WATER POLLUTION EMERGENCIES IN CHINA

Prevention and Response

The World Bank

This study was prepared by the Rural Development, Natural Resources and Environment Unit (EASRE) of the East Asia and Pacific Region of the World Bank.

Environment issues are an integral part of the development challenge in the East Asia and Pacific (EAP) Region. The Environment Strategy for the World Bank in the East Asia and Pacific Region has provided the conceptual framework for setting priorities, strengthening the policy and institutional frameworks for sustainable development, and addressing key environmental and social development challenges through projects, programs, policy dialogue, non-lending services, and partnerships. This study provides a forum for discussion on good practices and policy issues within the development community and with client countries.

The background study reports to the policy paper can be accessed at the China water AAA program website http://www.worldbank.org/eapenvironment/ChinaWaterAAA.

For more information on and other reports of the AAA Program, please contact Jian XIE, The World Bank, 1818 H Street, NW, Washington D.C, 20433, USA, Fax: 202-522-1666, Email: jxie@worldbank.org.

This publication is available online at www.worldbank.org/eapenvironment.

Sustainable Development Department
East Asia and Pacific Region
The World Bank
Washington, D.C.

June 2007

TABLE OF CONTENTS

LIST OF BOXES

LIST OF FIGURES

ABBREVIATIONS

AQSIQ	The Administration of Quality Supervision, Inspection and Quarantine, China
COMAH	Care of Major Accident and Hazard Regulations, UK
EA	Environment Agency, UK
EPB	Environmental Protection Bureau, China
EIA	Environmental Impact Assessment
HAZWOPER	Hazardous Waste Operations and Emergency Response, USA
HSE	Health and Safety Executive, UK
MOC	Ministry of Construction
MWR	Ministry of Water Resources
OSHA	Occupational Safety and Health Administration, USA
PSB	Public Security Bureau, China
RMP	Risk Management Plan
SAWS	State Administration for Work Safety, China
SEPA	State Environmental Protection Administration, China
USEPA	Environmental Protection Agency, USA

ABSTRACT

A high number of river pollution incidents in recent years in China, including the high profile Songhua River toxic chemical spill in November 2005, and drinking water source pollution by algae in the Tai Lake, Wuxi in May 2007, demonstrate that, if not immediately and effectively controlled, pollution releases can spread across boundaries of administrative jurisdiction, causing environmental and economic damage as well as public concern and the potential for social unease.

The past practice in water emergency management in China shows that the main focus of local government has been on mitigation after an incident. While this is a critically important part of any emergency response system, prevention is better than cure. Once an accident has occurred, the impact on the environment and human health becomes more difficult and more costly to control. Prevention of pollution by strict enforcement of appropriate policies and regulations is typically a more cost effective approach.

Aiming to assist the Government of China to improve its emergency prevention and response in high risk industries, this paper presents an analysis of the Chinese situation and systems currently in place for the prevention of and response to pollution emergencies, as well as some relevant international experience. It discusses weaknesses in the existing Chinese situation and highlights relevant international measures which have been developed in light of experience gained from industrial pollution accidents (not solely related to waterborne pollution) overseas. Based upon the analysis and discussion, this paper finally puts forward a series of policy recommendations for institutional reform, risk management and prevention, and emergency response and mitigation.

ACKNOWLEDGEMENTS

This policy note is produced by the World Bank through the study of water pollution emergency prevention and response under the World Bank's Analytical and Advisory Assistance (AAA) "China: Addressing Water Scarcity – From Analysis to Action". The AAA is a joint program in collaboration with a number of Chinese institutes and with the support of the Department for International Development, the United Kingdom.

The policy note is based on five background study papers on Chinese and international experiences and is prepared by a team comprising Jian Xie (task team leader), Zhong Ma (pollution management and the Songhua River water pollution case study), Jennifer Coleman (environmental pollution emergency and the UK experience), Yuyang Gong (environmental emergency and the U.S. experience), Hongjun Zhang (toxic chemical management), Manchuan Wang (government organization), Shuilin Wang (institutional arrangements), Hua Wang (information disclosure), Jeremy Warford (environmental economics), Shiqiu Zhang (welfare economics), and Xuejun Wang (environmental policy). The UK National Chemical Emergency Center contributed to preparing the case study of the Buncefield Incident in UK.

The policy note benefits from the discussion with and support from Andres Liebenthal, Leo Horn, John Warburton, Junkuo Zhang, Shiji Gao, Jie Feng, and the participants of the technical review workshop held in early November 2006 where the findings of the water pollution emergency prevention and response were presented and discussed. Peer reviewers were Ernesto Sanchez-Triana and Paul Procee of the World Bank, Wei Zhao of UNEP, and Weihua Zeng of Beijing Normal University. Bekir A. Onursal, Greg Browder, and David Meerbach provided useful comments. Lian Jiang and Xiangping Liu provided research assistance to the report. Yan Wang provided administrative assistance to the AAA.

The report was prepared under the general guidance of Christian Delvoie, Rahul Raturi, Magda Lovei, Teresa Serra, David Dollar, Elaine Sun, Bert Hofman, and Susan Shen at the World Bank and the members of the AAA working and advisory groups set up in China, especially Mr. Li Jiange, Vice Minister, the Development Research Center of the State Council of China. Officials and experts of SEPA, Ministry of Water Resources, and Ministry of Land and Resources reviewed the draft report and provided valuable comments and suggestions for its revision.

1. INTRODUCTION

China is now facing acute environmental problems after two decades of rapid economic growth, and water pollution is one of them. The severe water pollution incidents occurring one after another in recent years were a striking reflection of the problem.

Water pollution incidents can be categorized into two types. The first occurs when a great volume of pollutant is discharged within a short time period from an accident. The Songhua River toxic spill (Box 1) which occurred in November 2005 is a typical example of this type. The second type of water pollution incident is an accumulative effect of pollutant discharge over a long period which eventually causes severe water pollution at a certain time point. The drinking water source pollution in Wuxi by algae in Tai Lake occurred in May 2007 is an example of the second type. Once a water pollution incident occurs, no matter what type it is, it can be a serious threat to the local economy, people's livelihoods, health, and the aquatic ecological system in a short time. If the response is not appropriate, it could have cross-boundary effects. Therefore, it is a pressing task of the Chinese government to prevent water pollution incidents and take appropriate actions to mitigate their impacts once they occur.

As the direct causes of the two types of water pollution incidents are different, the measures to prevent and respond to them are also somewhat different. However, by improving management under normal conditions, both can be prevented more effectively. The responses to them can be more appropriate and their impacts can be mitigated to a greater extent by strengthening training. Even the water pollution incidents caused by accidents can be prevented to the greatest extent and their impacts can be controlled by improving normal daily management.

The Songhua River toxic spill is an example of the environmental risks associated with industries which pose a serious threat to the natural environment and public health, both locally and, on occasions, beyond administrative boundaries. The Songhua River incident, however, has helped raise the awareness of government and the public on the importance of environmental emergency prevention and response, providing a unique opportunity for institutional changes.

After the Songhua River toxic spill, the Government of China took some immediate steps to strengthen national environmental emergency prevention and response. "*The Decision on Implementing the Scientific Concept of Development and Stepping up Environmental Protection*" was released by the State Council in December 2005, which highlights drinking water safety, pollution control in key river basins, and water pollution accident prevention and response as the outstanding priority tasks to be solved. The "*National Plan for Environmental Emergency Response*" was adopted in January 2006. In early 2006, 11 enterprises in 9 provinces, which are located near rivers and identified as having notable environmental risks, were officially and publicly warned by SEPA, and 127 chemical and petrochemical projects with a total investment value of 450 billion yuan RMB underwent urgent environmental risk inspection[1]. Most provinces and municipalities established emergency response centers, developed plans for

emergency response, and underwent inspections of major sources of risks.

Despite these prompt actions, there is a need for continued reform and strengthening of existing institutions for environmental pollution emergency prevention and response. A sophisticated and effective environmental emergency prevention and response system calls for more institutional reforms in the legal framework, organizational arrangements, chemicals management, response plans, financial and incentive mechanisms, monitoring and reporting, information disclosure, community participation, remediation, and evaluation.

The purpose of this paper is to provide policy recommendations to assist the Government of China in improving environmental emergency prevention and response in the high risk industrial sector. The paper is based on background studies conducted by Chinese and international experts on the China situation, the Songhua River incident, and international experience in environmental emergency prevention and response and toxic chemical management. Water pollution incidents and their impacts are reviewed in section 2. The current state of and problems with prevention and response to environmental emergencies in China are discussed in section 3. Section 4 summarizes relevant international experience. Policy recommendations are provided in section 5.

Box 1. Water Pollution Incident in the Songhua River

The Songhua river is a major river in northeast China. It runs through many cities in the region before joining the Amur river and then entering into Russia. The river is the main water source of many cities and villages it passes by, including Harbin, the capital of Heilongjiang Province with a population of 3.5 million. Along the river is the old industrial base of China with many industries located on the river bank including the chemical industry.

On 13 November, 2005, an explosion took place at Jilin Chemical Industrial Co. plant (a PetroChina subsidiary) in Jilin, a city about 380 kilometers up river from Harbin, caused by a worker's attempt to clear a blockage in the nitration tower of a chemical plant producing benzene. The powerful blasts caused harm to the environment and human safety. Five persons were confirmed dead and nearly 70 people were wounded. More than 10,000 residents were evacuated as a precaution against further explosions and severe pollution from the plant.

The explosion led to an outpouring of around 100 tons of chemicals including mainly benzene, into the river Songhua. On Thursday 23 November, around 10 days after the explosion, an 80-km contaminated stretch of water reached Harbin and took 40 hours to pass through it. China's State Environmental Protection Administration (SEPA) said publicly on that day that the Songhua River had suffered "major water pollution" after the 13th November explosion at the plant upstream. The Municipal Government of Harbin had to temporarily shut down its water supply, leaving around 3.5 million people temporarily without access to tap water but bottled water provided by the government. The incident caused a serious water crisis in the region along the river.

Source: UNEP; www.uneptie.org, January 2006.

2. WATER POLLUTION INCIDENTS IN CHINA

Although China has implemented many policy measures to prevent and control water pollution, water pollution has not been contained effectively on the whole, and the problem is still serious. About 59% of the seven main rivers in China contained water graded Class IV, V or worse and were deemed unsafe for human consumption in 2005 [2]. The increasingly worsening water pollution as well as frequent water pollution incidents has become one of the most notable environmental problems in China.

As reported in the green national accounting study led by SEPA, the total cost of environmental pollution in 2004 was 511 billion yuan RMB (US$62 billion), equivalent to 3.05% of GDP (based on the human capital approach)[3]. If the value of statistical life (VSL) obtained from willingness-to-pay survey is used, this estimate would be roughly doubled. Thus the China Environmental Cost Modeling Study sponsored by the World Bank estimates the total cost of air and water pollution in 2003 to be equivalent to 5.78% of GDP[4]. Of the total environmental cost in 2004, 56% is due to water pollution. It includes the economic losses due to water shortages caused by water pollution, and the costs of pollution abatement, agricultural losses, impact on human health, and of drinking water protection.

There were 1,441 environmental incidents reported in 2004[5]. Half of them were water pollution related. It is likely that the numbers are on the low side because polluters and some local officials tend not to report environmental accidents. The total cost of water pollution accidents was reported at 254 million yuan RMB in 2004. The number represents a big jump by a factor of ten in the major water pollution incident category from 2003 [6]. But it is still an underestimate of the economic loss of the problem. Fishery losses caused by water pollution, both regular discharges and accidental releases, were reported as 1.08 billion yuan RMB in 2004[7]. Of all environmental incidents occurred in 2005, 97.1% were pollution incidents, of which, water pollution incidents accounted for 50.6%. During the period from the time when Songhua River pollution incident happened to mid-April of 2006, the total number of environmental incidents occurred across China was 76, about one every two days[8]. Three major examples were: the release of toxic smelting waste into the Beijiang (a branch of Zhu River) in December 2005; the release of cadmium-containing wastewater into the Xiangjiang (a branch of Yangtze River); and a spill of diesel oil into the Huang River in January 2006.

China's seven main river basins are all cross-provincial and cover a total area of 4.37 million square kilometers, amounting to 44% of the total territory and involving 29 provinces, municipalities and autonomous regions. Located in these areas are 88% of the country's population, and 80% of its arable lands. Controlling water pollution including pollution accidents in these basins and mitigating their impacts once accidents occur are critical for the health of people and for their economic and social development.

3. WATER POLLUTION EMERGENCY PREVENTION AND RESPONSE IN CHINA

Recent pollution incidents and their associated costs show the weakness of the environmental emergency prevention and response system in China. The analysis in this section further shows that the problem is attributable to many factors ranging from low awareness, lack of incentives, weak institutional arrangements, and poor chemical management systems to inadequate emergency preparedness and response planning, poor on-site coordination, monitoring, and reporting. These are all areas requiring improvement to build a sound environmental emergency prevention and response system in China. Although the analysis below focuses on the weakness of the current Chinese system, it is necessary to point out there are successful experiences in environmental emergency response in China, for instance, the successful handling of the explosion and chemical spill at a chemical refinery factory in Jiangdu City, Jiangsu Province in December 2005.

Awareness. Early in 1987, China promulgated the *Tentative Regulation on Reporting Incidents of Environmental Pollution and Damages*. But accidental pollution incidents did not receive sufficient attention from local governments until the Songhua River toxic spill. One reason for the low awareness is because the current overall performance evaluation system for local governments and officials focuses on GDP growth, and seldom includes environmental indicators which would provide stronger incentives to improve the environmental situation and monitor and control environmental pollution. Although SEPA has been studying and promoting the use of green accounting and other environmental accounting indicators, there is still a long way to go before the performance evaluation system becomes operational. Without the right incentives in place to guide sustainable development, sustaining an on-going effort of local governments to strengthen environmental emergency prevention and response is unlikely to be possible.

Legislative framework. There has been initial legislative effort in some Chinese laws which contain pollution emergency prevention and response requirements. For example, article 28 of the amended "Water Pollution Prevention and Control Law" contains a simple clause on the responsibilities of polluters with regard to emergency response, information disclosure and reporting. In the "Marine Environmental Protection Law" and the "Radiation Pollution Prevention and Control Law", not only the polluter, but also environmental protection agencies and local government responsibilities were addressed. Some requirements on emergency prevention plans and emergency response plans, as well as legal liability for pollution incidents were also addressed. Right after the Songhua River incident, the "National Plan for Environmental Emergency Response" was announced by the State Council on January 8th, 2006. Events causing environmental pollution and ecological damage are listed within the scope of the Plan.

Despite these efforts, China has not set up a complete legislative framework dedicated to emergency prevention and response. The clauses embedded in sectoral laws mentioned above are often general and simple. They provide the principles without details critical to implementation.

Moreover, compliance with and enforcement of these environmental laws and clauses have been very weak.

Organizational setup. Pollution incidents involve governments, companies, and the public, and they often cross administrative boundaries. In China, the groups involved in emergency prevention and response include the Public Security Bureau (PSB); the State Administration for Work Safety (SAWS), MWR, SEPA, the Administration of Quality Supervision, Inspection and Quarantine (AQSIQ), local police, fire brigade, local departments of environmental protection, transportation, water, construction, and planning as well as river-basin commissions. Unclear definition of responsibilities and insufficient communications between agencies often result in a failure to disseminate information and the subsequent inability to respond in a timely and well coordinated fashion in handling environmental emergencies.

Before the adoption of the "National Plan for Environmental Emergency Response," no dedicated national body existed to coordinate and lead the prevention and response to environmental pollution emergencies. The "National Plan" requires the establishment of an "Inter-ministry Roundtable for Environmental Protection" under the State Council responsible for coordination of environmental emergencies and information sharing. It also requires relevant line ministries and local governments to handle environmental incidents in their respective sectors or areas. Guided by the "National Plan", SEPA and some provincial EPBs have quickly set up their own Environmental Emergency Response Centers (EERC). These EERCs set up within environmental bureaus, however, have limited mandates or authority to coordinate with other agencies. The ability of The Roundtable to quickly and effectively coordinate a major pollution accident is still to be tested.

In the existing system, water pollution control has been the duty of local governments, but responsibility for trans-boundary river basin management has not been clear. China has established river basin water management commissions for its seven large rivers as subordinate organizations of the Ministry of Water Resource. These commissions only have the authority to monitor water quality, but no authority over pollution source management. An issue remains on how to more effectively coordinate the efforts of the commissions with the environmental departments in charge of pollution control to strengthen quality management for the whole river basin. In these commissions, no representatives of the provinces/ municipalities are involved. It is difficult for them to coordinate with related provinces/municipalities in river basin management.

In terms of chemical management, the responsibilities of production, transportation, inventory, and supervision are divided among various agencies without a unified management system or an effective coordination mechanism. Furthermore, local EPBs are currently under the direct management of local governments even though they also receive guidance from SEPA. Under such a management system, the ability of local EPBs in handling local pollution incidents objectively and independently is always questionable.

Industrial pollution management and prevention measures. China has had a system for Environmental Impact Assessment (EIA) since the 1980's. New construction projects of polluting industries

such as chemical plants are required to undertake an EIA and sign safety responsibility agreements in order to obtain permission for construction and a license to operate (LTO). Projects where hazards are present are required to undertake safety assessment and relevant contents on environmental risk analysis should be included in the EIA reports. EIAs are approved by various levels of the EPB or SEPA depending on the size of the plant. However, for different reasons, many EIA reports are not reviewed and checked very strictly, and required measures for risk prevention are not always implemented in practice. Older plants, built before EIA requirements, may have never formally assessed their potential environmental impacts/risks or the steps to minimize those impacts/risks. In addition, although regulations of AQSIQ require that operating licenses are subject to review every three years, in many cases, these regular reviews of environmental risk assessment and company management measures are not strict enough to ensure they remain adequate and up to date.

Due to low awareness of environmental problems in the past, many old, heavily polluting, or toxically dangerous industries have been located in populous areas or along rivers. The SEPA survey shows that among 7,555 chemical or petroleum projects in China, 81% are located in environmental sensitive areas such as water networks or dense population areas [9]. Environmental guidance in zoning and site selection in spatial planning is weak, if it exists at all. Strategic environmental assessment of spatial plans, required by the China EIA law since 2003, is not well implemented.

Financing and incentives. During the period of the last three five-year plans, environmental protection investments have accounted for only 0.68%, 0.81% and 1.19% of GDP, and 2.17%, 2.46% and 2.84% of the total value of fixed assets investment for the same periods respectively, not meeting the expected targets in the terms of ratios or growth rates. Environmental protection investment in the period of the eleventh five-year plan is planned to increase by 85% on the basis of the tenth five-year level. The growth rate of environmental protection investment has therefore not matched in any way the GDP growth rate of 80-120% every five years [10].

Moreover, investment by the central government in water pollution prevention and control have not kept pace with the dramatic increase in investment in flood control, soil erosion control and water resource allocation. Investment projects and plans of different departments across river basins or geographical areas are not well coordinated. Consequently, as the Chinese Government has openly admitted, the lack of investment in pollution control has contributed to the failure to meet the nation's pollution control targets, for example the failure to reduce COD discharge by 10 percent by the end of 2005. Inadequate funding is also leading to aging environmental protection facilities and equipment in many industries, further increasing the level of risk.

China has accepted the "polluter pays principle" and implemented pollution levy system for many years. But the levels of the pollution levy and fines for pollution accidents are low. It was estimated that in China the level of pollution charge standard was only 50% of the cost of pollution abatement, some even less than 10% [11]. For example, desulfuring cost is about 1.2 Yuan per Kg, but enterprises only pay 0.63 Yuan per Kg for SO_2 discharges according to the current pollution charge schedule. In developed countries, polluters are often liable for the full cost of remediation and

compensation. Currently in China, the legal limits for pollution penalties are not prohibitive and the cost of causing pollution is low compared to international standards. The low levels of pollution levy and fines for pollution accidents give little incentive for industries to abate pollution, reduce pollution discharges, and prevent environmental accidents.

Chemical inventories and information management. China is currently developing two chemical inventory systems. One is for new and imported/exported chemicals under the administration of the State Environmental Protection Agency (SEPA) and another is for dangerous chemicals managed by the National Chemical Registration Center under the State Administration for Work Safety (SAWS). Both registries are relatively lightly populated compared to more mature systems found overseas. Moreover, the two systems are separated from each other. How to make them consistent through coordination is still an issue. China is also introducing the Material Safety Data Sheet (MSDS) for production, transportation, storage and use of chemicals. But these are still at an early stage and not fully functioning.

Monitoring, reporting, and information disclosure. Water quality monitoring plays an important role in detecting incidents and understanding the impact on human health and the environment. China has much of the equipment and expertise to collect data on water quality but lacks the systems and sufficient funding to analyze and distribute the information to manage the whole of the river basin accordingly. Several bodies (such as the monitoring centers/stations under SEPA, MWR, and local EPBs) undertake monitoring but there is little coordination of results nor much in the way of a pre-determined and coordinated response in the event that pollution levels rise as a result of an accidental release. The Songhua River incident highlights some serious problems with the environmental information collection, reporting and disclosure in China. The situation will hopefully be much improved under the guidelines of the newly adopted "National Plan for Environmental Emergency Response".

On-site response and cleanup. The Songhua River incident indicated that the first responders had not been provided with adequate training nor had access to support from experts in chemical management. Those who were first on the scene did not know how to respond differently from the routine practice for a typical fire only incident. As a result the treatment of water soluble benzene with fire water only served to spread the pollutant rather than contain it.

Although environmental law clearly states that the polluter is responsible for the costs of environmental accidents, the current ownership and enforcement systems often fail to establish clear liability and responsibility for cleanup and compensation. There is also a lack of an adequate insurance system to cover the risks and costs of environmental disasters.

4. INTERNATIONAL EXPERIENCE

This section outlines international experience in the areas of emergency response. By its very nature each country will have a different story to tell and so it is impossible to give a comprehensive description of all the systems in place. However this section extracts common themes and provides specific country arrangements by way of example. More information is available in the background papers issued with this note.

4.1 Historical Development of Emergency Response Systems

The development of emergency response systems has been an evolutionary process as countries have learnt lessons from their own incidents and the incidents of others. There are a number of historical incidents that have shaped the development of emergency response policies, regulations and systems overseas, in particular:

- The oil spills of Torrey Canyon in UK (1967) and Exxon Valdez in Alaska, USA (1989) caused crude oil contamination from damaged shipping tankers off the coast of the UK and in Prince William Sound, Alaska, respectively.
- The Seveso disaster in Italy (1976) that led to a release of dioxin in an area near Milan.
- The Union Carbide Bhopal Chemical Spill in India (1984) killed or injured more than 2000 local people from a release of methyl icocyanate.
- The Sandos Chemical Spill (1986). This incident draws many parallels with Songhua River toxic spill, water being used to extinguish a fire in a chemical factory polluted the Rhine River, and affecting 6 countries along its course (see Box 2).

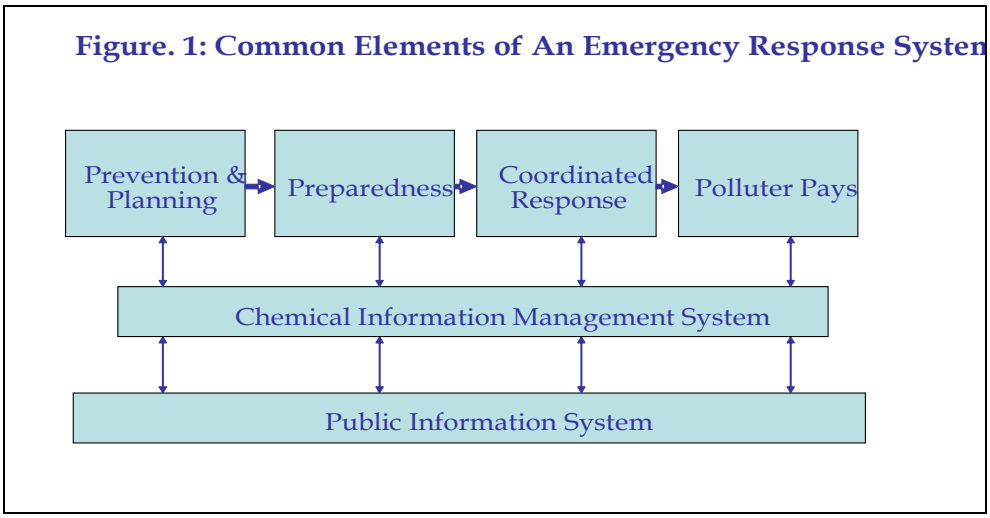
Box 2: The Sandos Chemical Spill from Switzerland Extending Down the Rhine

On 1st November 1986 an explosion occurred in the Sandos Chemical factory in Basel on the Banks of the River Rhine. The fire took five hours to extinguish, pouring between 10,000 to 15,000 cubic metres of water into the Rhine. That water contained organic mercury compounds, insecticides, fungicides, herbicides and other agricultural products which made their way down 900km of the Rhine, through six sovereign states and into the Baltic Sea. Nobody was killed but the spill killed hundreds of thousands of fish and waterfowl. 10,000 people marched on the streets on Basel and the economic loss to properties downstream was estimated to be 100million Swiss Franc.

Although at the time Switzerland was accused of concealing information, much of the delay was due to poor planning rather than deliberate secretiveness. Incompatibility between alarms delayed the response. However, even if warnings had been quicker much of the damage was inevitable once the pollution had entered the water. The greater part of the damage was not caused by the delay in the warning and information systems but by the failure of various safety systems to prevent the entry of chemicals into the river in the event of a fire namely the lack of adequate bunds, fire alarms, sprinkler systems and drainage seals

Lessons learnt from this incident have subsequently contributed to amendments to the European Union's so called Seveso II Directive, the development of the Basel convention and the Convention on the Protection of the Rhine.

- The 9/11 and subsequent terrorist attacks are creating an ongoing development of prevention, preparedness and response systems. Authorities are considering new risks and threats to the public and the environment.



4.2 Key Elements of Emergency Prevention and Response

Industrialized nations have learnt the lessons of emergency response the hard way and have developed emergency response systems with a number of characteristics in common. The basic elements of an effective response system are represented in figure 1.

- Prevention and planning – With a focus on risk assessment, prevention and planning emergency response plans are compiled and reviewed at plant site, local, regional and national levels. These plans clarify the roles, responsibilities and communication channels between groups. Site emergency plans must be approved before the site can operate. The adequacy of the plans is reviewed on a regular basis. The basis of the planned response is risk assessment and understanding the scenarios that could lead to an incident and the potential impact.

- Preparedness - An important aspect of effective response is the capacity of responders. Specialized training, the provision of equipment and regular drills to test plans and inter-organizational communication are essential elements of "being prepared".

- Coordinated response - Clear chains of command and interagency cooperation provide a coordinated and tiered response allowing for a rapid assessment and response at the point of the incident plus appropriate escalation to regional and national teams. There is coordination between those who physically respond to the incident and those who provide technical advice and information distribution. As well as coordination during an incident the bodies will work together to plan and train for emergencies.

- "Polluter pays principle" - In the event of an accident the polluter is responsible for clean up and compensation costs.

- Chemical information management systems - Inventory management tracks the flow of manufactured and

distributed chemicals, in particular toxic chemicals. The system also provides the necessary information for a quick and effective response if an accident happens, particularly when combined with consistent and available labeling that clearly identifies the chemical's human and environmental impacts.

- Public information systems - that provide information to the public about the hazards present under normal operations and timely information in the event of an emergency.

Box 3: Examples of National Legislative Systems

In the United Kingdom, the significant national legislation is the Control of Major Accident Hazards Regulation 1999 (COMAH), which enacts the European Union Directives on the Major Accident Hazards of Certain Industrial Activities (82/501/EEC) or Seveso Directives and the Civil Contingencies Act 2004.

In the United States, the major regulations include the Clean Water Act (1972); the Oil Pollution Act (1990); the Emergency Planning and Community Right-to-Know Act (1986); the National Oil and Hazardous Substances Contingency Plan (1968, amended 1994); the Clean Air Act (1970; amended 1990) and the Homeland Securities Act (2002).

4.3 Overview of Institutional Arrangements

Multilateral Environmental Agreements. The international community has adopted a number of relevant multilateral environment agreements to improve the management of chemicals and minimize the harm caused by chemicals, especially toxic and hazardous chemicals. The significant agreements to which China is a signatory are: the Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal; the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; and the Stockholm Convention on Persistent Organic Pollutants (POPs).

These agreements set an international framework for the management of chemicals and particularly hazardous chemicals on a day-to-day basis. Adherence to the principles of the agreements will help in the prevention of incidents as well as provide some protection and redress for harm caused by the intentional transboundary movements of unwanted hazardous materials. In addition the agreements facilitate the sharing of expertise between countries.

National Laws. Countries have developed national legislation. Box 3 shows how different systems have evolved in the United Kingdom (which responds to and meets the requirements of European directives) and the United States.

Organizational Structure. Typically effective emergency response depends on the coordinated efforts of a number of functions to maximize prevention and planning and to provide timely response to provide timely response and clean up in the event of an accident. While many different agencies can be involved, the local police and fire services, with technical support and guidance from health, safety and environmental authorities, are at the heart of the emergency prevention and response structure.

In the UK, for example, this means that the local EA and the HSE are often the nominated competent authorities required to provide approval for the emergency response plans for high hazard sites. In this

way they must ensure that all the health, safety and environmental risks have been identified, removed or minimized, and that appropriate plans are in place to minimize and mitigate the impact from any potential accidental release. In the event of an accident they would be on hand to provide technical advice to the police and fire brigade as well as to monitor the impacts of the release. They would also play an important role in the accident investigation and prosecution of polluters.

In addition to the local response which is based upon knowledge of the local situation, there is an escalation system that ensures that response is coordinated at the regional and national levels depending on the size and impact on accident. In the UK, cabinet level involvement, through the COBRA system can be activated for incidents with a national impact, for example COBRA has met in response to fuel strikes, a national foot and mouth outbreak and after the September 11 attacks. In the US, the Federal Emergency Management Agency under the Department of Homeland Security is alerted when federal response is required.

Transboundary Management of River Basins. In Europe a number of international river basin commissions have been established for those rivers that cross several countries for example, the Rhine (see Box 4), the Danube, the Kura and the Neman. Typically several countries are involved in the commissions and arrangements are in place to prevent pollution of the rivers as well as early warning and alarm systems that inform all countries in the event of an incident.

Box 4: Convention on the Protection of the Rhine

Signed by France, Germany, Luxembourg, The Netherlands, Switzerland and the European Union, the convention gives substantial powers to the Rhine River Commission on the monitoring and protection of water quality in the river. The scope of this Convention comprises the Rhine, the connected ground-water, aquatic and terrestrial ecosystems, and the Rhine catchment area.

The convention has the following goals:

- Promoting sustainable development of the Rhine ecosystem, by a) maintaining and improving the Rhine water quality by avoiding, reducing or eliminating pollution from point sources (e.g. from industry and municipalities) and diffuse sources (e.g. from agriculture and traffic) and through the prevention of industrial incidents and accidents; and b) preserving, improving and restoring the natural function of the stream and the natural habitats for wild animals and plants;
- Ensuring the use of Rhine water for drinking water purposes;
- Improving sediment quality to enable the safe disposal of dredged material; and
- Holistic flood prevention and protection, taking into account ecological requirements;

The Contracting Parties are guided by the following principles: prevention at source; precaution; the polluter-pays principle; sustainable development; application of the Best Available Technique and Best Environmental Practice; not to transfer environmental pollution between media.
Source:
http://ocid.nacse.org/qml/research/tfdd/toTFDDdocs/193ENG.htm

4.4 Risk Assessment, Prevention and Planning

The emergency response planning process plays an important part in ensuring that resources, skills and procedures are in place to respond to the incident scenarios that have been identified as part of a comprehensive risk assessment. Risk

assessment enables plants and the competent authorities to identify, eliminate or minimize the hazards and risks on site.

Competent authorities are required to approve the appropriateness of plans and ensure that adequate resources are available should an incident go beyond the control of the plant. As part of their responsibility the authorities will also regularly inspect facilities to ensure that situations have not changed and arrangements remain appropriate, and to gain first hand familiarity with the plant.

In Europe industrial sites are categorized according to their potential hazards. Before receiving a license to operate, high hazard sites are required to produce a Major Accident and Prevention Policy (MAPP) and a Safety Management System. These identify the potential accident scenarios that could impact on the environment and/or human safety and the appropriate response. Emergency response plans are compiled and reviewed at plant, local, regional and national levels. These plans clarify the roles, responsibilities and communication channels between groups. This would be subject to review at least every five years or sooner if changes have been made to the plant. In this way plant operators are forced to identify and implement preventive measures as well as response and mitigation measures.

4.5 Preparedness and Coordinated Response

Cooperation between agencies and across areas is an essential element of effective response. Coordination is tested through desk top exercises and drills, which saves time during an incident, avoids confusion and improves the chance of an effective response in the event of unforeseen circumstances arising.

It is common to operate under a unified command and in cooperation to respond to a pollution incident. The local response is coordinated and tiered allowing for a rapid assessment and response at the point of the incident plus escalation to regional and national teams if required. There is coordination between those who physically respond to the incident and those who provide technical advice and public information. As well as coordination during an incident the bodies will work together to plan and train for emergencies. A similar structure to the bronze, silver, gold command structure of the UK is found in the Unified Command of the Incident Command System in the US.

Specific emergency response providers are trained in the treatment of chemical hazards. In the UK, this takes the form of specially trained HAZMAT (hazardous materials) officers in local fire stations. The first responders are supported by standardized and comprehensive labeling systems on pipelines, storage units and transport vehicles which readily identify the chemicals present and their properties. This information saves valuable time at the time of an incident and can ensure that responders take appropriate, safe action to contain a spill or release. The response to the Buncefield Incident in UK (Box 5) demonstrates how the existence of an emergency response plan and training and coordination of first responders can lead to a rapid response that takes account of environmental damage as well as safety concerns.

Box 5: The Buncefield Incident, UK

In the early hours of Sunday 11th December 2005, a number of explosions occurred at the Buncefield Oil Storage Depot, Hemel Hempstead, Hertfordshire, UK. At least one of the initial explosions was of massive proportions (measuring 2.4 on the Richter scale) and there was a large fire, which engulfed a high proportion of the site. Over 40 people were injured; fortunately there were no fatalities. Significant damage occurred to both commercial and residential properties in the vicinity and a large area around the site was evacuated on emergency service advice. The fire burned for several days, destroying most of the site and emitting large clouds of black smoke into the atmosphere.

The fire at the Buncefield oil depot represented a major challenge to the emergency response systems in the UK. It required a multi-agency, coordinated response to the fire and its aftermath. In this incident responders were onsite within 10 minutes of the explosion, they knew the site and the chemical risks, had practiced the response and had immediate access to 24/7 technical support by phone. The scene was immediately declared a "major incident" and the sites emergency response plan put into action. This plan had already been submitted and approved by the competent authorities, which in this case are The Environment Agency and the Health and Safety Executive.

Key to the response was the coordination of a number of agencies including: the Fire Brigade; Police; Ambulance service; the Environment Agency, the Health and Safety Executive and the National Chemical Emergency Centre. Together these agencies developed a fire fighting strategy that minimized releases to the local water courses and kept the local public informed of the risks and the measures they needed to take

The USA has also established a well organized emergency response system. First responders are trained and certified in Hazardous Waste Operations and Emergency Response (HAZWOPER) and go through regular emergency response drills. Chemical plants are required to prepare and implement a Risk Management Plan (RMP) which provides first responders with information in the event of an accident.

4.6 Chemical Information Management

The operators of chemical registries plan a vital role in the response system, providing technical information by phone or in person to those at the scene of a chemical incident. In the UK, this is the role of the National Chemical Emergency Centre (NCEC), which provides a 24 hour telephone hotline and is staffed by appropriately trained and qualified staff. Contact numbers for NCEC are prominently displayed on chemical labels and at facilities.

Commonly across Europe Material Safety Data Sheets (MSDS) are produced for every dangerous chemical. MSDS are standardized and identify a particular substance or compound by a unique identifier. A TRransport EMergency (TREM) card is required to accompany dangerous chemicals on the move. The TREM card contains selected information from the MSDS about the nature of the hazard and risk presented by the chemicals. It details the personal protection, spillage, fire fighting, first aid and immediate actions to be taken by the drive of the vehicle and the first responders at the scene of an accident.

4.7 Public Information Systems

In the developed world, provisions for informing the public both at the time of the incident and in preparation for any potential incident are included in the emergency response plan. The emergency response plans of high hazard sites and local authorities are often shared with the public through a series of public hearings. In addition, a variety of systems, often using the internet, are used to make

monitoring information available to the public.

For example, in the US the "Scorecard" (available at www.scorecard.org) allows a member of the public to search for pollution issues by ZIP code. The UK Environment Agency provides similar information on water quality, flooding risks and the location of landfill sites through its website (http://www.environment-agency.gov.uk). This site is linked to the National Atmospheric Emissions Inventory (http://www.naei.org.uk/index.php) which provides public air pollution information. These systems provide a mechanism for local community engagement and an incentive for businesses and local authorities to ensure pollution is managed.

4.7 Financing, Penalties, Incentives and Liabilities

In the developed world there are a number of examples of financial mechanisms that are employed to recoup the costs of environmental protection beyond the factory fence and legislative enforcement.

In the UK, the operator of a COMAH registered site is charged for the time the regulator (EA and HSE) spends on the site beyond providing advice on compliance requirements. Inspector time spent assessing applications or accident investigation would be charged to the enterprise in addition to physical clean up costs. In the US, the Superfund (formally known as The Comprehensive Environmental Response, Compensation and Liability Act) created a tax on the chemical and petroleum industries and liability for spills. The Oil Spill Liability Trust Fund (Box 6) provides for clean up before responsible parties (the polluters) are identified or when no responsible party can be identified. These mechanisms are just part of the funding mechanisms that are based on the "polluter pays principle" which not only aims to recoup costs associated with pollution but aims to prevent pollution through financial incentives that reward the minimization of pollution. Trust funds provide readily available financial resources to enable immediate responses.

Typically, individual companies will have insurance to cover environment, health, safety and fire incidents. The cost of those premiums reflects the hazards and levels of risk management on site. Improved risk assessment and management can lead to reduced costs.

Box 6: The Oil Spill Liability Trust Fund , USA

In August 1990, following the *Exxon Valdez* incident in Alaska, the Oil Pollution Act (OPA) authorized use of the Oil Spill Liability Trust Fund (OSLTF), which had been created by Congress in 1986. The OPA consolidated the liability and compensation requirements from a number of laws and their supporting funds. These consolidated funds plus a tax on the petroleum industry and contributions created by the Energy Policy Act of 2005 created a fund of $2.7 billion to cover the costs of assessment, removal and clean up.

Structure of the Fund - The OSLTF has two major components.

1. **The Emergency Fund** is available for Federal On-Scene Coordinators (FOSCs) to respond immediately to discharges, 24 hours a day, every day and for federal trustees to initiate natural resource damage assessments.
2. **The remaining Principal Fund** balance is used to pay claims and support research and development

Sources of the Principal Fund - The Principal Fund of the OSLTF has several recurring and nonrecurring sources of revenue.

- **Barrel Tax -** a 5-cent-per-barrel tax, collected from the oil industry on petroleum produced in or imported to the United States. The tax is switched on and off, as required, to maintain the fund above $1 billion and below a statutory limit.
- **Interest –** from US Treasury Investments.
- **Cost Recoveries -** from responsible parties (RPs); those responsible for oil incidents are liable for costs and damages. NPFC bills RPs to recover costs expended by the Fund. Recovered monies are deposited into the Fund.
- **Penalties**. In addition to paying for clean-up costs, RPs may incur fines and civil penalties. Penalty deposits into the OSLTF are generally between $4 million and $7 million per year.

Source: The National Pollutions Fund Center, U.S.A

5. POLICY RECOMMENDATIONS

The actions needed for strengthening China's environmental emergency prevention and response are grouped under three areas – overall institutional reform, risk management and prevention, and emergency response and mitigation. Policy recommendations are provided as follows.

5.1 *Overall Institutional Reform*

Recommendation 1: To Improve the Legislative and Regulatory Framework. Effective emergency prevention and response requires a solid legal basis. With lessons from overseas, China can improve its legislative and regulatory system for emergency prevention, preparedness, and response by developing a national statute and strengthening specific provisions in existing regulations on the prevention and control of pollution incidents with more details on implementation issues. Specifically, it is recommended that:

1) The National People's Congress should provide a legislative framework for effective prevention and response to emergency situations addressing institutional organisational arrangements and establishing the fundamental principles such as prevention; precaution; polluter pays; the adoption of best available technique and best environmental practice whilst also providing the basis for further technical legislation and regulation.

2) NPC should also review the relevant provisions on prevention and control of pollution incidents in existing legislation and expand the proposed administrative regulation of the State Council with regard to the Management Regulation on Toxic and Harmful Chemicals.

3) The State Environmental Protection Administration, the State Administration for Work Safety, the National Development and Reform Commission, and other relevant agencies, should also review and analyze the necessity to revise their agency roles and adopt new legal and technical measures on emergency planning and response.

4) On the basis of these national laws, the national government should encourage local authorities to revise local regulations with more emphasis on clearer responsibility, training, enforcement and prohibitive penalties for non-compliance.

*Recommendation 2: To Improve Organizational Arrangements and Strengthen Coordination between Organizations***.** Environmental emergency prevention and response can involve multiple functions and skills over a wide geographical area ranging from the enterprise concerned to government agencies at local, provincial, and national levels. A critical element of responding to any incident and minimizing its impact is the ability to react appropriately in a coordinated fashion without delay. This requires appropriate authority, responsibility and technical knowledge. International experience shows that it is common to respond to an incident under a unified command. A clear organizational structure for emergency response is required, including procedures that define when and how to escalate the response beyond the local authorities. The roles, responsibilities, authority and mandate of each organization must be clearly defined and understood.

To improve organizational arrangements for more effective prevention and response to water pollution emergencies, it is recommended that:

1) Given the difficulty of inter-ministry and inter-regional coordination, the Roundtable

under the State Council should be elevated to a position whereby it can lead the national effort of emergency preparedness and response with well trained, permanent staff and management representatives from the fire and police services, SEPA, SAWS and the Ministry of Communications. The office should be given the authority to guide various government agencies, at central and local levels, in emergency prevention planning. The office should have responsibility for collecting information and coordinating all parties concerned when a major incident with potential trans-boundary impacts takes place.

2) The State Council should further clarify the responsibility and functions of relevant authorities at local and national levels with regard to i) the prevention of emergencies ii) actions in the event of a pollution incident and the escalation of response if an incident has a trans-boundary or international impact and iii) incident investigation and clean-up. Local governments are the first authorities responsible for handling on-site emergency response. Command and communication structures set up for emergency response should be clear to enable fast and appropriate local response with escalation to regional and national levels if necessary. Environmental and safety authorities including their newly established Emergency Response Centers should be in a position to: review and approve the adequacy of emergency response plans; provide technical advice to the police and fire services on the appropriate handling of releases; monitor the impact of accidental releases and contribute/lead accident investigations.

3) The national government (Roundtable) should be responsible for handling incidents that cross international borders. For trans-provincial river management, in the short term, the authority of the central government should be strengthened to improve supervision and coordination and the responsibilities of relevant provinces/municipalities should be defined more clearly. As organizations on behalf of the central government, River Basin Water Commissions could consider the involvement of representatives from SEPA. In the long run, River Basin Water Commissions should be restructured to include representatives from central government agencies (such as MWR and SEPA) and provincial/municipal governments to ensure appropriate accountability for basin-wide water resources management. The expanded role, authority and responsibility of river basin commissions should be clearly stated in relevant laws/regulations. These commissions, empowered with full participation of provincial/municipal governments as commission members, should be given greater responsibility for whole of river management planning including emergency response planning, monitoring and reporting water quality at provincial borders.

Recommendation 3: To Establish Mechanisms for Incentives and Liabilities. Awareness is an essential element of environmental emergency prevention and response. The Songhua River toxic spill has helped to raise the awareness of the government and the public on environmental incidents just as the floods of 1998, SARS in 2003 and a series of mine accidents did on public health, flood control and industrial safety in the past. To maintain the focus on environmental emergencies and continue to raise the awareness of local governments, the central government should reform the performance evaluation system and include environmental treatment, prevention and response to environmental accidents. Specifically, it is recommended that:

1) The number of environmental incidents and economic loss (per unit of population and output) should be added to the performance evaluation and promotion criteria for local government and relevant line ministry officials. Central and local governments should introduce a more comprehensive environmental indicator system, such as green accounts, to complement conventional GDP-centered accounting systems.

2) Given the important role of manufacturers

and consumers in producing, transporting, storing, and using toxic materials, effective incentive mechanisms, in the form of both rewards and penalties, should be in place to promote environmentally sound behavior and to minimize the potential for pollution accidents. Financial penalties and responsibility for incidents should be accorded to the polluter as a mechanism for recouping clean up costs and providing an incentive for preventing pollution. Polluting companies should be required to purchase insurance for environmental pollution accidents.

Recommendation 4: To Provide Funds through Proper Channels. To maintain operation of an effective emergency response system, it is recommended:

To establish an environmental fund with sufficient revenue to support such activities as information management, training and clean-up. Funds could be raised through an increase in the pollution levy on toxic chemicals to reflect their risks and economic costs and/or the introduction of environmental taxes as part of a product tax on toxic chemicals based on their potential environmental risks. In addition, increased fines for pollution accidents to cover the cost of clean-up and compensation could be considered as another source for the fund.

5.2 *Risk Management and Prevention*

Once a pollution incident has occurred, the impact on the environment and human health may be difficult and costly to control. An emphasis on prevention of pollution is more cost effective, easier to implement and enforce. In other words, prevention tends to be better than cure. Pollution prevention and preparedness involves risk assessment, a comprehensive chemicals inventory, information management, emergency planning, and pollution control measures.

Recommendation 5: To Strengthen Risk Assessment, Management and Planning. It is essential to have good information and assessment of the risks associated with industry. A well-designed assessment system, which includes environmental risk assessment, can play an important role in determining, assessing and managing the risks associated with existing and new projects as well as contributing to planning and development decisions for an area.

In China, inadequate and infrequent risk assessment leads to a poor understanding of the scenarios that could lead to an environmental emergency. Consequently response plans can be inappropriate and/or poorly resourced. To address this issue, it is recommended that:

1) The national and local governments (led by SEPA or the local environmental protection bureau in collaboration with SAWS and PSB as well as their local Work Safety Bureau and the Fire and Police Service) should institute a tiered system of emergency response planning at plant, industry park, local, provincial and national level that addresses pollution risk, based on compulsory comprehensive risk assessment. Industrial sites should be categorized according to the hazards present. Enforcement, monitoring and emergency response resources should be prioritized according to hazards.

2) SEPA, SAWS, the local EPB and safety agencies should be nominated as the competent authorities to approve the adequacy of environment and safety risk assessment, applying a thorough risk management approach that focuses on both prevention and mitigation of the impacts of chemical incidents. Approval from the relevant competent authorities is essential before an enterprise receives its license to operate. The license to operate, risk assessments and emergency plans should be reviewed on a regular basis or when a major change is proposed. All high hazard plants regardless of age should be subject to risk assessment and be required to prepare an emergency response plan.

3) All high hazard enterprises should inform

their surrounding communities of the environment, health and safety risks that could arise from the plant in the event of an incident and the procedures that residents should take should an accident occur. The emergency response plan should be shared with the public through a series of public hearings.

4) In addition to enterprise-specific risk assessment, environment and safety risks should also be fully assessed and appropriate management measures defined for local, regional and national planning purposes. The provisions of the current EIA and Strategic/Plan Environmental Assessment process should be reviewed and upgraded to provide adequate coverage of emergency situations.

Recommendation 6: To Improve Chemical Information Management. Understanding the locations and properties of sites producing or storing hazardous materials plus reliable release data from those sites is part of a risk management approach that enables authorities to effectively monitor plant performance and provides essential information to all stakeholders in the event of an accident. China is currently developing two national chemical inventories, through SEPA and SAWS, which are relatively lightly populated compared to their overseas counterparts. In some cities in China public information systems on pollution sources have been established including a level of disclosure via the internet. However, at this stage, the reliability of the information provided can not be guaranteed by the local authorities. There are a number of existing sources of information that could be made publicly available if reliability and coordination between departments was improved. They include emission reports and permit information on pollution sources, pollution levy data, planning information, and environmental impact assessments.

To improve chemical information management, it is recommended that:

1) The National Government (through SAWS and its National Chemical Registration Center) should establish and maintain comprehensive inventories of all chemicals and pollution sources containing information consistent with international standards. SAWS and SEPA are currently developing inventories. The function and effectiveness of two systems should be reviewed. Inventories should be consistent and comprehensive. They should be easily used in public emergency prevention and response.

2) The national and local governments (led by environmental protection agencies) should improve environmental monitoring systems to collect, analyze and respond to complete,

reliable and verifiable information on a timely basis. Plant data requirements should be clear, enforced, verified and publicly available. The existing or new monitoring centers established by line ministries or local governments can be gradually become independent of their parent agencies. They will be accredited periodically and provide objective and independent monitoring data to governments and the public. SEPA should assure the monitoring quality of key national pollution sources, drinking water sources and ecologically sensitive areas. The National Government should enhance the coordination between SEPA, MWR and MOC to improve the reliability and completeness of available information on water quality. Monitoring results should be made publicly available.

5.3 *Response and Mitigation*

Timely, appropriate response is critical to prevent pollution from spreading and minimizing environmental impact.

Recommendation 7: To Build the Capacity of First Response. It is essential that first responders and the public have access to accurate and up to date information about the risks of chemicals to which they may become exposed and information on what to do in the event of an accidental release of those chemicals. Given the number of chemicals in production, storage and use and their various and complex properties, it is essential that first responders are able to identify the chemicals they are dealing with. They need to understand the chemical's properties, potential impact, and the most appropriate approach and equipment to manage any incident. This information saves valuable time at the time of an incident and can ensure that responders take appropriate, safe action to contain a spill or release.

The combination of a pollutant release from an accident and natural dispersion patterns means that there is a risk of chemical releases going beyond the boundary fence of a factory. Speedy reaction time, appropriately coordinated actions of the first responders, and reliable detection systems are essential to minimize the spread of pollution and preventing its entry into natural dispersion paths. In this area, the developed world has much experience from which China can learn.

To improve the capacity of first response, it is recommended that:

1) SAWS, in collaboration with SEPA and other agencies, should establish and enforce a comprehensive labeling system for chemicals that is consistent with international standards and is applied to all parts of the production, storage and transportation process. First responders should be trained to interpret this information and on the specifics of handling chemical incidents: recognizing chemicals; different approaches to dealing with them; use of appropriate equipment and techniques; and dealing with the public.

2) The National Chemical Registration Center and its regional offices should establish a unit, independent from enforcement divisions, to provide 24 hour technical support to the emergency services on the properties and appropriate responses to specific chemical releases, from a safety and environmental perspective. The operators of the service should be well trained and have access to comprehensive and up to date information. It is also important that these centers can be readily accessed by anyone involved in dealing with a chemical incident, whether it is the plant, the first responders, or the general public. To that end the numbers and contact details should be displayed on labels and well publicized to relevant parties and the centers resourced to deal in real time with enquiries.

3) NPC should specify in law the unified command structure for responding to an (environmental) incident, with provisions and procedures to escalate the response from the

local to the national level depending on the nature of the incident. As part of the emergency planning and preparation process, responders should test the effectiveness of interagency response through desk top exercises and drills.

Recommendation 8: To Strengthen Monitoring, Timely Reporting and Disclosure of Emergency Situations. The Songhua River incident demonstrates the important role of monitoring systems in detecting an incident and understanding the impact on human health and the environment. Early detection of releases combined with informing local and national authorities in a timely fashion facilitates rapid decision making. This helps to minimize the spread of pollution and provide an understanding of the impact on water or air quality and will influence the mitigation steps required. It can also support the identification of the possible source of the pollution. Therefore, it is recommended that:

In the event of an incident, local environment and safety authorities should establish appropriate additional monitoring to assess the impact on the health and safety of the local communities and the environment. The potential pathways of the pollutants should be identified immediately and additional monitoring stations established without delay. Provincial and national bodies should be informed to advise if additional monitoring is required. The population potentially affected by the incident should be informed of the development of the incident and it potential risks on a timely basis.

Recommendation 9: To Cleanup Pollutants Rapidly and Mitigate Impacts. In the event of a release to water or land, quick containment will limit the spread of pollution, minimize the impact on the environment and health and reduce the complexity and cost of clean-up. So, it is recommended that:

Local governments should equip first responders with the mandate and resources (equipment and training) to contain pollution releases. Following an incident, the local EPB and SEPA should be responsible for setting standards and monitoring the effectiveness of the clean-up effort. The local EPB together with the responsible polluter (where identified) should begin the clean-up effort at the earliest possible time to prevent secondary pollution. Where the polluter is not identified the EPB should make efforts on clean-up without delay and aim to recoup costs at a later date.

Recommendation 10: To Undertake Incident Investigation and Draw and Share Experiences/Lessons. In China, incident investigation is still weak, seldom identifying the root cause of an incident or the steps required to prevent a similar incident in the future. The network for sharing investigation findings and new preventive practices across and between industrial sectors is weak. In developed countries, the environment and safety authorities play a leading role in accident investigation, often making findings publicly available. Lessons learnt are shared through industry associations or through the release of legally binding notices to industry sectors from the authorities.

To learn experience and lessons from water pollution incidents that have already occurred to improve prevention and response, it is recommended that:

Accident investigation should be mandated following an (environmental) incident with contributions from the relevant fire, police, environmental and safety authorities. Significant incidents should involve national authorities. Investigations should aim to identify the polluter and cause of the incident and how the incident can be prevented in the future. Investigation findings should be reported to the central authorities who should establish a mechanism to share lessons learnt and introduce new legally binding practices and procedures if

necessary. The public have the right to be informed of the final investigation results.

6. CONCLUDING REMARKS

The Songhua River incident clearly illustrates the weaknesses of the current system of pollution emergency prevention and response in China. Based on the analysis of water pollution incidents, the weaknesses in China and the experiences of developed countries, this paper provides a set of recommendations to reduce and mitigate the risks from environmental emergencies by taking a comprehensive approach that adopts risk assessment, risk management, prevention, interagency coordination and the "polluter pays principle". Such an approach should lead to:

- A reduction in incidents by focusing on and implementing preventive measures
- Improved control in the event of a pollution incident
- Reduction in risk to human health and the level of environmental degradation both locally and globally, through prevention, speedy response and improved mitigation
- Improved relations with neighbors (domestically and internationally)
- More efficient use of limited resources, with authorities focusing attention on riskier plants and more sensitive areas.

The Songhua River incident and a series of water pollution incidents afterwards also present an opportunity for China to take measures to change the current state, establish and improve the system of pollution emergency prevention and response, and strengthen pollution control and environmental protection. The Chinese government has already taken and is planning to take actions in many areas to prevent and respond to environmental (including water pollution) emergencies. It is hoped this paper can contribute to Chinese government's efforts in this regard.

7. ENDNOTES

[1] SEPA News Release. *SEPA Comprehensively Check New Petrochemical Plants*. http://www.sepa.gov.cn/xcjy/zwhb/200602/t20060207_73762.htm. February 7, 2006

[2] SEPA. *The State of Environment in China 2005*. 2006, Beijing.

[3] SEPA and NBS, 2006. *China Green National Accounting Study Report 2004* (Public Version).

[4] World Bank, 2007, *Cost of Pollution in China - Economic Estimates of Physical Damages*. Washington, DC, USA.

[5], [6], [7] *China Environmental Statistic Yearbooks 2004, 2005 and 2006*, China Statistics Press, Beijing, China.

[8] Zhou, Shengxian. Speeding up Facilitating Historical Transition and Creating a New Situation of Environment Protection: A Speech at the 2006 Meeting of Director-General of Local EPBs across China, April 18, 2006.

[9] Xinhua News Agency. *Half of China's Chemical Plants Endanger Environment*. http://news.xinhuanet.com/english/2006-07/11/content_4818672.htm. July 11, 2006.

[10] Ma, Zhong, Wang Yaoxian, Wu Jian. *Setting up the Environmental Financial Mechanism and Increasing Environmental Investment, the Key to Implement 'Decision' by the State Council*. China Environmental News. September 7, 2006.

[11] Hua, Shupeng. *Feasibility to Establish Environment Protection Tax in China.* http://www.chinalawedu.com/news/21602/21661/21674/2007/4/zh400133859447002462 0-0.htm. April 4, 2007.

Background Study Reports to the Policy Paper

1. *Strengthening the National Capability of Water Pollution Emergency Prevention and Control: Lessons Learnt from Songhuajiang River Water Pollution Incident*, prepared by Professor Ma Zhong, Dean, School of Environment, Renmin University, China (2006).
2. *United States Experience in Environmental Emergency Planning and Response*, prepared by Dr Yuyang Gong, Vice President, Louis Berger Group, U.S.A. (2006).
3. *The UK Emergency Response Systems: The Case of the Buncefield Incident and Lessons Learned, prepared by* The UK National Chemical Emergency Centre and Jennifer Coleman, UK, (2006).
4. *International Experience with Toxic Chemical Management*, prepared by Dr Hongjun Zhang, Partner, Holland & Knight LLP, U.S.A. (2006).
5. *An Overview of Major Multilateral Environmental Agreements on Hazardous Chemical Management,* prepared by Liu Guozhi, Senior Program Manager, SEPA, China (2006).