



## ***Cooperative Agreement R-83033301***

A Research Program of Wharton Risk Center

Risk Management  
and Decision  
Processes Center

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The Cooperative Agreement R-83033301 was initiated in 2002 as a joint activity between the Wharton Risk Management and Decision Processes Center and the U.S. Environmental Protection Agency/OEPPR. This Cooperative Agreement has as its primary objective the development of approaches that will enable one to develop meaningful approaches for reducing future losses using data from government and industry investigations of accidental chemical releases. Project activity has been focused on the implementation of section 112(r) of the Clean Air Act Amendments of 1990.

What follows is a “snapshot” summary of the most recent research activities undertaken at the Center on this program. It presents the scope and focus of this ongoing research. Summaries of recent working papers, journal publications and books written by Faculty at the Center are also presented with links to the complete documents from the Wharton Risk Center Website.

The Wharton Risk Center looks forward to working on these issues with its industry sponsors, research partners, public sector agencies and international organizations as well as with other institutions interested in joining this program. More details on the Wharton Risk Center can be found at its website: <http://grace.wharton.upenn.edu/risk/>.

Paul R. Kleindorfer  
Howard Kunreuther  
Co-Directors

The Wharton Risk Center  
“Cooperative Agreement R-83033301”  
Research Project

**Underlying Themes Guiding Work  
under the Agreement**

- 1. Developing informational and management based regulatory strategies and other so-called market-based approaches to substitute for or reinforce traditional “command and control” regulation.** This movement toward public-private partnerships and performance-based regulation will guide our future work on third party inspections and insurance for reducing future losses from catastrophic accidents.
- 2. Understanding the vulnerability of different industries through more sophisticated risk assessments including uncertainty analyses, which can then be utilized for developing risk management strategies.** By collecting and evaluating more sophisticated information on various categories of risk through the RMP process and related other databases, as well as near-miss studies, one can design programs for managing risk that will be evaluated and prioritized by these analyses.
- 3. Integrating risk management with site security, given the heightened concern since September 11<sup>th</sup> with the effects of disruptions caused by purposeful agents, e.g., terrorists, on facilities with potential for catastrophic failure.** These certainly include chemical facilities, especially with significant quantities of toxic chemicals on site. It is important to build on the detailed knowledge of OEPPR and the chemical industry regarding risk assessment and risk management strategies for dealing with chemical accidents to help inform the development of strategies for

dealing with terrorism risk. In particular, there are a set of lessons with respect to prevention, protection and post-disaster responses with respect to chemical accidents that can be used as a foundation for developing strategies for dealing with terrorism.

**Specific Activities in Support of These  
Objectives**

Based on the above broad themes, the Wharton Risk Management and Decision Processes Center proposes work in three basic areas:

- A. Accident Epidemiology and Related Data Quality Assurance Activities**
- B. Implementing the RMP Rule, including the use of Third Party Auditors**
- C. Evaluation of the Effectiveness of the RMP Rule in Conjunction with Management Systems and Organizational Structures**

The Wharton Risk Center has undertaken research under each of these areas of research for the year October 1, 2002 – September 30, 2003 (hereafter FY 03). The first of these two areas is covered under the **Accident Epidemiology Project**, the second under the **Third Party Audit Project**, and the third under the **Management System Effectiveness Project**. This report summarizes the details of the work accomplished under these three objectives in FY 03 and planned activities for FY 04.

## The Accident Epidemiology Project

This work is based on Themes 2 and 3 noted on the previous page and builds on Risk Center studies of the past years in analyzing RMP data. The **Accident Epidemiology Project** has as its primary objective the development of approaches that will maximize preventive learnings from government and industry investigations of accidental chemical releases. Activity in FY03 was concerned with the continued use and development of the epidemiologic approach utilizing the RMP\*Info database, both in its existing form and with the planned second tranche of data expected in 2004.

Analytic results thus far have investigated the relationships between the following factors:

- The Characteristics of the facility itself, including facility location, size and the type of hazard present (as characterized by the chemicals and process used, the training and management systems in place, and other facility-specific characteristics);
- The nature of regulations in force that are applicable to a facility and the nature of enforcement activities;
- The socio-demographic characteristics of the host community for a facility, which characteristics are intended to represent the level of pressure brought on the facility to operate safely and to inform the community of the hazards it faces.

Besides deepening our understanding of these underlying relationships, and finalizing the publication of our findings, we were also concerned in FY03 to undertake some site visits to inquire as to opportunities for improving data collected under the RMP Rule in 2004.

### Project activities for FY03 included:

1. The Team developed our initial financial analysis for RMP\*Info facilities whose parent companies are publicly traded, linking such financial indicators as overall parent company debt and profitability to the accident propensity of facilities owned by these companies.
2. We conducted a Roundtable on March 4, 2003 to review key findings to date of RMP\*Info research and to clarify outstanding issues of interest to stakeholders in the RMP process that might be informed by the next set of RMP data.
3. We conducted a set of site visits in Delaware, Pennsylvania and Oregon with facilities of various sizes to determine opportunities for improving data collection of RMP data in 2004. These visits attempted to clarify uncertainties and ambiguities in the RMP submit process, such as facility managers' interpretation of key terms in RMP (e.g., "an accident", reported consequences, etc.).
4. We conducted a series of visits to stakeholders, including facility and parent companies, selected state and local governments, LEPCs and public interest groups, to convey the findings of the March 4<sup>th</sup> Roundtable and to assess the needs and interests of these stakeholders and in using the data gathered in the RMP process with an eye on the 2004 data.

### Projected Plans for FY04:

- Complete analysis of financial data relating accident propensity to financial characteristics of the parent company, in interaction with facility and host community characteristics.
- Continue study of the scope of the RMP database, including non-compliance issues, threshold issues, non-covered facilities that are nonetheless hazardous, and other factors that influence which facilities are covered by the reporting requirements of the Rule and

the effects of this on the representativeness of the resulting accident history database. This will include analysis of outliers in the 1995-2000 RMP data.

- Begin development of analytic framework for analyzing the 2004 data. This will include replicating the analysis of the 1995-2000 data, and comparing this at a descriptive level with the 2004 data, together with additional work on secular trends in the data.

### **Presentations, Publications and Meetings:**

In keeping with the Center's traditional role as a "meeting point" for diverse stakeholder groups to express their views and to help design the Center's research agenda, a number of meetings were undertaken to present research results and to obtain guidance to support the informed development of the Accident Epidemiology Project. These included the following meetings.

- Meetings with Wharton Advisory Committee to get broad stakeholder input into the framework and process for the Project: Wharton, December 10, 2002 and April 29, 2003.
- Roundtable held on March 4, 2003, for key members of industrial community, with attendance also by representatives from NIOSH, ACC, CCPS, Mary Kay O'Connor Center, and OEPPR.
- Paul R. Kleindorfer made a presentation to the 3<sup>rd</sup> Annual Global Operational Risk Conference, New York, "Operational Risk and Near-Miss Management Systems", 11/02
- Paul R. Kleindorfer made a presentation to the Harvard, JFK School Seminar, "Risk Management in the Chemical Industry", 03/03
- Paul R. Kleindorfer made two presentations to Production and Operations Management Society Meeting in Savannah, "Managing Risks in Global Supply Chains", and "Accident Epidemiology in the U.S. Chemical Industry", 04/03
- Paul R. Kleindorfer made a presentation to the Production and Operations Management Society International Meeting, Lake Como, Italy, "Disruption Risk in Global Supply Chains", 06/03
- Paul R. Kleindorfer made a presentation to the Mary Kay O'Connor Annual Process Safety Symposium on "Accident Epidemiology", 10/03

## The Third Party Inspection Project

The purpose of the **Third Party Project** is the use of private market mechanisms, such as third party inspections, to facilitate firms complying with Section 112(r)(7) of the Clean Air Act of 1990 (the Rule). This should lead industrial facilities to institute process safety management programs that have been reviewed by knowledgeable individuals independent from the creators of the safety program. Work was directed towards determining if third-party audits could be structured to ensure that regulated facilities comply with the Rule. To this end, Wharton joined in a task force with OEPPR, EPA Region III and Delaware's Department of Natural Resources and Environmental Control (DNREC). The task force had to determine:

- What types of financial and legal incentives are needed to encourage regulated facilities to use third party auditors?
- What kind of financial and legal incentives are needed to encourage third party inspectors to participate?
- What procedures are needed to select, train, assign and evaluate third party inspectors?
- How can audits done by third party inspectors be evaluated from the standpoint of the facility, the third party inspector, the enforcement agency and the community?

### Project activities for FY03 included:

- Establish contact with OECA to explore the possibilities of revisions to Audit Policy in line with the benefits proposed in the draft revision to 122(r)
- Work with OECA to establish Audit Policy for the ammonia and chlorine industries as a possible alternative to the revision

- Review available data on the penalties levied against firms non compliant with RMP to determine if avoidance of fines would be a significant incentive to opt for a third party inspection.
- Conceptualized potential Roundtables for adding a security component to RMP inspections that would be performed by third parties.
- Worked on two initiatives outside EPA funding that furthered the third party inspection concept, a survey of the chlorine industry and the start of a project with Louisiana Workers Compensation Corp (LWCC) entailing enhancement of worker safety using third party inspections.

### Presentations, Publications and Meetings:

- Meetings with Wharton Advisory Committee to get broad stakeholder input into the framework and process for the Project: Wharton, December, 2002 and April, 2003.
- Attended the December 2002 Conference of the Multi State Working Group (MSWG) on EMS where initial contacts with OECA were established.
- Conference: Leveraging the Private Sector: Management Based Strategies For Improving Environmental Performance. July 31 –Aug 1, 2003 ( presented paper – “Private Inspections and Mandatory Insurance for Managing Safety and Environmental Risks”)
- Meeting: VPPPA Region III, July 9-10, 2003 (we operated a booth displaying third party and near miss projects)

## **The Management System Effectiveness Project**

The objective of this Project was to explore the use of the data from the RMP Rule, together with data from other sources, in order to understand the consequences of alternative management systems and organizational structures designed to manage environmental risks in the U.S. Chemical Industry.

This work is related primarily to Theme 1. One of the key trends in industry and in many initiatives fostered by the EPA, over the past decade has been an increasing attention to the bottom line consequences of EH&S activities. This has led, *inter alia*, to a better understanding of the financial consequences of spills and injuries and to considerable innovation in developing management systems that link EH&S activities to Quality, to Accident and Near-Miss Management Systems, and to internal and external financial reporting systems.

### **Project activities for FY03 included:**

We studied the Impact of Near-Miss Management and Related Quality Programs on Accident Performance. This activity continued earlier work of the Wharton Risk Center on this subject, which has led to a prototype design for near-miss management in the chemical sector.

### **Projected Plans for FY 04:**

1. A Roundtable will be conducted at Wharton in April, 2004 on the interaction of management systems (including both quality, risk and EH&S systems) on the performance of companies as measured by their accident and incident rates.
2. We plan a project meeting for Near-Miss Project participants to take place May 8, 2004 at Wharton.

## **Presentations, Publications and Meetings**

- The Near-Miss Project meeting convened on June 20, 2003, to finalize the prototype Near Miss Management System, and to discuss “prioritization” methods for Near-Miss Reporting.
- Paul R. Kleindorfer made a presentation to the Harvard-sponsored seminar on Management-Based Regulation in the Chemical Industry, held at RFF in Washington, DC, July 31-August 1, 2003.

## Recent Publications

- **“Environmental Justice: Frequency and Severity of US Chemical Industry Accidents and the Socioeconomic Status of Surrounding Communities”**, by Michael R. Elliott, Yanling Wang, Robert R. Lowe and Paul R. Kleindorfer, published in *Journal of Epidemiology and Community Health*, Vol. 58: 1, January 2004.

**Downloadable at:**

<http://opim.wharton.upenn.edu/risk/downloads/EJ-Press-Statement1.pdf>

- **“Accident Epidemiology and the U.S. Chemical Industry: Accident History and Worst-Case Data from RMP\*Info”**, Paul R. Kleindorfer, James C. Belke, Michael R. Elliott, Kiwan Lee, Robert A. Lowe, and Harold I. Feldman, *Risk Analysis*, Vol. 23, No. 5, 2003. pp 865-881

This article reports on the data collected on one of the most ambitious government-sponsored environmental data acquisition projects of all time, the Risk Management Plan (RMP) data collected under section 112(r) of the Clean Air Act Amendment of 1990. This RMP Rule 112(r) was triggered by the Bhopal accident in 1984 and led to the requirement that each qualifying facility develop and file with the U.S Environmental Protection Agency a Risk Management Plan (RMP) as well as accident history data for the five-year period preceding the filing of the RMP. These data were collected in 1999-2001 on more than 15,000 facilities in the United States that store or use listed toxic or flammable chemicals believed to be a hazard to the environment or to human health or facility employees or off-site residents of host communities. The resulting database, RMP\*Info, has become a key resource for regulators and researchers concerned with the frequency and severity of accidents, and the underlying facility-specific factors that are statistically associated with accident and injury rates. The article analyzes which facilities actually filed under the Rule and presents results on accident frequencies and severities available from the RMP\*Info database. This article also presents

summaries of related results from RMP\*Info on Offsite Consequence Analysis (OCA), an analytical estimate of the potential consequences of hypothetical worst-case and alternative accidental releases on the public and environment around the facility. The OCA data have become a key input in the evaluation of site security assessment and mitigation policies for government planners as well as facility managers and their insurers. Following the survey of the RMP\*Info data, this paper discusses the rich set of policy decisions that may be informed by research based on these data.

**Downloadable at:**

<http://grace.wharton.upenn.edu/risk/downloads/03-24-PK.pdf>

- **“The Role of Hazardousness and Regulatory Practice in the Accidental Release of Chemicals at U.S. Industrial Facilities”**, by Michael R. Elliott, Paul R. Kleindorfer, and Robert A. Lowe, *Risk Analysis*, Vol. 23, No. 5, 2003. pp 883-896

This article presents the results of an analysis of the accident history data reported under section 112(r) of the Clean Air Act Amendments. These data provide a fairly complete record of the consequences of reportable accidental releases occurring during the time frame 1995-1999 in the U.S. chemical industry and covering 77 toxic and 63 flammable substances subject to the provisions of section 112(r). As such, these results are of fundamental interest to the affected communities, regulators, and insurers, as well as to owners and managers in the chemical industry. The results show the statistical associations between accident frequency and severity and a number of characteristics of reporting facilities, including their size, the hazardousness of the processes and chemicals inventoried, and the regulatory programs (in addition to section 112(r)) to which these facilities are subject. He results are interpreted in light of economic drivers of protective activity and regulatory priorities for monitoring and enforcement.

**Downloadable at:**

<http://grace.wharton.upenn.edu/risk/downloads/03-23.pdf>

- **“Near-Miss Incident Management in the Chemical Process Industry”**, James R. Phimister, Ulku Oktem, Paul R. Kleindorfer, and Howard Kunreuther, *Risk Analysis*, Vol. 23, No. 3, 2003, pp 445-459.

This article provides a systematic framework for the analysis and improvement of near-miss programs in the chemical process industries . Near-miss programs improve corporate environmental, health, and safety (EHS) performance through the identification and management of near misses. Based on more than 100 interviews at 20 chemical and pharmaceutical facilities, a seven-stage framework has been developed and is presented herein. The framework enables sites to analyze their own near-miss programs, identify weak management links, and implement systemwide improvements.

**Downloadable at:**

<http://grace.wharton.upenn.edu/risk/downloads/03-01-JP.pdf>

The complete list of journal publications by the Center can be found at:

<http://grace.wharton.upenn.edu/risk/wp0104.html>