipeline manifold located on the seafloor at the base of the SPM. Each hose string is designed for a flow rate of 50,000 bph, and is approximately 1,100 feet long, made up of 24 to 26 hoses bolted together. The wall construction of a hose is an inner liner of <sup>1</sup>/4-inch-thick rubber, surrounded by <sup>3</sup>/4 inches of multi-ply cord reinforcement (either steel wire or poly cord), two helix windings of <sup>1</sup>/<sub>2</sub>-inch steel wire, a <sup>1</sup>/<sub>4</sub>-inch outer liner, and a <sup>1</sup>/<sub>4</sub>-inch reinforced rubber covering.

Total severance of a floating hose would cause a substantial pressure drop in the pipeline. This pressure drop would be detected by the SCADA sensors at the suction side of the booster pumps on the pumping platform, triggering alarms at the LOOP operations center. Simultaneously, the pressure drop would also be apparent to the cargo officer in the pump room aboard the tanker. The risk analysis determined that emergency shutdown and depressurization would take 3 minutes (1 minute for failure recognition, 2 minutes to trip pumps offline and close control valves on the tanker and SPM manifolds). Pressurized outflow during that period is estimated to be 1,667 barrels. Assuming complete volumetric loss of the hose contents itself (570 barrels) and the SPM manifold (96 barrels), the total spillage would be 2,333 barrels.

## 12. Other Pipeline Spills

The leak detection thresholds of the SCADA system are 314 barrels within 13 minutes, 503 barrels within 1 hour, and 1,257 barrels within 48 hours. Thus, the SCADA system is expected to detect any leak of 26 bph or more, for a maximum spillage of 1,257 barrels before discovery.

Leaks of a lesser rate would be below the detection level of the SCADA system and would therefore have to be detected visually as surface slicks, discovered from service vessels or overhead flights. Because of the high level of service vessel activity around the port, the risk analysis assumes that surface slicks within the LOOP safety zone will be discovered within 24 hours. Because of the high level of aviation (helicopter) activity around the waters of the Gulf, the risk analysis assumes that slicks in open water will be discovered within 72 hours. These discovery time delays are conservatively long, allowing for periods of night (when visual detection is unlikely) and also recognizing that small leaks from a seafloor pipeline (in 100 feet of water) may be thinly dispersed, and therefore more difficult to notice, by the time the oil reaches the surface. However, once discovered, leakages would be reduced to trickle amounts by shutting down and depressurizing the pipeline.

The LOOP risk analysis determined that small pipeline spills could result from corrosion pits, failure of bolted connections (gasket or flange leaks), lesser pipeline ruptures, or maintenance mishaps.

Leakage from corrosion pits in the pipeline would depend upon the size of the corrosion hole and the oil pressure within the pipeline. Initially, the hole