The George Washington University
WASHINGTON, D.C.

Assessment of Oil Spill Risk due to Potential Increased Vessel Traffic at Cherry Point, Washington

A Revised Technical Proposal Modification Submitted to

Ms. Christine Butenschoen
Contracts Administrator
BP Cherry Point Refinery
4519 Grandview Road
Blaine, WA 98230

Submitted by:

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and

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SEAS School of Engineering and Applied Science

Institute for Crisis, Disaster, and Risk Management

ICDRM

THE GEORGE WASHINGTON UNIVERSITY
RESEARCH DIRECTOR: J.R. HARRALD
RENSSELAER POLYTECHNIC INSTITUTE
RESEARCH DIRECTOR: MARTHA GRABOWKSI

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Introduction

This technical proposal modification is in response to a request in an e-mail from Scott MCreery dated February 12, 2007 to extend the Scope of the VTRA to include **the Puget Sound and an extension westward beyond Buoy "J" in the Strait of Juan de Fuca to the beginning of the Traffic Separation Scheme. This is approximately eight nautical miles west of Buoy "J"**. **The cost increase due to this extension is**

VCU 2007	**: $19578 (see Page 14)**
GWU 2008	**: $30844 (see Page 13)**
VCU 2008	**: $9789 (see Page 15)**
RPI 2008	**: $30000 (see Page 15)**
Total	**: $90,211**

and the project schedule will have to be extended by two months and two days with a revised completion date of:

05/31/08.

Hence the original total budget of Consulting Agreement C45669 of $885,750 is increased to a new total budget of:

$975,960.

A more detailed explanation is provided below. A final proposal and cost budget will be submitted to BP (Ms. Christine Butenschoen, Contracts Administrator BP Cherry Point Refinery, 4519 Grandview Road, Blaine, WA 98230) for approval. The work described in this proposal will be performed in close coordination with ENTRIX preparing an EIS (EIS contractor hereafter) for the Army Corps of Engineers (Corps hereafter). **The only modification of the original Scope of the original contract Consulting Agreement C45669 is the inclusion/revision of the text in bold font below.**

Revised Scope

The original Scope of Work shown was provided in part to GWU by the attorneys for BP and Ocean Advocates. Changes to the original scope are indicated in a bold font below.

- The study will evaluate the routes used by marine vessels to carry crude oil and petroleum products between the Cherry Point Refinery and:

  (1) the beginning of the Traffic Separation Scheme approximately 8 nautical miles beyond Buoy J offshore of Cape Flattery, and
  (2) the Puget Sound.

- The study will evaluate the incremental risk of (1) an accident (collision, grounding or other scenario) involving a tank vessel, (2) resulting in a discharge of crude oil or petroleum products, (3) associated with reasonably foreseeable increases in vessel traffic through calendar year 2025 to and from both wings of the Cherry Point

Refinery Pier, (4) as compared with the baseline traffic that the pre-North Wing pier could accommodate.

- In evaluating these risks the study will model all vessel traffic (not just vessels carrying crude oil and petroleum products) and reasonably foreseeable increases and decreases in vessel traffic along the entire pathway followed by vessels between;

  (**1) Cherry Point and the beginning of the Traffic Separation Scheme approximately 8 nautical miles beyond Buoy J, and**
  (2) Cherry Point and the Puget Sound,

  including but not limited to vessels calling in British Columbia, and vessels calling at the Cherry Point Refinery Pier, Conoco-Phillips, Intalco and reasonably foreseeable future marine terminal facilities in the Cherry Point area, including the proposed Gateway facility.
- The study will account for non-VTS reporting vessels (fishing vessels and recreation traffic) using methods developed in the modeling of traffic in San Francisco Bay as far as data or expert judgment is available to model this traffic in a reasonable manner.
- The study will evaluate low, medium and high traffic scenarios.
- The study will consider the impact of human and organizational error on the likelihood of accidents and the effectiveness of risk reduction interventions.
- The study will not evaluate vessel traffic risks at locations other **than those routes used by vessels traveling to and from Cherry Point.**
- The study will cover risks associated with the Haro Strait and Huckleberry-Saddlebag approaches to and from Cherry Point.
- The study will include identification and evaluation of potential vessel traffic management protocols that would reduce the risk of an accident and that can be instituted consistent with existing law. At a minimum, the vessel traffic management protocols studied will include: (1) use of Rosario Strait and Guemes Channel instead of the Huckleberry-Saddlebag traverse; (2) stationing a year-round prevention and response tug (of the kind currently stationed in Prince William Sound) in Neah Bay, Washington; (3) a single tug escort requirement for the Western reaches of Juan de Fuca Strait with hand-off between prevention and response tugs stationed in Neah Bay and Port Angeles; and (4) any additional vessel traffic management protocols or other mitigation measures selected for analysis during the scoping stage of the EIS.
- The study will include an impact analysis that will describe the outcomes of an accident as described by the location and size of oil outflows, but will stop short of examining the fate and effects of an oil spill.
- The study will use, but not be constrained by, the results of prior studies that examined various aspects of maritime risk in Washington State waters. The study will be directed by Jack Harrald and Martha Grabowski.

The project team (Study Team hereafter) from The George Washington University Institute for Crisis, Disaster and Risk Management, The Virginia Commonwealth University (VCU) and Rensselaer Polytechnic Institute (RPI) proposes to develop a maritime risk simulation to conduct the vessel traffic study above. The simulation will be based on the methodology developed for the dynamic risk simulation of tanker operations in Prince William Sound,

Alaska (1995-96), for the Washington State Ferries (WSF) Risk Assessment (1998-1999) and for the San Francisco Bay Exposure Assessment (2002). This methodology is described in:

- J.R.W. Merrick, J.R. van Dorp, J.P. Blackford, G.L. Shaw, T.A. Mazzuchi and J.R. Harrald (2003). "A Traffic Density Analysis of Proposed Ferry Service Expansion in San Francisco Bay Using a Maritime Simulation Model", *Reliability Engineering and System Safety*, Vol. 81 (2): pp. 119-132.
- J.R.W. Merrick, J. R. van Dorp, T. Mazzuchi, J. Harrald, J. Spahn and M. Grabowski (2002). "The Prince William Sound Risk Assessment". *Interfaces*, Vol. 32 (6): pp.25-40.
- J.R. van Dorp J.R.W. Merrick , J.R. Harrald, T.A. Mazzuchi, and M. Grabowski (2001). "A Risk Management procedure for the Washington State Ferries", *Journal of Risk Analysis*, Vol. 21 (1): pp. 127-142
- J. R. W. Merrick, J. R. van Dorp and A. Singh (2005). "Analysis of Correlated Expert Judgments from Pairwise Comparisons". *Decision Analysis*, Vol. 2 (1), pp. 17-29
- P. Szwed, J. R. van Dorp, J.R.W.Merrick, T.A. Mazzuchi and A. Singh (2006). "A Bayesian Paired Comparison Approach for Relative Accident Probability Assessment with Covariate Information", *European Journal of Operations Research*, Vol. 169 (1), pp. 157-177.

In this project, the Study Team proposes to use the methodologies and approaches they have developed during previous studies. While there is significant cost savings through the use of computer code and analysis developed in previous studies, to fulfill the scope listed above the Study Team must create specific models for this project using the most recent data sources and up to date expert judgment elicitations. The tasks involved are described in the next section.

Revised Project Schedule and Budget

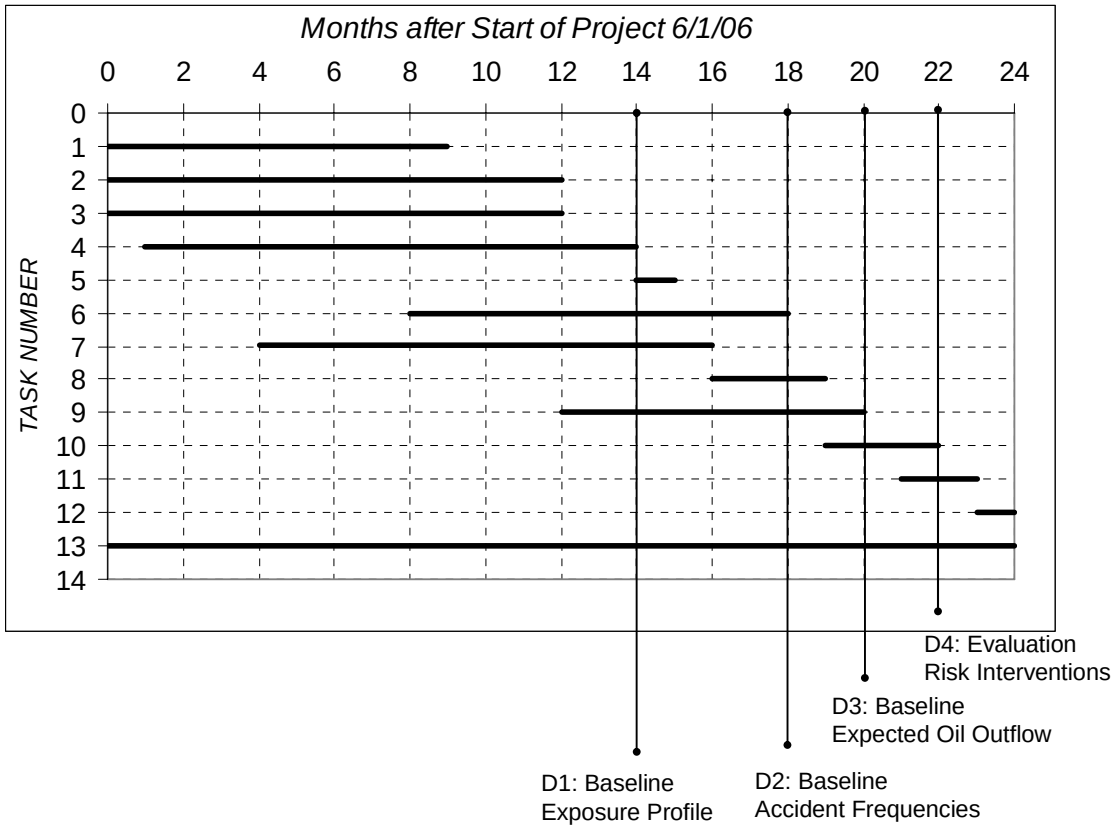
Technical task descriptions for this revised technical proposal modification are the same as those in the original contract document. A number of items contribute to a revision of the project schedule and budget. These are:

1. The inclusion of the Puget Sound area in the VTRA study area and the approaches approximately 8 nautical miles westward beyond buoy J as outlined in the revised Scope above.
2. The EIS Scoping process being drawn longer than anticipated leading to a natural shift of deliverables dates.
3. The Puget Sound Harbor Safety Committee (PSHSC) agreeing to act as an advisory committee for the VTRA study. Meetings of the PSHSC are held every two months requiring attendance of VTRA project team members.
4. Reconciliation of Canadian maritime traffic data and USCG traffic data has taken longer than anticipated due to observed discrepancies involving Haro-Strait. These discrepancies were presented to a joint Canadian and USCG meeting in Victoria, BC in December of 2007. A new joint data source was suggested during that meeting with the result that construction of vessel routes has to be revisited. This effort is currently underway.

The project start date was May 30, 2006 with an original approximate completion of all tasks at 22 months after receipt of order (ARO). We believe that the combined effect of the above items will result in an overall delay of schedule of approximately 2 months. Figure 1, at the end of this section, illustrates a Gantt chart of activities along an estimated revised timeline. A summary of the revised sequencing of the tasks above is presented in Figure 1 together with four intermediate deliverables D1, D2, D3 and D4. The first deliverable D1 (14 months ARO) is a baseline exposure profile that highlights traffic density across the study area. This profile is generated from the maritime simulation. Following the human factor modeling and expert judgment elicitation baseline accident frequencies can be evaluated which identifies the second deliverable D2 (18 months ARO). A geographic profile of expected oil outflow constitutes the third deliverable D3 (20 months ARO) and finally completion of the fourth intermediate deliverable D4 (22 months ARO) coincides with the evaluation of proposes risk intervention measures. The project completion time is projected at 5/31/08.

Only items 1 to 3 above lead to a revision in project cost. The projected additional labor cost for the extension of the VTRA study area (item 1), the additional time required for Scoping (item 2) and the additional time required to attend the PSHSC scoping meetings (item 3) amount to approximately an additional $90,210. The total revised total projected project cost amounts to $975,960. This budget amount $975,960 does not include travel expenses. The travel expenses of the Study Team members will be reimbursed directly to them by BP and not through their respective Universities.

Figure 1. Proposed Risk Assessment Plan



Task 1: Definition of System Requirements
Task 2: Identification of Potential Risk Intervention Measures
Task 3: Data Assessment
Task 4: The development of a base maritime system simulation
Task 5: Calculation of baseline exposure profile
Task 6: Human Factors Modeling
Task 7: Elicitation of Expert Judgment
Task 8: Calculation of baseline accident frequencies.
Task 9: Development of Consequence (oil outflow) model)
Task 10: Evaluation of risk reduction interventions
Task 11: Preparation of Draft Final Reports and Briefings
Task 12: Review of Draft Final Reports and Preparation of Final Report
Task 13: Communication, Project Briefings, Project Team Meetings, Travel, Project Management.

Project Team

The Study Team description below developed the dynamic system simulation methodology for Maritime Transportation System (MTS) risk assessment utilized in PWS Risk Assessment, the Washington State Ferry Risk Assessment and the San Francisco Bay Exposure Assessment and was included in the description of the original consulting agreement **C45669**. Prior maritime risk projects are described on the web site:

http://www.seas.gwu.edu/~dorpjr/tab3/NSFProject_GWU_VCU/NSFMain.html.

The Study Team includes 6 senior personnel and four highly qualified doctoral research assistants from GWU, RPI and VCU. **The additional funds requested for GWU in 2008 are solely for J. Rene van Dorp. Details for additional funding for VCU and RPI are reflected in their included revised budgets in a separate column.**

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http://www.gwu.edu/~icdrm/.

His professional interests concentrate in maritime safety and security, emergency, disaster and risk management. Dr. Harrald is a retired USCG Captain and has served as a USCG Captain of the Port. His email address is: jharrald@gwu.edu.

MARTHA GRABOWKSI, Ph.D. – Study Research Director is a Professor and Director of the Information Systems program at LeMoyne College in Syracuse, New York and Research Professor of Decision Sciences and Engineering Systems at Rensselaer Polytechnic Institute in Troy, New York:

http://web.lemoyne.edu/~grabowsk/.

She is Vice Chair and Chair-elect of the National Research Council's Transportation Research Board/Marine Board and a member of the American Bureau of Shipping. Her research interests focus on the impact of technology in large-scale systems, human and organizational error, and risk assessment in safety-critical systems. Her email address is: grabowsk@lemoyne.edu.

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THOMAS A. MAZZUCHI, D.Sc. – GWU is a Professor of Engineering Management and Systems Engineering at The George Washington University. His professional interests concentrate in human reliability modeling, quality control, reliability and risk assessment. His email address is: mazzu@gwu.edu.

GREGORY L. SHAW, D.Sc. is Managing Director of the Institute of Crisis Disaster and Risk Management. His professional interests concentrate in maritime safety and security, emergency, disaster and risk management. He is a Certified Disaster Recovery Planner through Disaster Research Institute International. .Dr. Shaw is a retired USCG Captain and commanded four USCG cutters. His email address is: glshaw@gwu.edu.

Graduate Assistants-- GWU, VCU and RPI will each use one graduate research assistant for data gathering, data analysis, modeling support, and project support. These students are doctoral students in Systems Engineering (GWU), Operations Research and Statistics (VCU), and Decision Sciences and Engineering Systems (RPI).

Dr. Harrald and Dr. Grabowski will serve as research directors, and Dr. Merrick and Dr. van Dorp will conduct the main tasks of maritime simulation development, expert judgment elicitation design and analysis. Dr. Shaw will provide maritime expertise, administrative project support and conduct expert judgment elicitation support. Dr. Mazzuchi was the lead scientist of the PWS and WSF risk assessment and will assist Dr. Merrick and Dr. van Dorp in accident probability model development and expert judgment elicitation by providing quality control and oversight.