COOK INLET MARITIME RISK ASSESSMENT

WORK PLAN

Approved

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Revised

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Background

The interest of maintaining safe maritime navigation in the Cook Inlet Regions has been a high priority for the Cook Inlet Regional Citizens Advisory Council (Cook Inlet RCAC), Alaska Department of Environmental Conservation (ADEC) and U.S. Coast Guard (USCG). In 1999, the Cook Inlet RCAC sponsored a Safety of Navigation Forum with the goal of identifying steps that can be taken to prevent oil spills. In 2000, the USCG sponsored a Ports and Waterway Safety Assessment of the Cook Inlet Region, which identified risks and potential mitigation measures.

The February 2, 2006 grounding and oil spill from the Tank Vessel (T/V) *Seabulk Pride* reinforced the need for safe navigation and operations. The *T/V Seabulk Pride* was loading oil from Tesoro's refinery at Nikiski when the vessel broke away from the Kenai Pipeline Company. dock during heavy ice conditions. Its crew could not start its engine before it grounded off the East Forelands of the Kenai Peninsula.

In February 2007, the Cook Inlet RCAC sponsored the Cook Inlet Navigational Safety Forum with the goal to share information about Cook Inlet navigational risks and discuss possible interventions to reduce the risk of vessel casualties and oil spills. The primary consensus points reached at the forum were:

1. Cook Inlet RCAC should move forward with a risk assessment,
2. Engaging in the political process will be necessary to obtain funding, and
3. Public participation and outreach will be critical to the success of the risk assessment.

A risk assessment is a systematic approach used to evaluate the level of safety of a complex system and to identify appropriate safety improvements. It is an established engineering discipline and has been used in the maritime industry in the past with varying degrees of success. The ADEC and USCG have had experience with maritime risk assessments (Prince William Sound and Aleutian Islands), and both understand the complexity of the problem at hand, as well as the need for a well-designed process that would ensure a successful outcome.

The risk assessment described in this Work Plan generally follows the process established in the National Academies' Special Report 293: Risk of Vessel Accidents and Spills in the Aleutian Islands-Designing a Comprehensive Risk Assessment. An electronic copy of the report (Special Report 293) can be found at http://onlinepubs.trb.org/Onlinepubs/sr/sr293.pdf

Risk Assessment Limits or Bounds

The risk assessment for maritime operations in Cook Inlet specifically addresses the risk of spills from marine vessels transiting through, near and/or servicing the region described below. The following bounds will be applied to this study:

Petroleum Products

This risk assessment will consider spills of petroleum products, including oil carried as bunkers and cargo. Table 1 lists the type of oils to be addressed.

Table 1: Types of oil addressed in the study

General Persistence Categories[1]	Suggested Oil Categories[2]	Examples in Category
Non-Persistent	Volatile Fuels	Jet fuel, kerosene, gasoline[3]
Persistent/Non-Persistent	Light Fuels	Diesel, No. 2 fuel, home heating oil, marine diesel
Persistent	Lube Oils	Lubricating oils
	Crude Oil	Medium crude oils[4]
	Heavy Oils	Heavy fuel oil, bunker oils, Bunker A, Bunker B, Bunker C, intermediate fuel oils (IFO), No. 4 fuel, No. 5 fuel, No. 6 fuel, transmix, residual oils/fuel, waste oil

Types and Sizes of Vessels

All marine vessels of more than 300 gross tons (GT) carrying oil described in Table 1, and all smaller vessels having a fuel capacity of at least 10,000 gallons will be considered. The risk assessment will consider all vessels above 300 GT, which include but are not limited to the following types:

- Containerships,
- Bulk carriers,
- General cargo vessels,
- Gas carriers,
- Roll-on/Roll-off vessels and car carriers,
- Cruise ships,
- Crude oil carriers,
- Product tankers,
- Tank barges and Tugs,
- Cargo barges and Tugs,
- Chemical carriers,
- Offshore Supply Vessels
- Mobile Drilling Rigs
- Tugs, including those less than 300 GT, and
- Government vessels

[1] There is no standard method to determine oil persistence. For example, diesel fuel is sometimes classified as "persistent" and sometimes classified as "non-persistent" (See Davis et al. 2003; Etkin 2002)

[2] The categories have been used by the EPA in its assessment of impacts of spills from inland facilities regulated by the agency (Etkin 2004)

[3] Gasoline can be separated out as a separate category if desired

[4] Heavy crude oils have many of the same characteristics as heavy oils, and light crudes tend to be more like light fuels. Since most of the crude oil transported through Cook Inlet will be a medium crude oil this is immaterial in this study

The study will include vessels currently transiting the region, as well as those that can reasonably be anticipated to do so during the 10-year study period (discussed below).

Accident Types

The risk assessment and proposed risk reduction measures will focus on spills from a variety of accidents. Major accident categories to be considered are collisions, allisions, powered groundings, drift groundings, foundering, structural failures, mooring failures, and fires and explosions. The risk assessment excludes operational and intentional discharges from ships.

Geographic Region

Vessel traffic operating in and through the inland waters of Cook Inlet as defined in 46 CFR 7.165(A):

> "A line drawn from the southern most extremity of Kenai Peninsula at longitude 151° 44.0 W to East Amatuli Island Light; thence to the northwestern extremity of Shuyak Island at Party Cape; thence to the eastern most extremity of Cape Douglas"

The study region is intended to cover vessels transiting and calling on ports in Cook Inlet, and fishing boats, processors, and other vessels operating in the region. Whereas the assessment of vessel traffic and the locations of spill accidents should be restricted to the study region, the environmental and socioeconomic consequences of these spills may extend outside the study region, depending on the fate of the spill.

Timeframe

The study time period is 10 years, from 2010 to 2020. The study period identified is sufficiently long to provide a basis for life-cycle cost-benefit analysis, and to reflect anticipated changes in vessel traffic and vessel types and designs, as well as the impact of known and reasonably expected regulatory changes. 2010 will be used as the base year, where actual vessel traffic will be determined. The subsequent nine years will consist of projections of the base years.

Risk Assessment Organization and Management Structure

The risk assessment organization and management structure consists of three groups: a Management Team, an Advisory Panel, and Project Managers. The USCG, ADEC, and Cook Inlet RCAC constitute the Cook Inlet Risk Assessment (CIRA) Management Team. The Cook Inlet RCAC is the entity responsible for administering the funds dedicated to paying for the risk assessment. The Management Team will solicit and recruit individuals with the goal of establishing an Advisory Panel. The Project Managers will coordinate the project on behalf of the Management Team and provide for sub-contracting services necessary to conduct this work plan. Tim Robertson, Nuka Research and Leslie Pearson, Pearson Consulting will act as Project Managers for this work plan.

The Advisory Panel will represent a structured stakeholder/participatory approach intended to build trust, clarify the values and goals that will inform the assessment, incorporate local information and knowledge that could otherwise be missed, and potentially provide a path to policy change that might not otherwise be available. The composition of the Advisory Panel should consist of stakeholders and experts who can offer local knowledge and expertise on all

issues pertinent to the assessment, such as local infrastructure, relevant industries, waterways and their navigation, weather, and habitats. The Advisory Panel is intended to operate as an independent entity from the Management Team.

Project Tasks and Deliverables

The 1st Phase of the Cook Inlet Maritime Risk Assessment will be limited to a semi-qualitative analysis. The purposes of the semi-qualitative risk assessment is to identify the significant risks related to spills from shipping and provide a basis for the identification and initial ranking of risk reduction measures. The study is intended to provide a high-level understanding of relative risks taking into consideration types of vessels and oil type, and the locations where discharges are most likely to occur. The risk assessment will utilize relatively simple tools, avoiding detailed event tree analysis and complex simulation models to the extent practical. The study will rely primarily on historical data, expert opinion, and lessons learned from prior studies.

Where possible, historical data will be used to determine traffic and commodity flows, as well as the likelihood and size of spills. Care will be taken when applying these historical data since reporting standards are rarely consistent within a given database, and no single database is comprehensive. Although data specific to the local region are generally preferred, the sparseness of accident and spill data for large vessels in the study region may necessitate use of national and international data on spill frequency and size to generate statistically significant estimates. The Project Managers may also find it necessary to obtain proprietary data. When data are unavailable or characterized by considerable uncertainty, the use of expert judgment, simulations, and other analytical models may be necessary. The use of simulations or expert opinion to predict the likelihood of major spill events will be minimized to the extent possible. The uncertainty of the estimates derived will be carefully assessed, and sensitivity analyses carried out as appropriate.

Task 1- Provide for Project Communications

The Project Managers will develop a public project website with relevant Cook Inlet specific documents for the Management Team to review and approve prior to going live and prior to website updates. Website updates will occur on an as needed basis (weekly/monthly) throughout the duration of the project. Private websites will be developed for use by the Management Team and Advisory Panel. The Project Managers will develop an email project contact list. The email contact list will be used to inform and communicate project updates and progress.

Task 2- Facilitate and Provide Administrative Support to the Management Team and Advisory Panel

The Project Managers will provide support to the Management Team in the following ways:

- Provide for regular teleconferences to cover project progress and seek Management Team approval for necessary actions
- Provide monthly project updates
- Provide quarterly budget and expense statements

The Project Managers will develop a solicitation method with the Management Team and recruit Advisory Panel members. A membership selection criterion will be developed to aid the Management Team in their selection. A charter will be developed for the Advisory Panel, which will be reviewed and approved by the members. The Advisory Panel will meet no more than five times during the life of the project. The following proposed meetings are listed in Table 2.

Table 2: Proposed Advisory Panel and Management Team meetings

Meeting	Project Timeline	Purpose of Meeting
1st	1st Year- 3rd quarter	Discuss the Advisory Panel role, expectation, administrative items, project schedule and charter. Discuss the results from the vessel traffic study
2nd	2nd Year- 1st quarter	Discuss the results from spill and accident study report
4th	2nd Year- 2nd quarter	Consequence analysis workshop. (Pending additional funding)
5th	2nd Year- 3rd quarter	Risk reduction evaluation methodology and identify risk reduction measures. (Pending additional funding)
6th	2nd Year- 4th quarter	Discussion and review of priority risk reduction measures (Pending additional funding)

Task 3- Conduct a Traffic Study

The Project Managers will select one or more subcontractors to perform a vessel traffic study to characterize the existing fleet and traffic in the region and the quantities of , both bunkers and cargoes, being moved. The study will also examine project growth in trade, changes in vessel design and size, and the impacts of known and reasonably expected regulatory changes. The information collected will be used to project the fleet makeup over a 10-year study period (2010-2020).

3A: Determine the makeup and traffic patterns of the fleet transiting Cook Inlet or operating in the study region.

An analysis of traffic through the study area will be developed using the best available data. Automatic identification system (AIS) vessel traffic data have been compiled for transits through Cook Inlet since 2006. The AIS data provides the most accurate information on the number, types, and routing of larger vessels transiting the Cook Inlet Region. Communication with weather routing services and shipping companies may also be required to augment the data. Communication with the Alaska Department of Fish & Game may assist in determining concentrations of fishing vessels.

The various data sources will be used to develop best estimates of traffic for vessels carrying at least 10,000 gallons of fuel or other oil products. These estimates should provide a picture of traffic patterns, broken down by vessel types, age of vessels by type, amounts and types of oil, and seasonality. Ship data should be evaluated to determine design characteristics required for the risk analysis, such as the percentage of single-hull versus double-hull tank vessels, the extent of double-hull protection provided

for fuel tanks, and the range of bunker tank capacities applicable to the various vessel types.

The categories of vessel types and sizes should be sufficiently detailed to allow assessment of measures that may be particular to a given trade or vessel type. The vessel categories should include at least the following:

- Product Tankers (laden and in ballast)
- Crude oil carriers (laden and in ballast)
- Tank barges (laden and in ballast)
- Liquefied natural gas (LNG) carriers
- Container ships of less than 4,500 20-ft equivalent units (TEUs)
- Container ships of more than 4,500 TEUs
- Bulk carriers of less than 60,000 tonnes deadweight tonnage (DWT)
- Bulk carriers of more than 60,000 tonnes DWT
- Ro-Ro's and vehicle carriers
- Offshore supply vessels
- Mobile drilling rigs
- Other cargo ships, government vessels, fishing vessels, tugboats, and other smaller vessels

3B: Estimate the current movements of cargo oils, containers, bulk cargoes, bulk chemicals, and other commodities through the study region, and develop yearly estimates for the movement of cargoes through the region over the 2010-2020 study period.

Commodity movements through the Cook Inlet Region will be estimated on the basis of fleet and traffic data, together with data from the various national port databases documenting trade. Historical growth in trade should also be reviewed. To forecast oil and dry cargo transport quantities for the period of 2010-2020, data will be solicited from the various trade organizations, the U.S. Department of Energy, the Maritime Administration, U.S. Minerals Management Service, State of Alaska, Ports, Municipalities and other sources.

3C: Project the fleet makeup over the study period, anticipating likely changes in vessel size and design.

Over the 10-year study period, changes to the design of ships and barges transiting the Cook Inlet region can be anticipated. The growth in ship size will reduce the number of vessels trading, but the average fuel tank capacity of ships will increase. The growth in vessel size will have a bearing on longer-term spill risks. Regulations adopted by IMO and applicable to the international fleet also will influence the design and arrangement of ships. The impact of these regulations (e.g., OPA 90 and MARPOL double-hull regulations for tankers; MARPOL Regulation 12A; MARPOL Regulation 23, etc.) on ships expected to transit the Aleutians during the study period, including any phase-in period for the regulations' implementation, will be considered.

3D: Develop yearly estimates for vessel traffic and the movements of ship's fuel oil (bunkers) and cargo oil through the study region for the 2010-2020 period.

The understanding of existing vessel traffic gathered in Task 3A, the forecasts of growth in trade and commerce derived in Task 3B, and the characterization of the future fleet obtained in Task 3C will be used to project the traffic flow and fleet makeup for the study period. When projecting movements of petroleum products, consideration will be given to the anticipated increase in exploration for and the production of gas and oil, and mineral extraction/export that may affect the Cook Inlet Region.

3E: Cook Inlet Traffic Study Report

Submit a draft report that includes the findings from Task 3A through 3D to the Management Team and Advisory Panel for review. Based on comments received, finalize the report.

Task 4- Prepare a Baseline Spill and Accident Causality Studies

The Project Managers will select one or more subcontractors to develop a spill baseline over the 10-year study period (2010-2020) as the product of the projected movements of oil and the estimated average spill rates. Frequency is developed in terms of accident return period for each type of ship and accident. Consequence is initially expressed in terms of the expected or average spill outflow, which together with the spill frequency defines the spill rate. This projection will be designed to provide an understanding of the most important hazards and serve as a baseline for later assessment benefits.

4A: Estimate the spill frequency and projected spill size distribution by vessel type

The baseline spill study should include the following accident types:

- Collision
- Drift Groundings
- Powered Groundings
- Allisions
- Structural Failures
- Mooring Failures
- Foundering
- Fire/Explosions

Historical spill statistics for the study area will be used to determine the distribution of spill sizes and the frequency of accident scenarios leading to the outflow of oil bunkers or cargo. Data from the USCG, State of Alaska, and industry, as well as other local records, will be reviewed. Given the scarcity of significant spill events in the region, it will be necessary to augment the local spill data with data on U.S. and international spill events.

Due to the scarcity of data and the evolution of ship designs, it will be necessary to use expert opinion and limited numerical simulations to determine accident frequency. The scarcity of data on outflow from cargo tanks on double-hulled tankers as well as double-hulled bunker tanks means that probabilistic oil outflow analysis based on historical damage data or simulation will likely be needed to develop spill size distributions for

collisions and groundings. These estimates will be verified against historical data for reasonableness.

The overall estimate of spillage will be subdivided among major ship categories. At a minimum, the following categories should be considered:

- Tank Ships
- Tank Barges
- Containerships
- Other large commercial vessels, i.e. cruise ships, bulk cargo vessels, etc.
- Fishing vessels, by size less than 300 GT and 300 GT and larger.
- Other small craft

Separate statistics will be provided for persistent and non-persistent oils. Multiplying the frequency of spills by the average spill size will yield an overall estimate of spillage (in terms of barrels per year).

This spill study will also provide the information needed for Task (5) and Task (7) assessments. The types of accidents and the vessels involved will be evaluated against indicators of consequence, such as the types of oil spilled, the maximum expected outflow (upper limit), the distribution of spill size, the likely location of spills, the seasonality (likely time of year) of spills, and safety implications in terms of loss of life and serious injuries.

The projection developed will assume full implementation of the Oil Pollution Act of 1990 (OPA 90) and International Maritime Organization (IMO) regulations that have already been adopted. Examples of regulations that will impact the environmental performance of ships built during the study period include the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex I, Regulation 23, Accidental Oil Outflow Performance, which specifies subdivision requirements for the cargo spaces of oil tankers, and MARPOL Annex I, Regulation 12A, Oil Fuel Tank Protection, which specifies double-hull or equivalent protection for fuel tanks.

The baseline projection will assume that no additional risk reduction measures would be implemented during the study period. The baseline will represent a hypothetical future without the potential beneficial effects of the risk reduction options being investigated in the CIRA.

4B: Develop the oil spill baseline over the 10-year study period as the product of the projected movements of oil and the estimated average spill rates

The product of the projected quantities of oil moved over the 10-year study period by each vessel type and the spill rate for that vessel type provide the oil spill baseline.

4C: Characterizing Spills from the Highest-Risk Accidents

Using the findings of the traffic spill study produce a matrix that identifies for the higher risk accidents the following information:

- Type of accidents (e.g., drift grounding, collision)
- Type of vessel involved (e.g., containership, tank vessel, fishing boat)
- Type of oil spilled (e.g. crude oil, heavy fuel oil, marine diesel)
- Representative spill size (50^{th} and 95^{th} percentile spill volume)
- Likely geographic location(s)
- Seasonality (likely time of year)
- Biological seasonality component (abundance of wildlife)

This information will be used as input for the Consequence Analysis Workshop (Task 5). Determine which accidents are of sufficient concern to merit assessment of risk reduction measures.

4D: Accident Scenarios and Causality

For the five most dominant accident types identify at least twelve representative accident scenarios that characterizing spills from the highest-risk accidents. These scenarios will by their nature describe principle causes. Probabilities of occurrence for these scenarios should be assigned and presented with the associated consequences (in terms of expected spill sizes, types of oil spilled). The confidence level in the probability figures should be clearly stated, as it is recognized that many of these figures will have a high level of uncertainty.

To the extent practical, the historical data used in the baseline spill study will serve as the basis for these probabilities. In many of the casualty and incident reports, cause is not clearly specified. Analysts will need to rely on sources from outside the Cook Inlet region, other risk assessments, and expert opinion in conducting this study of accident scenarios and probabilities.

4E: Baseline Spill and Causality Study Report

Submit a draft report that includes the findings from Task 4A and B to the Management Team and Advisory Panel for review. Based on comments received, finalize the report.

Task 5- Coordinate and Facilitate a Consequence Analysis Workshop

The Project Managers will provide for a workshop to be held to gather expert input on likely consequences of the scenarios described in Task 4 above. Data from this workshop will provide for a preliminary spill impact and fate analysis for the scenarios identified in Task 4. The intent is to gain an understanding of the relative impact characterized by: spill size, types of substances spilled, spill location, and potential environmental consequences. The report of this workshop will provide a qualitative assessment of the potential resource damage and socioeconomic impact of a representative mix of spill scenarios.

The consequence analysis will be a qualitative, high-level assessment of natural resource vulnerability, rather than a comprehensive assessment of biological impact and costs of natural resource damage. The extent and concentration of oil will be used as a surrogate for impact on natural resources. During this consequence analysis workshop, assessment of impacts will be based on expert opinion on a variety of impacts, such as: socioeconomics, subsistence, fisheries, birds, marine mammals, fish, and wildlife.

Task 6- Identify Risk Reduction Options

To complete the semi-qualitative risk assessment, the Advisory Panel and Management Team will identify and perform a qualitative assessment of risk reduction options. This effort will include soliciting risk reduction option ideas, compiling a list of risk reduction options, and working to clearly document each option for consideration. At a minimum the following risk reduction options will be considered:

- traffic separation schemes and routing measures;
- long-range vessel tracking systems developed under section 70115 of title 46, United States Code;
- towing, response, or escort tugs;
- vessel traffic services;
- emergency towing packages on vessels; H. R. 3619 84
- increased spill response equipment including equipment appropriate for severe weather and sea conditions;
- the Automatic Identification System developed under section 70114 of title 46, United States Code;
- particularly sensitive sea areas, areas to be avoided, and other traffic exclusion zones;
- aids to navigation; and
- vessel response plans.

The Project Managers will facilitate deliberations to provide background information and document the outcome.

Task 7- Evaluate Risk Reduction Options

This task evaluates the effectiveness, order-of-magnitude cost, and ease of implementation of various risk reduction options. The Project Managers will make an initial, qualitative effort to estimate the benefits and costs of the risk reduction options identified on a final list to be prepared by the Advisory Panel and Management Team. The Advisory Panel, in consultation with the Management Team and Project Management Team, will review these estimates and adjust them where deemed appropriate. The Project Managers will produce a risk reduction report based on adjustments and comments received by the Advisory Panel and Management Team.

Task 7A- Estimate the benefits of the risk reduction measures

The Project Managers will assist the Advisory Panel and Management Team with estimating the benefits of the risk reduction measures. A risk priority matrix will be developed and used to generate an overall risk reduction score to evaluate the effectiveness of the risk reduction options. A given risk reduction measure may be effective for a number of different accident types, and the cumulative impact of the measures must be considered when they are ranked. The Project Managers will be prepared to make an initial, qualitative effort to estimate the benefits and costs of risk reduction options as part of this effort.

Task 7B- Estimate the cost of the risk reduction options and the cost-benefit ratio.

The Project Managers will select a subcontractor to assist the Advisory Panel and Management Team with categorizing the risk reduction options based on cost and estimating a range of costs for each such category. After the cost categories have been developed, the Project Managers will make an initial attempt to assign cost categories to the risk reduction options. Costs should include industry compliance costs, costs borne by the public, and enforcement costs. A cost-benefit ratio can be developed by dividing the relative risk reduction score by the cost rating.

Task 7C- Assess the ease of implementation of risk reduction options.

The Project Managers will assist the Advisory Panel and Management Team with assessing the ease of implementing the various risk reduction options. The practicality of implementing and enforcing a risk reduction measure should also be evaluated, as well as the regulatory path for implementation (i.e. International Maritime Organization, federal, state and/or local). Ease of implementation should be assigned a category rating to be applied to the range of potential risk reduction measures.

Task 7D- Assess the potential unintended negative consequences of risk reduction options.

The Project Managers will assist the Advisory Panel and Management Team with assessing the unintended negative consequences of the various risk reduction options and a qualitative rating.

Task 8- Prioritize Risk Reduction Options and Prepare Phase I Final Report

The final task of the risk assessment is ranking the risk reduction options taking into account all of the factors applied in Task 7A-C. This effort will be undertaken primarily by the Advisory Panel, Management Team and Project Managers. The Project Managers will participate by providing support to the Advisory Panel and Management Team in culling the highest priority risk reduction options based on factors such as the likelihood of providing significant benefit, the satisfaction of cost-benefit analysis, and the consideration of uncertainty as it relates to the predicted efficacy of a given risk reduction option. A report will be developed to capture the basis for prioritization and justification to recommend immediate implementation of some of the potential risk reduction measures.

Project Timeline

The following timeline is proposed for the Cook Inlet Maritime Risk Assessment.

Milestone	Completion
Form Advisory Panel	1st Year- 3nd quarter
Draft Vessel Traffic Study	1st Year- 3rd quarter
Final Vessel Traffic Study	1st Year- 4th quarter
Draft Spill and Casualty Study	2nd Year- 1st quarter

Final Spill and Casualty Study	2nd Year- 2nd quarter
The following timeline will be determined pending additional funding for the project:	
Consequence Workshop	2nd Year- 2nd quarter
Consequence Report	2nd Year- 3rd quarter
Identify Risk Reduction Options	2nd Year- 3rd quarter
Rank and Prioritize Risk Reduction Options	2nd Year- 4th quarter
Draft Final Report	2nd Year- 4th quarter
Publish Final Report	2nd Year- 4th quarter