Phase A Risk Assessment - ERM & DNV Models

Traffic Study and Chemical/Oil Spill, Fate/Transport, and Effects Modeling

Introduction

The Risk Analysis Team bridges collective modeling expertise to the Phase A study as described below:

- DNV brings the Marine Accident Risk Calculation System (MARCS) model. MARCS calculates its main outputs as accident frequencies and quantities of cargo and bunker fuel spilt at a particular location, and
- ERM brings their capabilities in spill trajectory modeling and fate analyses using COSIM.

COSIM

Though there are several publicly available models to simulate an oil or chemical spill, most do not provide the necessary flexibility and detail needed for an accurate hindcast or forecast of a release to enable proper understanding of the fate of the various components of the oil. ERM has addressed this need through COSIM, Chemical/ Oil Spill Impact Module. This tool is a plug-in component to ERM's Generalized Environmental Modeling System for Surfacewaters (GEMSS), a numerical waterbody modeling package, capable of one-, two-, or three-dimensional hydrodynamic analyses. GEMSS can be applied to any type of waterbody and can compute the circulation and transport of water and any constituents, including water quality parameters and the chemical or oil constituents of concern. The GEMSS-COSIM modeling system can produce time-varying mass balances to examine the fate of the released chemical constituents into the various phases and forms including the surface slick, shoreline, atmosphere, water column (dissolved or entrained), sediments, or removed via cleanup activities. The fate calculation includes the following processes: advection, spreading, evaporation, dispersion, dissolution, emulsification, photo-oxidation, sinking/ sedimentation, biodegradation and encapsulation (when ice is present).

Several features set COSIM apart from more traditional two-dimensional surface-only spill models. COSIM has the flexibility to examine any location, whether coastal or inland, without being restricted to the shorelines built into the model.

One of the strongest distinctions is its capability to examine in three-dimensions water column and sediment concentrations of specific released contaminants. Unlike other spill models, COSIM can perform simultaneous mass balances for a full suite of specific chemicals. This feature enables greater precision by applying chemical specific rates for solubility, evaporation, solids partitioning, and toxicological response estimates.

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Marine Accident Risk Calculation System (MARCS)

Overview

MARCS provides a geographical picture of the distribution of marine risks, in terms of traffic densities, accident frequencies and accident consequences at each location within an area. MARCS can be tailored to marine traffic and environmental conditions in any area, allowing assessment of overall risks in the area or risks associated with specific shipping trades, routes or vessels. Detailed analysis of the results provides an objective and transparent understanding of the main underlying causes and factors influencing marine risk levels. The most effective ways to reduce risks can be identified, and risk management decisions are, therefore, based on sound assessment. MARCS can be used to evaluate the effectiveness of a wide range of measures to reduce overall risk, both onboard ships and over a marine area; cost-benefit analysis can then be used to compare alternative proposals. Running MARCS with alternative vessel traffic data also provides information to assist planning for possible future shipping traffic levels and new hazardous cargo trades.

Modeling Methodology

MARCS modeling methodology is summarized in the model block diagram below. MARCS models a number of different types of marine accidents. Fault and event tree models, and/or historical accident statistics, are used to deduce accident frequency and accident consequence parameters for each accident type. These are combined with data on shipping lanes and environmental data to produce geographical distributions of accident and spill risks. The frequency and consequence of all accidents is determined for each calculation location within a study area.