FP6-PLT-506193

POP&C

POllution Prevention & Control

Specific Targeted Research Or Innovation Project

Thematic Priority: Sustainable Development, Global Change & Ecosystems

Periodic Activity Report
Publishable Executive Summary

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Dr Seref AKSU (Technical Coordinator)
NAME-SSRC

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Authors

Name	*Company*
Dr Seref AKSU	NAME-SSRC

Reviewing/Approval of report

Name	*Company*	*Approved*	*Date*

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Revision	*Date*	*Company*	*Initials*	*Revised pages*	*Short description of changes*
final		NAME-SSRC	SA	First Draft	

Publishable executive summary

POP&C

Pollution **P**revention and **C**ontrol - Safe Transportation of Hazardous Goods by Tankers

For the last ten years single hull tankers have been phased out gradually according to the International Maritime Organization's global regime. Recent tanker accidents in European waters led the EU to consider and implement an accelerated phase-out, which has since led to the international phase-out being accelerated too.

Despite the social, political and economic importance of these issues, some of the relevant new regulations still tend to be made before incidents have been properly investigated. Proper risk analysis may often determine: which types of oil tanker pose the highest pollution risk, what is the relative safety of new tanker designs, or what is the most appropriate response to an evolving oil pollution incident.

The POP&C project proposes to deliver a framework and suitable tools for a methodological assessment of risk to be undertaken to provide a rational basis for making decisions pertaining to the design, operation and regulation of oil tankers. Such support can be used to make more informed decisions, which in turn will contribute to reducing the likelihood and severity of future oil spills.

POP&C is a three-year research project which started on the 1st January 2004. The project's total budget of 2.2 million Euros is supported with funding of up to 1.55 million Euros by the European Commission under the Growth Programme of the 6th Framework Programme. The support is given under the scheme of STREP, Contract No. FP6-PLT-506193.

POP&C Objectives

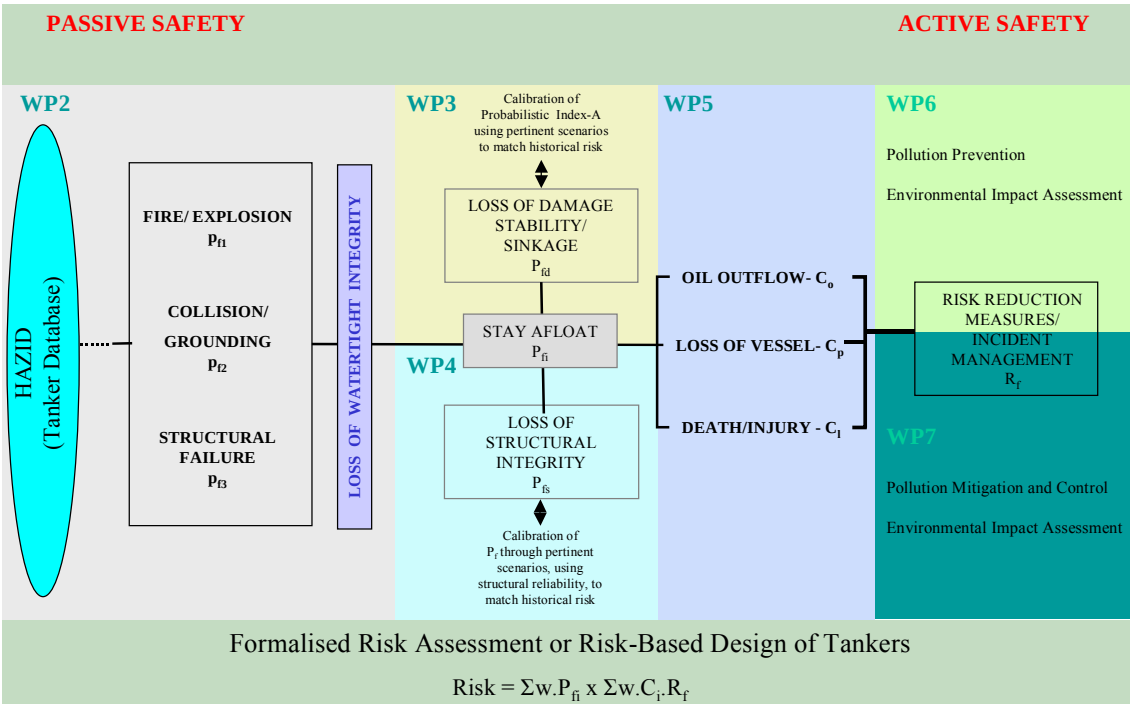
The consequences of tanker accidents are often catastrophic, as can be vividly attested by the recent disasters of the M.T. ERIKA and M.T. PRESTIGE, raising the issue of oil spills to the highest priority for the EU community. The POP&C project aims to address this issue head on by focusing on prevention and mitigation in ship design and operation for both existing and new vessels. Specific objectives include:

- To develop a **risk-based methodology** to measure the oil spill potential of tankers
- To develop a risk-based methodology for **passive pollution prevention** (design and operational lines of defence)
- To develop a risk-based methodology for **active post-accident pollution mitigation and control**.

The methodology of the POP&C project is illustrated in Figure 1. As can be clearly identified from the figure, the research work is divided into 6 technical work packages (WP). These are

- Identifying and ranking critical hazards such as collision, contact, grounding, fire, explosion and structural failure (WP2);

- Estimates of probability of capsizing/sinking from loss of stability (WP3)
- Estimates of probability of structural failure (WP4);
- Estimates of consequences within a risk-based framework, will provide pollution risk (WP5).
- Risk reduction through preventative measures (WP6)
- Risk reduction through post-accident mitigation and control measures such as decision support tools, human-machine interface, and safe refuge (WP7).



POP&C Project Partners:

PARTICIPANT ROLE	Participant Number	Participant Name	PARTICIPANT SHORT NAME	Country
CO (Coordinator)	1	International Association of Independent Tanker Owners	INTERTANKO	UK
TCO (Technical Coordinator)	2	University of Strathclyde	NAME-SSRC	UK
CR (Contractor)	3	Bureau Veritas	BV	France
CR	4	Sirehna	SIREHNA	France
CR	5	Center of Maritime Technologies	CMT	Germany
CR	6	National Technical University of Athens	NTUA	Greece
CR	8	Gdynia Shipyard	GDY	Poland
CR	9	STC B.V.	STC (formerly MSR)	Netherlands
CR	10	Lloyd's Register	LLOYD'S REGISTER	UK
CR	11	NAVANTIA	NAVANTIA	Spain
CR	12	SSPA Sweden AB	SSPA	Sweden
CR	13	Istanbul Technical University	ITU	Turkey
CR	14	Herbert Software Solutions- Europe	HSSE	UK
CR	15	Overseas Shipping Group	OSG (formerly SOU)	UK
CR	16	University of Newcastle Upon Tyne	UNEW	UK

Furthermore, IMO Secretariat is participating in the project as an observer/advisor.
The project co-ordinator for years 2004 and 2005 was Dr. Nikos Mikelis (INTERTANKO) and Dr. Seref Aksu (NAME-SSRC) at seref.aksu@na-me.ac.uk (+44 141 548 4779) contributes in the capacity of technical co-ordinator. Dr Seref Aksu has been the acting project coordinator since the start of Year 2006 due to Dr Mikelis's change of employment. More information about the POP&C project can be found at the project website http://www.pop-c.org/.

Management Activities During Reporting Period

- Preparation, conduct and follow-up of all project meetings (quarterly);
- Preparation and submission of the annual management report for 2006 (Deliverable D1.8);

- Internal review and final submission of all project deliverables to the Commission;
- Active engagement in solving any issues regarding the project partners' work responsibilities, management and financial matters;
- Correspondence and response to external communications
- Registering and starting electronic Technology Implementation Plan;
- Updating and maintaining of the project web site;
- Active engagement in the dissemination of the project findings and results;

Technical/Scientific Work Performed and Results Achieved During Reporting Period

The work associated with WPs 2, 3 and 4 were completed before the reporting period. Only activity that has been carried out in relation these workpackages during the reporting period was dissemination; a journal paper was published related to POP&C data analysis (WP2), and one conference paper and one journal paper have been prepared from the WP4.

WP5 was completed during the reporting period. The workpackage combines the risk factors from WP2, WP3, WP4, and risk reductions from WP6 and WP7 within a risk-based methodology to determine an overall risk index. As explained in the previous reporting period, a consequence analysis model, referred as "the US Marine Board study" where a non-linear consequence function was generated for varying amounts of oil spills based on a reference oil spill by considering only physical parameters of the oil spill, is utilised to assess the environmental pollution risk. The use of this consequence model was decided based on a POP&C study where the validity of consequence function introduced by US Marine Board for EU waters was confirmed.

Although the overall risk methodology considers the three risk components (environmental risk, risk to lives and risk to property) and these have been incorporated in the assessment, the project focuses on the environmental risk.

In Task 5.3, an overall quantitative risk assessment tool was developed. For quantitative assessment, methods for developing frequency of oil outflow and consequence of the spill are applied to accidents resulting from collision, contact, grounding, non-accidental structural failure, fire and explosion to evaluate the environmental risk of the current fleet of Aframax tankers and to place it in the context of the reduction of risk from single hull tankers to the fleet as it will be characterized at the completion of the phase-out of single hull tankers. Environmental risk was derived by multiplying the frequency of oil spills by the consequence of the spill. Consequence is evaluated on the basis of mean oil outflow and using a non-linear function that accounts for a reduction in consequence per additional tonnes spilled as spill sizes grow.

Quantitative assessment provided some striking results. For example, if the environmental risk in early 1990s (all single hull ships) is taken as the basis, an average of 19.4 % environmental risk reduction was achieved through improvements between 1991 and 2003. Similarly, the current fleet at risk (as at end of 2005) represents a reduction of 35.6 percent compared with early 90s all single hull fleet and when all single hull tankers are phased out (in 2010), a 53.7 percent risk reduction will be achieved in comparison to 1990 fleet.

A series of case studies evaluating the application of risk control options (RCOs) and pollution control options (PCOs) utilizing information from WP4, WP6 and WP7 were conducted. These include alternative tank arrangements, alternative partial loading approaches, increased scantlings and the effects of updated damage extents based upon analytical work. In addition, case studies such as ineting ballast tanks and application of dynamic underpressure to cargo tanks have been investigated where both qualitative and quantitative assessment were made. The use of the quantitative environmental risk assessment methodology in risk based design and optimisation process was also demonstrated with examples.

A final case study evaluated a conceptual Aframax tanker that applies some of the lessons learned in the course of the POP&C project. Whereas this design is at an early concept level all arrangements and systems have already been applied in the industry. Risk reductions on the order of 35 percent are achievable. Optimization of this design is certainly possible. Assessment of the cost effectiveness of the design requires evaluation of the impact on construction, operational and fuel costs however there is a clear indication that significantly more environmentally friendly tankers are feasible. These findings were reported in Deliverable 5.4.

As part of Task 5.2, the project made an attempt to establish acceptability criteria for environmental risk. The project therefore went on to detail an ALARP (As low As Reasonably Practical) region for oil spills based on comparing the pipeline and offshore industries to the tanker fleet. Some corrections to the ALARP region were needed to take into account the huge benefits that tankers bring to the world. Figure 1 shows proposed F-C (Frequency-Consequence) curve with intolerable and negligible regions.

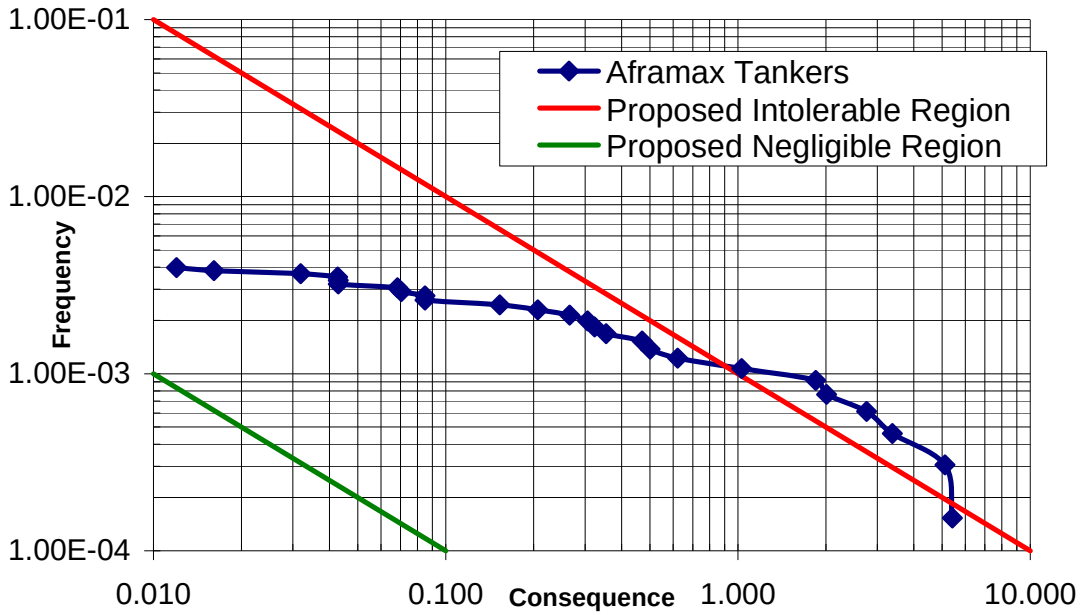


Figure 1 Aframax tankers Frequency-Consequence (F-C) curve for environmental risk assessment

The proposed ALARP region implies that the intolerable region for spills with a consequence of 1 (roughly 1892 m^3) is a frequency of 1 in every 1000 ship years, or once every 2 calendar years for the AFRAMAX tanker fleet of approximately 500 ships. The negligible region for the same size spill is once every 100,000 ship years or once ever 200 calendar years for the fleet.

POP&C further investigated the proposed ALARP region against oil outflow as a consequence and also analysed which category of accident events contributed the most to the AFRAMAX tanker fleet's risk level. Further analysis also confirmed that the key to reducing the intolerability of tankers is to control the grounding accidents and, to a certain extent, the non-accidental structural failure accidents. This analysis forms the basis for Deliverable 5.3.

WP6 was active in Tasks 6.2, 6.3 and 6.4 during the reporting period. As part of Task 6.2, Deliverable 6.2 - *Framework for Simulation Based Assessment of Risk Control Options* was finalised. This deliverable details the selecting, planning, conduct and analysis of the simulation studies.

The Decision Support Tool (DST) developed as part of Task 6.3 (Deliverable 6.4) which provides a computer based on-line early warning system for grounding avoidance was installed and incorporated to STC facilities in Rotterdam. Due to some difficulties in planning and executing the experiments, simulation based experiments using the STC facilities could not be carried out by the official end date of the project. However, these experiments were soon after conducted by STC and the results were included in Deliverable 6.2. The proposed scenarios were used to investigate whether DST and AIS could improve the safety of navigation of tankers to reduce the risk of collisions or groundings.

Based on the executed runs, the first impression of the navigators was that the DST tool will be able to improve the accuracy of navigation under more critical circumstances. However, the report made a number of recommendations on the use of the decision support tool and the conduct of simulation tests in order to achieve an acceptable standard and gain useful information from these simulations.

Covering the Task 6.4, Deliverable 6.3 which contains the information on the risk reduction index for selected Risk Control Options was prepared.

In WP7, Tasks 7.3 and 7.4 were active during the reporting period. During the reporting period draft Deliverables D 7.3 and D7.4 were reviewed and finalized. Deliverables 7.5 and 7.6 were also completed which concluded the work in WP7.

As part of Task 7.3.2, the effectiveness of the "virtual" decision support tools was assessed by considering 5 inter-related decision support tools (complementing each other) to support the selected pollution control actions identified in D7.4. These were

- DST 1 : Potential root change, speed reduction and other navigational changes during an emergency situation involving oil leakage,
- DST 2 : Options Analysis for relocating the distressed ship (for example Safe refuge based on IMO guidelines,
- DST 3 : Transfer of oil to internal tanks, Off-load oil to external tank, Flood tank for hydrostatic balance and Balasting/debalasting options,
- DST 4 : Stress monitoring of the structure,
- DST 5 : Intentional Grounding.

The identified generic decision support tools, employed either independently or in tandem with several others were assessed to be useful in reducing the consequences of major accidents, thus reducing the environmental risk associated with Aframax tankers.

Task 7.4 presents an overall assessment concerning risk reduction through post-accident pollution mitigation and control measures. Its goal is to give a realistic view of the anticipated efficiency of risk reduction measures and come up with feasible proposals, in relation to a logical crisis management effort. In this task, the potential of the selected control measures have been evaluated. The effectiveness of any PCO is measured by its potential for reducing the severity of the initial incident from a catastrophic (scale 4), to a severe (scale 3), to a significant (scale 2) or most preferred to a minor one (scale 1). The failure in reducing the severity of the initial incident is also recorded (the final scenario after the introduction of the measure has equal severity to the initial one).

One basic conclusion is that nearly all PCO's may succeed in reducing the severity of the initial incident when used by one scale (from a catastrophic accident to a severe one). It is noted that this reduction is of great importance since in a catastrophic scenario the ship does not survive and the situation is described as unmanageable whereas in a severity 3 scenario the pollution is significant and urgent action should be taken however the ship survives and the situation could be controlled, if the appropriate external aid is available. It is noted that PCO's were found to be more effective in SH scenarios than in DH regarding the specific reduction (from severity 4 to severity 3). The upper bound of effectiveness of some of the PCO's used in SH scenarios was closed to 90%. That means that they have succeeded 9 times out of 10 in avoiding a total loss and occurrence of big unmanageable sea pollution. For the DH scenarios the most effective PCO's have an upper bound of effectiveness that does not exceed the 60%. The methodology has examined 19 out of 21 PCOs in all 215 scenarios. This analysis forms the basis for Deliverable 7.6.

Plans for Disseminating the Knowledge

Several project publicity and dissemination activities have already taken place and several others have been planned. Summary of the dissemination activities are given in the table below.

Table: Summary of Dissemination Activities

Reference & Planned/actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible /involved
March 2007	Conference paper Presented at the Presented at the International Conference on "Towing and Salvage of Disabled Tankers" TSDT2007, Glasgow, UK.	Industry (Marine and mechanical), Higher Education, Research	International	50-60	NAME-SSRC
June 2007	Journal paper A paper published at the Journal of Engineering for the Maritime Environment (IMechE publications)	Industry (Marine and mechanical), Higher Education, Research	International		NTUA-SDL / INTERTANKO, BV, NAME-SSRC
October 2007	Paper finalised and to be presented at the PRADS 2007 Conference, San Diego, USA	Industry (Marine and mechanical), Higher Education, Research	International	300-400	UNEW, HSSE, BV
2007	Journal paper A paper accepted for publication at the Journal of Ship and Offshore Structures during second half of 2007.	Industry (Marine and mechanical), Higher Education, Research	International		NAME-SSRC

Expected Outcomes

The POP&C project contributed to the European Union's scientific and technological objective of "Increasing road, rail and waterborne safety and avoiding traffic congestion" through the risk-based pollution prevention and control options that

- provided a framework to assess the oil spill potential of both existing tankers and new designs in a rational way;
- integrated existing and developing technologies to provide operational assistance so as to improve the safety of tankers;
- assessed the effectiveness of computer-based decision support tools and information services on the condition of vessel operational responsiveness, to yield risk reduction through prevention and mitigation;
- encouraged best practice in the tanker shipping community.

Foremost among these contributions, POP&C could assist in reducing the number and severity of oil pollution incidents by providing a more rational basis for designing, operating, and regulating oil tankers. Reducing oil pollution at sea is an important step towards achieving environmental and economic sustainability for the future transportation systems.