Excerpt from Special Report 293, Risk of Vessel Accidents and Spills in the Aleutian Islands DESIGNING A COMPREHENSIVE RISK ASSESSMENT, pp 120-122.

Phase A Consequence Analysis

Although spill size serves as an indicator of consequences, it does not by itself define consequences to the extent that it can be used to compare reliably the risk posed by certain accidents and risk control measures. The type of oil or other hazardous substance, the location of the spill, and the time of year the spill occurs influence the extent of damage to natural resources, cleanup costs, and socioeconomic costs, and they should be considered along with spill size when consequences are evaluated.

To illustrate the importance of substance type, spills of persistent oils, such as the heavy fuel oil used for bunkers of large commercial ships, have properties different from those of the diesel oil and marine gas oil used for propulsion of smaller craft, such as fishing boats. The lighter refined products are more volatile, and their evaporation reduces the amount of oil remaining on the surface. Compared with spills of heavy oil, spills of diesel oil and marine gas oil generally have much lower cleanup and socioeconomic costs. Spills of diesel oil and marine gas oil also generally have less impact on seabirds and mammals, cause less shoreline contamination, and have lower cleanup costs than spills of heavier oils. On the other hand, the lighter oils dissolve and disperse more readily into the water column and can be expected to have greater impacts on fish and invertebrates in the water and on demersal fish and invertebrates in the benthic zone.

Likewise, the impacts and costs of spills are highly area dependent. Those impacts and costs are influenced by a range of factors, such as environmental conditions (tide, current, wind, sea state), sensitivity and exposure of natural resources, and the extent of economic and societal reliance on the sea and coastal regions. To provide an understanding of the relative influence of substance type, spill size, and location on spills in the study region, a scoping spill consequence analysis should be performed as part of the Phase A Preliminary Risk Assessment. At this stage, the consequence analysis should be a high-level assessment of natural resource vulnerability rather than a comprehensive assessment of biological impact and costs of natural resource damage. As necessary, more detailed analyses can be carried out when risk reduction measures are assessed.

The Phase A consequence analysis, then, should cover a mix of spill sizes, substance types, and locations. As noted in the preceding section, the specific parameters to be addressed by the analysis should be determined on the basis of the results of the traffi c, spill baseline, and spill likelihood and size studies. The following scope is suggested for the analysis:

• Spills of two to four types of substances should be evaluated. At a minimum, heavy fuel oil and diesel oil should be evaluated. On the basis of the projected spill rate data developed during the spill baseline study, it may be decided that certain chemicals or other products, such as crude oil, marine gas oil, or gasoline, merit inclusion in the consequence analysis.

• Three to five geographic spill locations should be evaluated. These locations should include those where spills (particularly larger ones) are likely to occur and where environmental or economic impacts are expected to be most severe.

• Two or three sizes of spills should be evaluated, including the 50th and 95th percentile

spill volumes (a typical and a large spill).

The physical fate model used should be three-dimensional and capable of calculating mass balance for relevant spaces, including the water surface, the shoreline, the water column, and sediments. The model should permit evaluation over time of the surface oil distribution and concentrations of oil in the water column and sediments. The environmental conditions (wind, currents, tides, and waves) input to the models should be derived from local long-term statistical data, with the date and time varied randomly to provide a range of weather conditions.

For this preliminary consequence analysis, the extent and concentrations of oil should be used as a surrogate for impact on natural resources. To provide an indicator of impact on seabirds and mammals, exposure should be expressed in terms of water surface area oiled, geographic extent of shoreline oiling, and percentage of oil washed ashore. To provide an indicator of impact on fish and invertebrates, the volume of water affected above thresholds of concern, as well as the area of bottom sediment contamination, should be determined.

In the detailed consequence analysis that may be required for assessment of risk reduction measures or for cost–benefit analysis, a biological model should be applied to measure exposure of aquatic habitats and wildlife to the substances spilled. Such a model should determine the impact of the substances on populations, given abundance data for the species of interest. It is important for the fate and biological modeling tools to be well established and calibrated against actual spill data.

During this preliminary consequence analysis, assessment of socioeconomic impacts should be qualitative. Such impacts are difficult to quantify, especially during the preliminary stages of a risk assessment, but are a significant part of the overall consequences of a spill. Studies (e.g., McCay et al. 2003) indicate that when all impacts are quantified, the socioeconomic costs alone can exceed the aggregate cost of property damage, cleanup, and resource damage for some scenarios. The Aleutian region is characterized by a high level of resource dependency (see Chapter 3) and therefore a high level of community vulnerability to spills of oil and other hazardous substances. (See Appendix I for further discussion of resources at risk, resource dependency, and community vulnerability in the region.)