Improving Environmental Safety Through Third Party Inspection

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Improving Environmental Safety Through Third Party Inspection

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Risk Analysis
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1. INTRODUCTION

This paper makes the case for relying on decentralized market-based incentive mechanisms to supplement performance-based regulations for promoting industrial safety. In particular, we examine how third party inspections coupled with insurance protection can encourage firms to reduce their risks from accidents and disasters. Our proposal is thus an example of a management-based regulatory strategy where the locus of decision-making is shifted from the regulator to firms who are now required to do their own planning as to how they will meet a set of standards or regulations.(1)

The third-party inspections we have in mind would take the form of a voluntary contractual relationship between the firm and the party auditing the facility rather than relying solely on the regulatory agency as enforcer. In undertaking the inspection, the third party can simply play the role of informing the firm that it is in violation of a regulation or, going one

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step further, it can assist the firm in developing a program for reducing its risks to comply with a particular standard or regulation.[2]

The passage of Section 112(r) of the Clean Air Act Amendments (CAAA) of 1990 offers an opportunity to implement such a program. This legislation created two new federal regulatory programs aimed at preventing releases of hazardous chemicals: the Occupational Health and Safety Administration (OSHA) Process Safety Management (PSM) standard and the U.S Environmental Protection Agency (EPA) Risk Management Program.

The OSHA program was enacted in 1992 and requires facilities containing large quantities of highly hazardous chemicals to implement accident prevention and emergency response measures to protect workers. The EPA Risk Management Program regulation, published in 1996, borrowed the same accident prevention concepts and language from PSM but went beyond the OSHA program. It also required facilities to perform a hazard assessment, estimate consequences from accidents and submit a summary report to EPA by June 21, 1999 called the Risk Management Plan (RMP)[3]. The challenge is how to encourage compliance of these regulations so that firms will be operating in a safer manner than they otherwise would be.

The paper proceeds as follow. In the next section we make the case for well-enforced RMPs and then show in Section 3 why firms may not voluntarily comply with this regulation. Section 4 shows analytically that third party inspections coupled with insurance provide economic incentives for many firms to undertake RMPs voluntarily and encourages the remaining recalcitrant firms to comply with the regulation. Section 5 illustrates implementation challenges in utilizing third party inspections while at the same time pointing to their successes in a variety of different contexts. The concluding section discusses a set of open issues and questions, the need for future studies and what analysts and practitioners can learn from this work.

2. THE NEED FOR WELL-ENFORCED RMPs

Catastrophic events, such as the accidental release of methyl isocyanate (MIC) at the Union Carbide plant in Bhopal, India in 1984 and the Chernobyl nuclear power plant accident, raised the public's consciousness regarding the potential consequences of future accidents . As Slovic et al [4] point out, individuals may view catastrophic events or even near misses as signals that there are problems with a particular technology. If there are emotional concerns, such as fear, dread and anxiety that arise from these events, then government agencies may feel pressure to impose regulations and standards, such as RMPs, to reduce future losses. With respect to chemical accidents and related low probability-high consequence events there are additional reasons why there is a need for such regulations

Inability to Distinguish Low Probabilities One reason why RMPs are desirable from a societal point of view is the inability of individuals to distinguish between accident probabilities when the event has a very small chance of occurrence. There are a

number of published studies that show the difficulties people have in interpreting low probabilities when faced with risks that may affect them personally.[5,6] A recent series of experiments show that individuals are insensitive to probabilities of a chemical accident when judging the safety of a facility even when the likelihood differences ranged from 1 in 10,000 to 1 in 1 million.[7]

In a recent study of several hypothetical managerial decisions, Huber, Wider and Huber [8] found that when subjects are required to search out their own information, they rarely even ask for probability information. One group was given a minimal description and the opportunity to ask questions. Only 22% of these respondents asked for probability information. Their questions only concerned imprecise probability information. Not a single person asked for precise probability information. Another group of respondents were given precise probability information, and fewer than 1 in 5 of these individuals mentioned the probability in their verbal protocols.

Externalities Another important reason for having well-enforced RMPs is to assure that industrial plants undertake an accidental release prevention program when they may not have financial incentives to do. For example, some of the consequences of a chemical accident will impact on the residents in the area surrounding the plant, but the industrial facility will not be held fully liable for these impacts.

To illustrate this point, suppose there are decreases in property values to homes in the surrounding area or there are disruptions in community life because of an accident. The firm causing the accident will not be responsible for these losses. The firm may thus underestimate the benefits from an RMP and decide not to take action when it would be in the public and society's interest that the plant does this. Ashford [9] has reported that for every $1 of direct cost associated with an accident there is $4 to $10 in social costs not borne by the firm.

The same rationale has been used to justify well-enforced building codes on homes in hazard-prone areas. [10] When a building collapses it may create externalities in the form of economic dislocations and other social costs that are beyond the economic loss suffered by the owners. These may not be taken into account when the owners evaluate the importance of adopting a specific mitigation measure. For example, if a building topples off its foundation after an earthquake, it could break a pipeline and cause a major fire that would damage other homes not affected by the earthquake in the first place. In other words, there may be an additional annual expected benefit from mitigation over and above the reduction in losses to the specific entity adopting this loss-reduction measure. [11]

3. WHY FIRMS MAY NOT VOLUNTARILY INVEST IN RMPS

Consider a chemical plant that has a relatively high probability (p_h) of causing an accident which results in a loss (L), where L is a multidimensional vector reflecting both

direct impacts which include lives lost or injured, damage to physical property as well as environmental and social impacts that are borne by the firm.[2]

The firm has an opportunity to reduce future direct and indirect losses from accidents by implementing a risk management plan (RMP) that will reduce the probability of an accident to $p_l < p_h$ at a fixed cost C. The magnitude of C is based on the expenditures in both time and money in implementing a strategy for reducing the risks of future accidents.

Suppose the chemical plant was risk neutral so that its objective was to maximize expected profits. By implementing an RMP suppose it determined that its expected annual savings from taking this action would be $S= (p_h - p_l)L$. If the plant is assumed to achieve S at the beginning of each year and expected to be in business for T years then the expected discounted benefits of undertaking an RMP would be given by:

$$B = \sum_{t=1}^{T} S /(1+r)^{t-1} \qquad (1)$$

where r is the annual discount rate

The decision rule facing the chemical plant is a simple one. If $B > C$ then they should invest in the RMP; otherwise they should not.

There are a number of reasons why a firm may not invest the time and money in programs, such as an RMP, to reduce their risks even if there was good reason to believe that the net benefits from taking this action would be positive.

Threshold Models of Choice For one thing it may be very difficult for the firm to compute the reduction in probabilities and losses that will occur if they implement such a plan. Instead of undertaking the costs of such an exercise, the plant may estimate that the probability (p_h) of a catastrophic accident under its current operations was below some threshold probability p*. They then utilize the following simplified decision rule: if $p_h <$ p*, do not invest in an RMP. In other words the chemical plant would not even compute the expected benefits implied by (1) and compare them with the costs of the RMP.

There is considerable empirical evidence that firms utilize this type of threshold model for making their decisions as to ways that they can reduce their risks. [(13)] Union Carbide did not vertically integrated their process of synthesizing and using methyl isocyanate (MIC) to make insecticides because they perceived the chances of a Bhopal-like disaster as so small that it was not worth taking into account.3 By not taking this action it was

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[2] We could also include indirect impacts in this analysis so that the loss is a function of time (L_t) but this complicates the analysis without changing any of the qualitative results. Indirect impacts include business interruption should the plant be damaged or destroyed, the effect on property values in the community, social and emotional stress to the community as well as long-term impacts on the industry.

[3]Paul Shrivastava [(12)] points out "the technological preconditions for a major accident were embedded in the design of the Bhopal plant, which allowed for bulk storage of MIC in large, underground tanks in a

forced to store MIC in large quantities, thus opening up the possibility of a large chemical release.

Short Time Horizons Another reason why firms may not invest in RMPs is that their decisions are guided by short-run considerations. Managers responsible for these decisions may have their performance evaluated on their expenditures during the year and hence would want to make sure the expected benefits over a relatively short time horizon exceeded the upfront investment costs, C. As one truncates the time horizon T to a relatively short interval, then the benefits shown in equation (1) will decrease.

To illustrate this point consider the case where L==$6,000,000 p_h =1/100 and p_l=1/200, so that the expected *annual* benefits from investing in an RMP is

$$S= (p_h - p_l)L = (1/100-1/200)\ \$6,000,000 = \$30,000 \quad (2)$$

If the annual discount rate is 8% and the time horizon T were 20 years, then B from (1) would be approximately $318, 000 If the managers were utilizing a time horizon of T=2 then B would be only about $58,000. There would thus be a wide dollar range for C over which the plant would want to invest in an RMP had they utilized a long time horizon, but would prefer not to incur these costs if they were myopic in their thinking.

Limited Assets Small firms may also not want to invest in RMPs because they have limited assets (A) and hence they would declare insolvency should their losses exceed A after a catastrophic accident. Rather than investing some of their limited capital in an RMP, they may prefer to take their chances, since the net benefits in any year would be less than if they had enough assets to cover their losses.[4]

Note that if A<L the firm's benefits from risk reduction is $(p_h-p_l)A$, instead of $(p_h-p_l)L$. For example, assume the RMP reduced the probability of an accident from p=1/100 to p=1/200 and L =$ 6 million. Suppose that A=$3 million so that S= $15,000 and the discounted total benefits (B) from (1) were then only $159,000. In this case, if C were between $159,000 and $318,000, the firm would not implement an RMP due to their limited assets. They would have taken this step had A ≥$ 6 million.

4. USE OF THIRD PARTIES WITH INSURANCE TO ENFORCE REGULATIONS

EPA and other regulatory agencies have been searching for ways to ensure a high compliance level with respect to their regulations and standards. Consider the case of enforcing Section 112(r) of the CAAA of 1990. There is some urgency for a type of

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production environment that used manual noncomputerized control systems" (p. 54). His comment suggests the value of a vertically integrated process.

[4] Of course, shareholders or creditors would bear these residual losses.

decentralized procedure with appropriate incentives due to the EPA's limited personnel and funds for providing technical guidance and auditing regulated facilities.

Challenges to Using Centralized Procedures Chemical firms, particularly smaller ones, have little financial incentive to follow centralized regulatory procedures if they estimate that the chances that they will be inspected by a regulatory agency is very small and/or they know the fine should they be caught will be low. In such case they may be willing to take their chances and incur the fine should they violate the existing rule or regulation and be caught.

Consider the tradeoffs that a firm faces when determining whether to adopt a particular regulation for which they incur a cost (C). For simplicity assume that the firm perceives no benefits to them from adopting the regulation and that they are myopic in their decision making process so that they only consider the consequences to them of being inspected over the *next year*. Suppose they estimate the chances that the regulatory agency will inspect them next year as q, in which case they will incur a fine F (which will include the cost of adopting the regulation). If the firm is risk neutral then it will only decide to incur a cost C today if $C < qF$. Should the firm be small so that its assets A are less than F, then one would replace F with A in the above inequality to reflect the maximum the firm could pay before becoming insolvent.

Under the General Duty Clause of the Clean Air Act, there are fines of up to $27,500 per day. Recent discussions suggests that the General Duty clause is rarely imposed by EPA because they do so little monitoring. For example, EPAs Region III has only five auditors for inspecting its many industrial facilities. In this case, F is relatively high but q is extremely low so that firms are not concerned about being inspected by the regulatory agency.

An Enforcement Model Using Market Mechanisms The combination of third party inspections in conjunction with private insurance is a powerful combination of two market mechanisms that can convince many firms of the advantages of implementing RMPs to make their plants safer and encourage the remaining ones to comply with the regulation to avoid being caught and fined.

To show the conditions under which third parties can be effective we now develop a simple model where there are two types of firms---high and low risk. Firms are assumed to maximize their expected profits. The probability of an accident is p_l for a low-risk firm and p_h for a high risk firm ($p_l<p_h$). The losses from an accident are L whether the firm is low or high-risk.

In this model firms are required to have insurance to cover their losses should a catastrophic accident occur. There may be a several bases for such a requirement. Financial institutions may require insurance as a condition for a mortgage to protect the bank's investment. The regulatory agency could require this coverage, so that the firm will not declare insolvency should it suffer a severe loss from an accident. Having

insurance can also increase the public's confidence that the firm is operating safely and that it will not become insolvent in case of a catastrophe.

Insurance is available through a competitive market with rates based on risk and equal to the expected cost of an accident. Third party inspections can distinguish low-risk from high-risk firms. If a firm agrees to be audited, the third party will charge C for the inspection and the insurer will charge a premium that reflects the outcome of the inspection. A low risk firm will be charged $p_l L$ and a high-risk firm will be charged $p_h L$. If the firm refuses to be audited, it will be presumed to be high-risk and will be charged a higher premium.
The intuition behind using third parties and insurance to support regulations can be stated in the following way. One of the biggest concerns of a regulatory agency (RA) is that it doesn't have enough resources to audit all firms in the industry. Low-risk firms, who the EPA has no need to audit, cannot credibly distinguish themselves from the high-risk ones without some type of inspection . By delegating part of the inspection process to the private sector through insurance companies and third parties, the RA provides a channel though which the low-risk firms can speak for themselves. If a firm chooses not to be inspected by third parties, it is more likely to be a high- rather than a low-risk one. Therefore this mechanism not only substantially reduces the number of firms the RA has to audit, but it also makes their audits more efficient.

One-Period Model To determine how firms make the decision as to whether to be inspected by third-party auditors, we first consider a simple one period model and then extend it to the multi-period case. All firms are identical except for their risk of a major accident. Each firm has initial assets A and must decide whether or not to be inspected. If a low or high-risk firm chooses inspection voluntarily, it incurs an inspection cost C. Low-risk firms are assumed to have already adopted an RMP voluntarily and the inspection will reveal that their risk of an accident is p_l. An inspection of the high risk firm reveals that it has not adopted an RMP, and therefore it will have to incur an additional investment cost I to reduce its risk level from p_h to p_l. Third parties help firms reduce this investment cost by providing technical assistance as part of their services.

Firms who do not volunteer to be inspected may be audited by a regulatory agency with probability q. If a high-risk firm is audited, it will incur a penalty F and in addition will have to incur an investment cost $I^* > I$ to reduce its risk level from p_h to p_l. The investment cost (I*) is higher when the regulatory audit is undertaken because the firm does not have the benefit of the third party's technical assistance. Table 1 summarizes the high and low risk firms' costs.

Table 1
Costs to High and Low Risk Firms Due to
Inspection by Third Parties and Audit by Regulatory Agency

	Premium	Low-Risk Firm Cost	High-Risk Firm Cost
If inspected by third parties	$p_l L$	C	C + I
If not inspected by third parties and audited by a regulatory agency	$p_h L$	Not Applicable	F + I*

We assume that the cost of inspection $C < S = (p_h - p_l)L < C+I$. This means that low-risk firms will always want to have a voluntary inspection to take advantage of the more favorable insurance premium (C<S); without government intervention , high-risk firms will not choose to have an inspection because the cost of inspection plus the investment cost exceeds the expected benefit (S<C+I).

The more interesting question is how high F has to be for a high-risk firm to voluntarily choose third party inspections. If a high-risk firm decides **not** to undertake a third party inspection and adopt an RMP, then it must pay an insurance premium p_hL. If the firm is subsequently audited by a regulatory agency, it incurs a penalty F as well as investment costs I^* to reduce its risk. The probability of being audited by government is q. So the expected expenditures are $p_hL + q(F+I^*)$ But if this same firm voluntarily chose an inspection by a third-party, it would have to pay a cost $C+I$ and would then be charged a lower insurance premium p_lL. The decision on whether to have a third party inspection or take ones chances that a government agency will not audit them is determined by computing the difference (D) between these two choices which is given by

$$D = S + q(F+I^*) - (C + I) \qquad (3)$$

where $S = (p_h - p_l)L$

Whenever D >0 the high-risk firm will want to incur a third-party inspection. A regulatory agency can increase the chance that a firm will want to have a voluntary inspection by increasing the F and/or raising q.[5]

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[5] This footnote provides a more formal proof of the tradeoffs between a high risk firm deciding to undertake a third party inspection or taking its chances on being audited by a regulatory agency assuming the firm has sufficient assets (A) to cover the costs of fines, inspections and improvements necessary to make it a low risk firm. If a high-risk firm chooses third-party inspection in the first period, its expected assets at the end of the second period are $U_1 = A - C - I - p_l L$. If the firm doesn't choose inspection, its expected assets are $U_2 = q(A - p_h L - F - I^*) + (1-q)(A - p_h L) = A - p_h L - q(F + I^*)$. $U_1 > U_2$ if and only if $D = (p_h - p_l)L + q(F + I^*) - (C + I) > 0$, or $F > [C + I - (p_h - p_l)L]/q - I^*$.

To illustrate, consider the following simple example with the following data:

$p_h = 1/100$
$p_l = 1/200$
L = \$6,000,000
q=1/10
C=\$10,000
I=\$30,000
I*=\$40,000

Based on (3), D>0 when F > \$60,000. In other words if there is a 1 in 10 chance that the regulatory agency will inspect the firm, the fine has to exceed \$60,000 to motivate high risk firms to choose third party inspections voluntarily. If the third parties can further help firms reduce the investment to I =\$ 24,000, then no fine is necessary for firms to want to adopt third party inspections.

This analysis suggests that the government fine associated with a regulatory audit needs to be carefully considered as a part of the policy process. If there is a small chance that a firm will be audited, then F has to be much larger than if q was relatively high. There is likely to be political pressure from the regulated industry for low fines, since small firms may have to declare insolvency if F is too high. To the extent that third parties provide other risk management services to firms leading to an increase in I*-I, then voluntary inspection becomes a more attractive option for any given (q, F) combination.

Extensions to Multi-Period Model When this analysis is extended to a T>1 period case, then there is a greater incentive for low-risk firms to invest in an RMP for a given inspection cost C. The probability increases that high risk firms will invest in an RMP for the following two reasons: (1) the probability that a high risk firm will be audited increases over time as firms reveal that they are low risk and some high risk firms are audited by the government agency (2) as both q and T increase, the high risk firm voluntarily chooses to undertake a third party inspection because the expected costs of doing this are less than the expected costs of taking their chances and hoping that they will **not** be audited by the government.

To see how the process unfolds suppose that the time horizon is T periods so that any low risk firm that incurs a one-time inspection cost C receives a premium reduction of $S= (p_h - p_l)L$ during each time period t, t=1…..T. The net-benefits for the low-risk firm (NB_l) of inspecting in period 1 is computed as:

$$NB_l = \sum_{t=1}^{T} \frac{S}{(1+r)^{t-1}} - C \qquad (4)$$

For any given inspection cost C, as T increases and r decreases the value of S per period for a low risk firm to want to inspect voluntarily decreases.

The net benefits NB_h to the high-risk firm of inspecting in any period t* is identical to the one period model [see equation (3)] except that the firm saves premiums over T-t* periods and the probability of being audited is given by q_{t^*} where $q_t > q_{t-1}$ for all t . This can be written as

$$NB_h = \sum_{t=t^*}^{T} \frac{S}{(1+r)^{t-1}} + \frac{q_{t^*}F}{(1+r)^{t^*-1}} - (C+I) \quad (5)$$

To illustrate how q_t changes over time suppose that there are N=1000 firms in the industry and that the regulatory agency (RA) can only undertake n=100 audits each period. At the beginning of the process (period 1), suppose that all the low-risk firms decide to inspect voluntarily because they determine that equation (4) yields $NB_l > 0$. These firms reveal their status to the RA. The high risk firms, on the other hand, find from (5) that $NB_h < 0$ when t* =1 so they do not voluntarily inspect.

Suppose that there are an equal number of high and low risk firms in the industry so that $q_1 = 100/500 = 1/5$. In other words, 100 high risk firms will be audited during period 1, will be forced to adopt an RMP and hence be classified as low risk. At the beginning of period 2 only 400 high risk firms will remain in the pool as candidates to be audited by the RA. This means that in period 2 $q_2 = 100/400 = 1/4$.

If none of the high risk firms decided to undertaken inspection voluntarily, then another 100 firms will be audited by the RA in period 3 and $q_3 = 100/300 = 1/3$. As q_t increases so does NB_h .The first period where $NB_h > 0$, all the high-risk firms will want to inspect voluntarily. If none of them choose to incur a voluntary inspection, eventually the RA will audit them all. For this example, all the high-risk firms will have been audited by the end of period 5 since $q_5 = 100/100 = 1$.

5. IMPLEMENTATION CHALLENGES

We now turn to the implementation challenges in utilizing third party inspections to help enforce environmental regulations. In this section we provide examples of their success in four different contexts that can serve as possible role models. We then describe pilot studies in Delaware and Pennsylvania in the context of Section 112r of the Clean Air Act Amendments that provide guidelines for a national program that is under consideration by the US EPA.

Steam Boilers [14] The Hartford Steam Boiler Inspection and Insurance Company (HSB) initiated boiler inspections coupled with insurance in the 1860s. HSB has always stressed that insurance was secondary to loss prevention with engineering and inspection services making up a large part of the insurance premium. In an effort to reduce future risks, HSB undertook studies of boiler construction, which eventually led to boilermakers adopting safer designs.

One of the key elements leading to the reduction in the number of boiler accidents is that all of the states in the US require annual inspections of pressure vessels by a

representative licensed by the state, county or municipality in which the facility is located. Inspectors are qualified by either a formal examination or through a certificate of competency issued by the National Board of Boiler and Pressure Vessel Inspectors.

Workers Compensation [15,16] The Occupational Safety and Health Administration (OSHA) has been regulating workplace safety directly since 1971. Though it has been promoting safety to some extent, the effects have not been nearly as positive in reducing workplace risks, especially the fatality rate, as has market-based workers' compensation insurance. Today almost every worker in the United States is covered by some kind of workers' compensation insurance system. Moore and Viscusi [15] show that worker's compensation has created substantial incentives for firms to promoting safety. Since premiums are usually linked to performance, firms have financial incentives to invest in reducing risk levels.

In addition to the savings from lower premiums, firms can also reap benefits from wage reductions. It is well known that workers demand higher wage when they are required to work in adverse working conditions. By reducing its risk levels, the firm can pay a lower wage than it otherwise would be able to offer. In this sense safety expenditures are self-financed at least in part through wage reduction. An additional decrease in death rate per 100,000 workers results in a weekly wage reduction of $1.31, or about $68 savings per worker annually (in 1982 prices). [15]

The worker's compensation mechanism has some similarities to our proposed system. Insurance companies undertake an inspection and firms pay premiums based on their risk level. Insurers often provide technical assistance to firms as a part of their services to help reduce firms' compliance costs. However, the types of accidents considered in this paper (e.g. chemical explosions, chemical fires, or chemical releases) usually generate more costs to the external world than do workplace hazards. Large-scale industrial accidents often impact on the whole neighborhood and surrounding area while workers accidents are normally confined to the employees in the firm.

Hygiene Quality in Restaurants [17] In December 1997 the Los Angeles (LA) County government passed an ordnance requiring restaurants to display a grade cards resulting from a hygiene inspection by the Department of Health Services (DHS). The grade cards rank restaurants based on numerical scores. For scores from 70% and above the restaurant is issued a qualitative rating varying from A (90-100%) to C(70-79%). Restaurants are given a card reporting the actual score if it is below 70%. Restaurants are closed by the DHS if two consecutive inspections result in a score below 60% or if they discover a severe hygiene problem.

Incorporated cities within LA County are free to adopt the ordnance. All restaurants in the county are inspected but they are not required to display the grade card if the city has not adopted the ordnance. Jin and Leslie [17] study the impact of this disclosure law on hygiene quality in restaurants as well as restaurant revenues. They find that voluntary

disclosure of grade cards causes an increase in hygiene quality as well as an increase in revenues for those restaurants with the highest hygiene scores. Mandatory disclosure has an even stronger effect on hygiene quality and revenue increase for the restaurants with the highest score on their grade cards than does voluntary disclosure.

The LSP Program in Massachusetts for Waste Clean-up[6] Under Chapter 21E of the Massachusetts General Law, enacted in 1983, the Department of Environmental Protection (DEP) was given the task of ensuring permanent cleanup of oil and hazardous materials (OHM). The law was implemented through regulations known as the Massachusetts Contingency Plan (MCP). In 1992, because the cleanup rate was too slow, DEP modified the MCP to use third-party auditors known as Licensed Site Professionals ("LSPs"). The purpose of the LSPs was to manage and oversee the assessment and cleanup of sites that activity owners were required to address on the contamination that has been released to the ground or groundwater at thousands of non-Superfund sites throughout the state.

Before the start of the LSP licensing program in 1993, the legally responsible site owners and operators were required to hire environmental contractors who had to receive DEP's approval before conducting each phase of the assessment and cleanup work, much like EPA requires at Superfund sites. But DEP was unable to handle all of the requests, and backlogs developed. By licensing approximately 500 LSPs, and allowing them to oversee the work at sites, many government-related obstacles to prompt cleanup were eliminated.

LSPs are not assigned by the agency but must bid on jobs and be selected by the site owners and operators. They may be discharged at any time subject to the terms of their contracts. To ensure that LSPs do an adequate job overseeing site assessments and cleanups, and do not simply close sites at least cost without addressing significant risks, the LSP Board has established Rules of Professional Conduct that all LSPs must meet when providing professional services. The LSP Board also receives complaints, many filed by DEP, that LSPs have violated these Rules, and the LSP Board takes disciplinary action when it finds those Rules to have been violated by LSPs. Disciplinary actions have ranged from censures to license terminations.

The opinion expressed by many is that the LSP process in Massachusetts has worked extremely well and is representative of what third party auditors can do to assist governmental agencies ensure compliance with environmental regulations.

The Delaware [(18)] And Pennsylvania [(19)] Pilot Experiments Over the past two years two pilot studies on third parties and insurance have been undertaken by a task force convened by the Wharton Risk Management and Decision Processes Center

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[6] The information in this section is based on material which can be found in the Massachusetts Department of Environmental Protection Website (www.state.ma.us/dep/bwschome.htm) and on the Licensed Site Professionals Board's Website (www.state.ma.us/lsp).

consisting of the EPA's Chemical Emergency Preparedness and Prevention Office (CEPPO), EPA Region III, and the State of Delaware's Department of Natural Resources and Environmental Control (DNREC).[7]

Third party auditors have been used to examine RMPs and ensure compliance with Section 112r of the CAAA in Delaware and Pennsylvania at both water chlorination and ammonia refrigeration facilities.[8] Ammonia and chlorine were the chemicals selected in the experiment because they represent 50% of the hazardous chemicals that facilities report under section 112(r) of the CAAA and because the task force was confident that the third party auditors could be trained to conduct audits in chlorine and ammonia facilities in a two-day training period.

In both Delaware and Pennsylvania the owners and operators of facilities were sympathetic to having third party inspections and would be inclined to use them if they yielded certain benefits. More specifically, facility owners said they would be especially interested if the EPA or a regulatory agency gave them a seal of approval based on the results of the inspection, if there were economic benefit offered them by the insurance companies by undertaking the inspection, and if the community viewed positive results from an inspection as a signal that the firm was operating safely.

These pilot experiments indicate some of the additional actions that EPA must consider if it modifies the provisions of section 112(r) of the Clean Air Act Amendments to allow for third party auditors to be used on a national basis. For one thing the agency needs to establish a certification mechanism for the selection and training of third party auditors. They also need to expand the selection and training of third party auditors to include all chemicals listed on the EPA list, not just ammonia and chlorine. The agency also has to address the issue as to actions need to be taken if an inspector discovers that the firm is operating in way that may be hazardous to employees and/or residents in the region. How can one maintain the confidentiality of an inspection process while making sure the public is adequately protected?

6. CONCLUSIONS AND FUTURE RESEARCH

In this paper we have focused on the role of third party inspections coupled with insurance as a type of management-based regulatory system and an alternative to the standard command-and-control procedures used by regulatory agencies in the past. The passage of Section 112r of the Clean Air Act Amendments of 1990 provides an opportunity

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[7] State of Delaware, Department of Natural Resources and Environmental Control (DNREC) is the state agency that is the implementing agency for the Extremely Hazardous Substances Risk Management Act.

[8] Delaware was selected as one location to carry out experiments because it has had a state regulation for inspecting chemical facilities since 1990. Pennsylvania was selected to conduct third party audits because state officials in Pennsylvania do not routinely inspect chemical facilities for their risk management programs. .

for utilizing these market-type mechanisms as a way for firms to show that they have adopted a risk management plan (RMP).

Firms are often reluctant to adopt an RMP because they are costly and they feel that the chances of severe chemical accidents are so small that it is below their threshold of concern. Small companies have an additional reason not to consider undertaking RMPs: they know that if there is a major accident they will become insolvent and it is not cost-effective for them to invest in preventive measures.

By linking a required insurance policy with a third-party inspection there is an opportunity to convince both large and small firms that it is worthwhile for them to undertake an RMP and voluntarily have an inspection. This action will be particularly attractive if the inspector can provide special risk management services in addition to its audit function. In addition, it is important for the regulatory agency to be able to charge an appropriate penalty if a firm is not in compliance. For example, if the US EPA imposes the maximum allowable fine it can impose of $27,500 per day should it discover that a firm does not have an RMP, then this may be an added incentive for industrial facilities to undertake a third party inspection voluntarily.

The implicit assumption in the analysis in this paper is that if a high-risk firm undertakes an inspection and does not want to incur the costs associated with investing in a process to make it a low-risk enterprise, then it not be required to do so. Furthermore we have assumed that there is no obligation by the firm or the third party to report the results of the inspection to the regulatory authority. In practice there may need to be exceptions to this rule. As pointed out in the last section, if an inspector finds that a facility poses a hazard where employees in the firm are in imminent danger then he would be torn between maintaining confidentiality with the client and exposing individuals to possible injury or death. One way to deal with this situation would be to require the inspector to reveal this information to the relevant regulatory authority if the firm refuses to take any remedial action within a prespecified period of time. Such a procedure would be in line with current OSHA policy for consultants to the agency who discover such a situation.[20] More studies need to be undertaken to determine under what situations inspectors have an obligation to reveal the results of their findings to employees, citizens and/or the regulatory authority.[9]

The use of third party inspections has had very beneficial effects on reducing the risks associated with different activities. Steam boiler accidents have been very rare ever since it was required that boilers be inspected. If the safety incentives of workers compensation were removed, there would be an increase of over 30% in fatality rates in the U.S. This translates into an increase in 1200 workers who would die from job-related accidents. [16]

[9] See Collins et al [21] for a more detailed discussion on how much legal liability third party auditors would acquire by participating in this program.

After Los Angeles instituted a third party inspection program by the Department of Health Services, hygiene quality in restaurants within LA County has increased.[10]

At an operational level, these incentives, legal, financial and social, are now being explored to expand the successful pilot studies in Delaware and Pennsylvania. The objective is to promote national compliance with section 112(r) of the CAAA, to improve the protection of the environment, to increase the stability and economics of the chemical industry, and to provide communities with increased social stability. Meetings are being conducted with large chemical companies, chemical trade associations, engineering groups, environmental groups, legal groups and community groups on ways to implement these concepts. It will be necessary to determine how to establish credibility for third party auditors, how they are registered to conduct audits, and how they can be evaluated by local regulatory agencies.

At a theoretical level, this paper should be viewed as a first step in exploring the role of third parties with insurance to deal with the risk management of firms. There are a number of open issues that have to be explored in future research. These include the ability of inspectors to determine how safe a firm actually is, the asymmetry of information between firms, insurers and inspectors and the ability to estimate the risk of chemical accidents and the costs of preventive actions.

In our model we assume that third party inspections can perfectly distinguish high-risk firms from low-risk ones. It is important to examine how firms would behave if misclassification exists. We also assume an asymmetry of information between firms, regulation agencies, and third parties. Only the firms know their own risk levels. But firms sometimes actually do not have a clear idea as to how safe there operations are. How will firms behave when the asymmetry has been removed? Further research on these questions is needed to shed light on the opportunities and challenges of utilizing third party inspection in concert with insurance, government regulations and/or well-defined standards.

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