Comments to Docket No. CSB-10-01

Inherently Safer Chemical Processes: The Use of Methyl Isocyanate at Bayer CropScience by the National Academy of Sciences (NAS)

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4/26/2010

The key to effective management of catastrophic risk is ability to think the unthinkable.

Methyl Isocyanate (MIC) is a useful chemical intermediate, but is so dangerous that special precautions are needed to protect people who work, live or travel near a place where MIC is present in any appreciable amount. The proposed study to identify inherently safer alternatives to current MIC practice should address four specific aspects:

First, storage of MIC (e.g., the 37,000 lb storage tank at Bayer) must always be done in a tank that is physically isolated from any other process or storage unit. Pipes connecting this tank to units that make and use MIC must have isolation block valves on each end, be water-jacketed with flowing water and monitored continuously, with the effluent water passed continuously through a reactive resin bed to remove MIC by reaction. Cool water fed to the piping jacket will help dissipate heat of reaction in case of a leak. This will enable detection of a leak in a matter of seconds, enable leaked MIC to be contained by the water jacket until removed in the resin bed, dissipate heat of reaction, and afford time to evacuate non-essential personnel and mobilize the hazardous event team.

In addition to the above, the entire MIC system should be designed to withstand the most severe natural or man made events likely to be encountered at the plant location - fire, flood, windstorm, freeze or earthquake.

Second, areas where MIC is made, stored or used should be provided with a 'water curtain' - a high-volume water spray system similar to that used on oil refinery alkylation units that use anhydrous hydrogen fluoride as catalyst (so-called HF alky units). Because of the relatively slow reaction of MIC with water, provision will be needed to capture and contain the runoff until MIC destruction is essentially complete.

Third, an existing facility should cease making MIC, use up what is on hand, and shut down until brought into compliance with the measures outlined in the first and second items above.

Fourth, a truly desirable outcome would be a new or redesigned process where MIC is made and either used in-situ or immediately transferred to an adjacent reactor where it is transformed into the desired product. In such a system, no more than a minute amount of MIC need be present at any time. Of course, all the safety precautions discussed above should be applied wherever MIC is made, stored or used.

Thank you for asking for input. If you have questions or need more information, please let me know. My contact information is below.

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CSB-10-01 - Security and CSB IST Study

This weekend I heard a reader comment on my blog last week on the CSB IST study. He noted that there was nothing in the CSB notice that said anything about security and asked why I thought that it would have an effect on the CFATS IST debate. That's a question that certainly deserves discussion here.

IST Proponents

First off, inherently safer technology (IST) has always been a safety technique. That fact is explicit in the name as well as in how the concept was developed by the chemical safety community. Even the people that insist that the concept has application to security for high-risk chemical facilities acknowledge that this is a safety issue. They argue that, if chemical processes at a high-risk facility were made inherently safer, then the facility would not be a potential terrorist target. Or, at least, it would be at a lower risk for being targeted.

Actually, the most vocal proponents mandating IST provisions in the renewal of CFATS authority are not as concerned about a terrorist attack causing a toxic release, as they are concerned about the potential for a toxic release from any cause. They certainly have a point since, extrapolating from recent history, an accidental release is more likely than a terrorist caused release. The cause of the release is not really important to most of the IST proponents.

IST Opponents

Opponents to including an IST mandate in CFATS reauthorization legislation do not argue with the basic idea that techniques for reducing the risk for a toxic release will reduce the attractiveness of the facility as a target. What concerns them is the apparent belief that it is a relatively simple matter to replace highly toxic chemicals with less toxic alternatives. They are concerned that an assessment procedure that does not adequately address the complexity of chemical processes has the serious potential to disrupt or even shut down their businesses.

Since there is no established methodology for identifying and evaluating the application of IST techniques, opponents are concerned that legislators or DHS administrators could establish administrative review techniques to evaluate potential techniques. These reviews could then result in mandated application of techniques that would adversely affect either the manufacturing process or its financial stability.

Safety professionals are concerned that a potentially limited and simplistic evaluation procedure will not address the shifting of potential risk from an existing facility to some other location, either in transit or at another physical plant. They fear that assessments that do not address the potential shift of risk may actually increase the over all societal risk.

NAS IST Study

The National Academy of Sciences study being commissioned by the Chemical Safety Board (CSB) may go a long way to helping to resolve at least some of these differences. If the study is

able to produce an assessment methodology that adequately addresses the complexity of the processes involved, then there will be less resistance to the inclusion of such an assessment in a security analysis for high-risk facilities.

Of course, the important phrase in the previous paragraph is “adequately addresses the complexity of the processes involved”. For this NAS study to resolve this political discussion, there will have to be a consensus in both communities that the study participants represent a proper mix of experts and the parameters of their investigation have been adequately defined. A one-sided panel, either way, will be ignored by the other side. A flawed study will be of no use either.

Now I am not naive enough to assume that there is even a remote possibility that there can be an NAS study that will completely eliminate the differences on this political issue. There are people on both sides of the issue that will never admit that the other side has legitimate concerns. What a properly designed and executed study will do is to provide political cover for moderate politicians on both sides to come up with a compromise measure that can be approved.

Adequate Design

With the importance of this study extending beyond one facility in Institute, WV, it is very important that the design is up to the political task. I am concerned that the 15-day comment period that the CSB has established for this study is inadequate to the task. Corporate decision makers are notoriously slow to respond calls for public comments on controversial topics. The process of identifying and addressing issues, developing a written response, and then vetting that response through the various internal communities in a large organization does not happen quickly.

I understand the urgency of this particular situation in West Virginia. But, given the fact that there will be at least 12 months before this study is completed, an additional ‘delay’ of 15 days is not unreasonable. A 30-day comment period will be inadequate for some commentors, but is an established standard used in developing many rules. I am sure that the next couple of days will see comments filed requesting this type of extension of the comment period. I urge the CSB to extend their comment period to 30-days to protect the political viability of the proposed study.

Patrick J. Coyle
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4/26/2010

CSB: I believe that you will find that DuPont reduced its inventory of MIC to about 40 pounds at its La Porte Texas plant, starting about 1983, by producing the MIC “as needed”, rather than storing the MIC.

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The role of government in this situation is to protect the general welfare of the populace while still protecting the rights of the business entity to function without undue interference. One legal issue should be resolved clearly, the owner of the business entity must be held accountable personally for the operations for which they are responsible. Every member of the board of directors along with the CEO must understand that they will be charged criminally in the event that the company is found knowingly at fault. Without debating the roles for federal, state, and local governments, the acceptable probability and quantity of a release event should be established by a group consisting of domestic industry peers, AIChE advisors, and independent Process Safety/Reliability Study professionals. Recognizing that these values cannot be zero and that it is possible to design adequate control and abatement systems for highly hazardous chemicals, an entity wishing to store MIC must design adequate systems to meet these release objectives minimally. If they choose to design a significantly more rigorous system, they should be rewarded with meaningful tax credits by the regulating authority lasting as long as the unit operates. T

The applicable state regulatory agency would enlist two established, professional PSM/Reliability Engineering firms to independently evaluate the design and report their results within two months. If results from both firms meet the established event probability and impact values then the plan is permitted. The construction and start-up of the facility would be audited by an independent PE firm who will come on-site as needed to coordinate the oversight activities and to confirm all relevant items. The two PSM/Reliability Eng firms would be given the procedures to be used for pressure testing/water batching/proof-testing of the completed system prior to introduction of chemicals for review and acceptability. If either firm feels the procedures are inadequate, the entity would collaborate appropriately and incorporate suggestions adequate to satisfy good manufacturing practice. They would also be provided the spill management plans, equipment decontamination procedures, and ultimate clean-up/abandonment capabilities. How would MIC be removed from the equipment safely? After construction completion and final system proof-testing, the PE would sign off on acceptability, notify the regulatory agency that everything is a go, and would provide his report to all parties.

When the business entity decides to introduce MIC into the system, one of the PSM/Reliability Eng firms will have a representative on site to observe operations through functional start-up. Significant deviations will be reported immediately to the regulatory agency and the business entity and operations suspended or terminated as appropriate. A report of the start-up will be generated and distributed. Care must be exercised with regard to what a "significant" deviation is; start-ups are expected to have challenges and issues. Primary focus here would be containment issues of the chemical; not whether a pump is wired backwards or a valve handle opens the wrong way.

Routine PM schedules for equipment must be maintained, regular operator training conducted, and necessary repairs made and logged. PSV's, relief systems, abatement equipment, access control and area containment items must be inspected regularly. Auditing of the system, logs, documentation, etc. should be conducted on a frequency established by the regulatory agency, not more than every five years. The audit team should include a representative from a professional PSM/Reliability Eng firm if the regulator is unfamiliar with this specific technology. In addition to a scheduled audit, it would be good to have annual, unscheduled visits by the local DEP or equivalent to review operations.

I believe good engineering design and rigorous operating discipline can manage even the most hazardous chemicals given the resources and commitment.

Gary Donnor
4/27/2010

4/27/2010

I have come to the conclusion that this move has the potential to restrict the availability or prevent the use of chemicals currently in use and which could be beneficial in the future. I note that Bayer have agreed to reduce their inventory of MIC by stopping production of certain products. This is fine for old products but what about the ones that are being developed or may be developed in the future? Generating and consuming nasties instantaneously in situ is not always (or often) an option.

There must always be a balance between inventory control and restrictions on beneficial production.
Should the "nasty" be made on site thus restricting traffic movements where possible?
Should the storage tank be large enough to reduce traffic movements?
Should the inventory be kept small to protect the neighbourhood? - but run the risk of being involved in RTAs

Should it arrive on Site by pipeline? - what are the security and safety issues?
To restrict the potential for chemistry to develop new and beneficial products would be a bad move.
It would be a poor outcome if the result of this review was to push manufacture to areas of the world where health, safety and the environment are less well regulated and people may not have the depth of understanding about the issues and means of keeping themselves safe.

Jennifer M Braithwaite

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There are many hazardous chemicals that are vital to the economic prosperity of the US. Notoriety and striving for political correctness are not good reasons to ban chemicals. There are groups of people that are promoting the idea of banning chlorine in the US. If it was not for chlorine our life expectancy would still be 40 years old as it was in 1902.

Methyl isocyanate and toluene diisocyanate and various alcohols are routes to poplyurethanes, which make outstanding corrosion control coatings, floor finishes and the like.

Water is a dangerous chemical. Ban water. More people died in India from water than at Bhopal.

Kir George Karouna

Maybe there should be regulated monitoring of the safety standards of the production facilities of such highly hazardous chemicals. Operating companies must comply with, in particular:

1- Rigorous/ mandatory protocols for operating and maintenance for such known but risky technology (something like NRC dictated)
2- Required training for management/ supervision of such companies must be certified by a third party.
3- Required training for workers of such companies must be certified by a third party
4- Mandated annual audit and reporting to agencies for follow up actions

A joint panel of companies and governmental agencies should formulate these enhanced & mandatory operating & maintenance protocols.

Quang Nguyen
4-27-2010

4-27-2010

Dear CSB,

First I would like to thank you for the service you provide and the fact that your materials are free helps me teach clients. I have only one suggestion, and this may not be possible. Before launching this study, please use a series of mailed audits to direct your collection of data. I have investigated many incidents over the last 30 years and one thing they all have in common is a series of events, not a single event. These causes all have behavior attached to them in some form or another, and this behavior usually conceals and under minds the best of safety systems.

One way to identify some of the concealing behaviors is to release an audit in any form and see if it is returned, accurate, and timely. The grade of these three scores will reveal this behavior. Go to the lowest performing audit companies that return an audit.

Before you choose send a group of private third party individuals to audit the audits returned for an onsite check of accuracy.

I believe if some kind of system is used before the study, the chance of the studies success would be greatly enhanced.

Thank you for your time and all you do, everybody.

Be Blessed,

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It is alright to be out of compliance; it is not alright to stay there!

If truth is stranger than fiction, it is because it has a better author.

April 27, 2010

Dr. Daniel Horowitz
Director of Congressional, Public, and Board Affairs
Chemical Safety and Hazard Investigation Board
2175 K Street, NW, Suite 650
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Dear Mr. Horowitz:

I applaud the planned study by the National Academy of Sciences (NAS) to examine the use and storage of methyl isocyanate (MIC) including the feasibility of implementing alternative chemicals or processes and an examination of the cost of alternatives at the Bayer CropScience facility in Institute, West Virginia. The safety of the nearby community must be the highest priority when hazardous chemicals are stored and used at a manufacturing facility. The degree of risk associated with the possible release of MIC far outweighs any costs associated with management considerations.

I am commenting as a private citizen, although I have worked for an environmental oversight group for 13 years and also work closely with emergency planners in my current position. I have ten additional years experience in hazardous waste management with private consulting firms.

The following questions have been posed for public consideration, and my responses follow each one.

1. Does the proposed Task Statement include the appropriate topics for consideration by the NAS? Are there any additional general or specific topics the NAS panel will need to consider in order to reach a satisfactory answer on the feasibility and costs of reducing the use and storage of MIC?

In general the proposed topics are appropriate. What is missing from task 2 "Examine the use and storage of MIC at the Bayer CropScience facility in Institute, West Virginia" is a risk assessment based on modeling the effects of a release during a variety of meteorological conditions. In addition, the ability of local emergency responders to respond to such a release and any plans in place to notify and protect the public should be examined.

2. If funds are available, should the CSB initiate a second, related study to consider the feasibility, costs, and benefits of inherently safer alternatives to other chemicals? For example, should a study consider alternatives to the use of hydrogen fluoride in refinery alkylation processes and/or to the use of chlorine in water treatment? What other chemicals or processes should be considered if a second study is undertaken?

Yes, this should be a priority. Not only the intrinsic safety of such operations, but also their vulnerability to malicious attack, whether domestic or terrorist, should be evaluated.

3. What kinds of backgrounds and expertise should be represented on the NAS panel?

In addition to the types of individuals listed, ("expert panel with diverse representation, including individuals with industry, academic, community, environmental, and labor experience and backgrounds") specific expertise should include chemical engineering (perhaps a retiree from a related chemical industry), emergency response, and risk assessment. It is very important that the local community have at least one and preferably two representatives who are unaffiliated with Bayer CropScience.

4. Is the proposed timetable appropriate?

The timetable is aggressive and may be difficult to meet. The quality of the deliverables is more important. I suggest an 18- or 24-month study length, with intermediate findings released as appropriate. These might include recommendations to increase the immediate safety and security of MIC storage at the Bayer CropScience facility.

Thank you for the opportunity to comment on this proposed action.

Sincerely,

Susan L. Gawarecki, PhD, PG
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4/27/2010

Dear CSB,

I have been reading investigation reports and watching videos since last four to five years produced by CSB. They are informative, and would like to thank for those at first instance.

For the subject storage of MIC at the Bayer CropScience pesticide manufacturing complex. An inherent safe solution for storage of MIC would be storing it in diluted form. Methyl isocyanate is soluble in water to 6–10 parts per 100 parts of water. The process for producing diluted MIC is exothermic, but it will be mainly carried out at supplier end. This will also ensure the supplier tanker supplying MIC to Bayer will have less hazardous material and thus reducing the transportation risk.

A simple process of de-hydration can be added at the Bayer CropScience pesticide manufacturing complex, to obtain the required concentration of the MIC. The de-hydration process can be designed in such a manner that the MIC production rate shall match the required consumption rate for production of a given pesticide.

In this manner the concentrated MIC is only present in the process, where lot of known process safe guards can significantly reduce the possibilities of release. In case of the loss of containment of storage tank containing diluted MIC, the risk of exposure will be reduced significantly.

I hope the above idea can be helpful and developed further.

Would be happy to assist further in future.

Kind Regards

With kind regards,

Vinod Wagh
Safety and Risk Management Consultant
HSE Department

Step into our consultancy and engineering world

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I believe a study should be conducted of methyl isocyanate (MIC) to reduce the amount of material maintained at facilities and to find potential alternatives to the product. Other hazardous materials should also be included in this study. MIC is not the only hazardous material that can cause injury or death to the employees at these facilities and to the general public if it is improperly handled or an accident occurs.

Something to consider is reducing safety stock. I work for a chemical company, and we reduced our stock to the minimum level of what we will use. If the companies that use MIC and other hazardous materials have not considered reducing stock levels and maintain only what can be consumed in a short period of time, then this consideration should be investigated.

Thank you for asking my opinion,

Christopher D. Childers
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To: Chemical Safety Board May 7, 2010
Re: MIC comments

In my opinion the focus on MIC as the "worst chemical" is much more the result of an emotional response that a thoughtful approach. To be sure, more people could have been hurt than were and for that not happening we are all grateful. But serendipity really has no place in an operation of that sort, especially in light of Bhopal, i.e. disastrous consequences can result. I believe that the true cause of this event as well as others recently has been the lack of "operating discipline". I use this as a generic term to include the entire organization: from operators and mechanics to high management. Let me illustrate by an example.

The CSB video concerning the Ghent propane explosion was excellent; I used it in my Industrial Safety course to illustrate that "being safe" is a 24/7 occupation. Why did that event happen? A number of people didn't recognize the hazard because they had not been educated and/or trained. However, there were persons within the organization that could have recognized the hazard and reacted with the correct response. The fact that their information had not been transmitted was not transmitted to key parts of the organization illustrates the idea of operating discipline as an organizational responsibility (along with some other elements which I regard as unconscionable!). Often when accidents occur persons become very emotional and angry; that certainly can have its place, but the best use of that "energy" is to become very focused and direct their energy towards eliminating the root cause. I believe that training and education are as much an integral part of operational discipline as is hazard recognition (see attachment for a "real" example).

Applying this perception to the Bayer incident is appropriate as I have visited Leverkusen and was extremely impressed by the operation. Leverkusen has many computer controlled processes with fast emergency shutdowns that can be easily accomplished by a computer or even manually if the interlocks are not bypassed. At Institute, it is apparent that at some point, the key features of hazards reviews involving design, installation, and startup were missing "operating discipline" component. Also, the test runs should have provided information about the ability to fill a vessel, etc. The point is that all this information resides somewhere at Bayer, as I saw at Leverkusen. To castigate MIC as the villain is very unsupportable in my opinion; I would much rather work with MIC (and have) than several other chemicals I have also worked with. What is missing is a process to provide continuity of understanding of the hazards and the proper levels of protection necessary to insure there are no safety implications. This is contrasted to the statement often made, "Organizations have no memory and similar accidents reoccur."

Levels of Protection can be easily described; they are independent systems of safe guards to protect the individual performing an action. A seatbelt in a car is one level which can provide, say, 95% protection in the event of a wreck. An airbag could be a second which provides 95% coverage of the 5% unguarded by the first level. Keeping speed under 50mph could be a third level. In most of the incidents I have investigated people have

not recognized the hazard and therefore have not insured they have two LOP's against the hazard.

I have worked with phosgene, HCN, huge quantities of ammonia, chlorine, oleum, etc. for 28 years and during that period had one minor injury to someone who worked for me. An operator decided to push on what he thought was a leaking bromine unloading hose (under pressure) because he thought it had a leak. Our operating philosophy was never to undertake any sort of operation (except for emergencies) without a quick review with at least one other knowledgeable person and whatever action was being taken should have at least two levels of protection (LOP). Some of our chemical system had four LOP's because they were that critical; we described several of them is a public presentation called "Safety Street" in Charleston, WV in the early 1990's. The technical details overwhelmed the public; "we have to trust you because we don't understand." That became a huge burden for many, me included as I was in charge of a 20,000 ton anhydrous ammonia tank at the time.

My assessment as to the focus of this investigation should be one of figuring out the guidance to pass on to companies and/or Congress to devise an institutional process that should be audited to insure that internal "institutional renewal" of a process/chemical safety be held when more than, say, two key critical process safety personnel or a 25% operating staff turnover in three years occurs. The company should be required to perform this replacement effort in a satisfactory manner (details are in the attachment) and the reward would be a "permission to operate", or the converse. Companies will need to evaluate their strategy. This could apply to all companies since many that do not handle dangerous chemicals still have numerous preventable accidents, but currently CSB has a specific charter. It seems to me that this country is faced with a very large personnel turnover in the next 10 years.

Returning to MIB and Bayer, there exists technology to make MIC in situ so that the amount is less than 500 pounds (US patent 4,082,787, offered to Union Carbide after Bhopal and, although there are modified claims, I know Bayer is sound enough to make it work). This lack of "organization operating discipline" seems to be a generic phenomenon as I recently ran into the lead design engineer I worked with in building the phosgenation unit at the DuPont Belle Plant. He was as livid as I was about the death of Danny Fish. Our conversation focused on the safety upgrades we had proposed for the phosgenation unit which were apparently left on the shelf. We both believe these improvements would have prevented this incident and potentially others. I have attached a document about organizational learning and safety that is yet another example about organizational memory loss. It has been forgotten and yet it gets at the root cause of the operation at the DuPont Belle Plant; in defense of some at that Plant, they don't know it exists. In my opinion, the above issues reflect a much needed safety process which CSB could address. For additional discussion you should also see Trevor Kletz"s book, "Lessons from Disaster" Gulf Publishing (1993).

Regards,

Professor Richard Squire
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PERTINANT PUBLICATIONS

1) R. H. Squire, "Ammonia Storage Tank Study" , Ammonia Plant Safety, 30, 89, (1990), published by the American Institute of Chemical Engineers
2) J. R. Tilton, R. H. Squire, C. S. Saffle, and C. R. Atkins, "Ammonia Storage Tank Study, Part II", Ammonia Plant Safety, 32, 63, (1992), published by the American Institute of Chemical Engineers
3) R. H. Squire, "Zero Period Safety Process", American Institute of Chemical Engineers, Ammonia Safety Symposium Series**,** Vol 41, 54 (2001)
4) R. H. Squire, "Zero Period Process – A Description of a Process to Zero Injuries, Progress Safety Progress, Vol. 20, No. 1, 1 (2001)

Zero Period Process—A Description Of a Process to Zero Injuries

Richard H. Squire
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At the Dupont plant, located in Belle, West Virginia, we have marked three years without an OSHA recordable injury. While earlier speculation suggested that a process might exist to accomplish this sustainable level of performance, the road to actually developing the needed processes was not at all straightforward. We have summarized this work in the paper.

INTRODUCTION: SAFETY OVERVIEW

Everyone wants to be safe. After all, injuries hurt and most of us respond negatively to pain and try to avoid it. So why does it seem that there are some people who don't have injuries and others who have them frequently? It is because the avoidance of injuries, called safety, is an acquired or learned trait. Obviously, this trait is not acquired simply by urging people to "be safe" every day. So, the second point of this brief overview is to acknowledge a sin that I and numerous others have committed. After years of exerting people "onward and upward," towards the safety goal of zero, I have finally learned that getting there in a sustainable way requires an understanding of various safety processes and the level of results achievable by each process. This paper illustrates the overall hierarchy of these various processes. Hopefully, it provides an understanding so they may be used effectively.

Beyond that, we want to introduce a new process, which we have used to achieve zero injuries at my current industrial site. This paper is dedicated to all those who have worked diligently and have suffered along the way through their injuries so that the "ZERO PERIOD" process could be uncovered for others to use. While we have tried to make this process easy to comprehend, the choice as to whether this process will be used is, as is the case with most safety issues, yours.

HOW SAFETY WORKS

Safety, to some degree, is in the eye of the beholder. The following section looks at it from the point of view of several supervisors, each of whom have spent more than 20 years working on safety issues, in an industrial environment. We are not judging whether an issue is good or bad, although you may think so from some descriptions. Rather, we are trying to build bridges with the reader through common experiences. If somewhere in this chapter you say, "These people have been there," we'll have met our goal. Also, please recognize that we have cited exaggerated behaviors to emphasize the points we want to make. The individuals we have worked with in the chemical industry are, by and large, well-trained, capable individuals.

A Learning Curve for Safety

When I was first hired by DuPont, I was amazed at how ludicrous some of the safety rules appeared to be. It was hard to imagine that someone would actually do some of the things suggested, such as tripping on a hose placed across a pathway or being injured because a co-worker was kidding around with them (water in an upside-down hardhat). These were rules when an actual incident occurs and someone has gotten hurt. (Later we'll discuss the value of this exercise.)

In the first two years I was told, "Follow all the rules, no matter what." That was not bad advice for anyone with zero to two years of industrial experience as my "hazards recognition" was not well established. The "wisdom" of the reason for the rules was clear in only a few of them. Through informal discussion with my co-workers, I developed an appraisal of what the rule was intended to prevent, and was able to exert judgment as to whether the rule actually measured up to its intent. Figure 1 contains a graph that shows the danger of this informal learning process. If the individual didn't ask questions about the "whys" of various guidelines, and didn't use sound judgment in situations where the rules didn't extend, at a minimum, the ability of the individual becomes limited and could possibly reach an early plateau. At a maximum, the individual could have been injured. The position of the plateaus will certainly vary based on the group to which one belongs. In Curve 3 safety capacity doesn't change much as experience grows

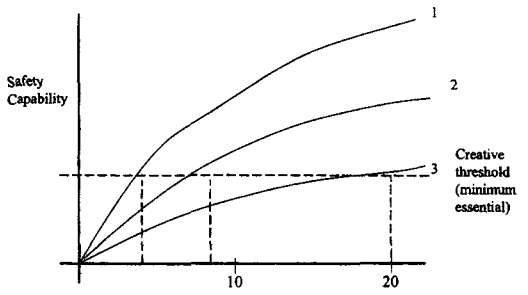

Figure 1. Safety capability vs. time.

and so the individual and the business have been cheated out of almost all value-adding contributions. In Curve 2 the individual has learned on their own, asked lots of questions, and figured out many of the whys for the rules. In Curve 1 the benefit of a cohesive and driven work group has raised the capacity not only to offer valuable suggestions, but also to contribute to the generation of sensible, well-understood rules and practices. The performance crosses the creative threshold much quicker. (The creative threshold is the ability to improve existing safety rules by virtue of understanding the intent of the current ones.)

The later case is, of course, the best of all possible worlds. The intuitive, self-driven employee can be limited by at least three major factors. These are: group interaction, supervisory interaction, and lack of formal processes.

Group interactions may not be as pleasant as described above. Members of the group may not have time to help a new member, may not want to help ("they've got to pay their dues"), or they just may not be skilled enough to help, and actually could pass on misinformation, accidentally or intentionally. If a group member trains others one-on-one, and their knowledge is only 80% perfect, and they pass on only 60% of it, and the person they pass it on to then trains another, passing on only 48%, and the next trainee gets only 29%, this is not very effective training. We'll describe a much better process later in this article.

Supervisory interactions probably cover the widest variability. A supervisor can greatly facilitate the processes in the paragraph above but this may not happen for a number of reasons. Many supervisors are less directly connected with safety, yet their influence around it is almost immeasurable. I have seen several cases where the supervisor just doesn't have the training and/or experience to deal with everyday events, or he/she feels threatened and either "gives up" or lashes out from frustration so "people will know who's in control." Maintaining control is one of the fundamental issues for supervisors. A new supervisor who doesn't know much about the day-to-day operations gets tired of being corrected on a daily basis. He/she may have studied how to manage but not necessarily how to lead. They become accustomed to the employees' complaints and respond by telling them what to do—many times without regard for right or wrong. For the person who has worked as an operator or mechanic for 30 years, it's offensive. When the supervisor is condescending, the final impact is that, almost always, the operator/mechanic focus on their task gets impacted, and they are less safe on the job. This could be categorized as an unsafe act by the supervisor's leader/boss who may not have the "people skills" to properly train them, or is unable to recognize that a problem exists. We will discuss the importance of this interaction later. The bottom line—no matter where you are in the organization, don't let a hostile supervisor affect your safety performance or place it in jeopardy because their action or inaction has broken your focus.

So why is there a need for any formal training process? Because excellent safety performance is a complicated system of processes and skills **and by themselves, almost no one can get there**. We at the DuPont Belle Plant have been working as a team for more than two years to figure out the answers presented here. We have a process to ensure that each employee properly learns the fundamental initial skills, intermediate training, and finally, the capability to conceptually think a job through to completion before starting it. This requires a certain degree of formal teamwork.

It should become obvious that excellent safety takes a mental effort. Hopefully, it has become clear that it just doesn't happen by itself, or with only a few involved. It requires a team effort while working in a disciplined process towards a common goal. The end result will be more than just an excellent safety record. It will produce a more cohesive business teamwork, improved communications, and efficiency. There is a tremendous value in doing the safety 'right' so that the other benefits may follow.

WHERE ARE YOU IN YOUR SAFETY PERFORMANCE?

The "you" in the title refers to both you personally, as a work group, and also to the larger group, your plant site. There is a very good reason for doing this. This paper can help you as an individual to get better at safety performance, but the best you can do, as an individual is still not as effective as a team effort where real teamwork is happening. There is one other reason for looking at larger groups—to measure safety performance in a statistically meaningful way. You may never have an injury your entire life, yet you may not be very good at safe operating procedures. You have just defied the odds, which is not an explanation for any excellent safety record. So, in this section the two important ideas to understand are 1) How and why do we measure safety? and 2) The importance of the team for achieving excellence.

Measuring Safety

We have divided safety performance into five categories based on injury frequency, or the number of injuries (OSHA recordable criteria) a group has times 200,000, divided by the number of exposure hours the group worked. Exposure hours are defined as the

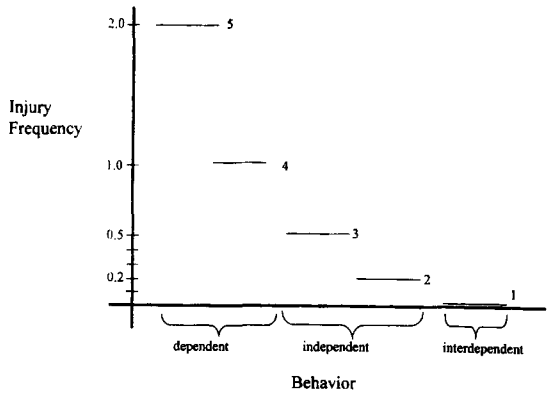

Figure 2a. Injury frequency vs. behavior.

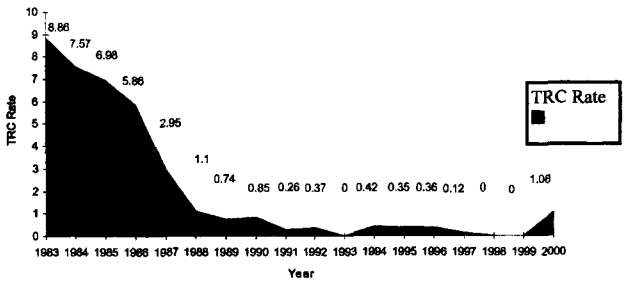

Figure 2b. Belle Plant historical injury record.

number of people times the number of hours they work. The five levels are:

Level 5 - 2.0 injury frequency. Your site has a good chance to experience a major incident or injury.
Level 4 - around 1.0 frequency. If you are not working on some safety process, you will be at level 5 soon.
Level 3 - about 0.5. You are good.
Level 2 - leveled off between 0.2 and 0.5. You need a new process to get you to excellence.
Level 1 - 0.0, sustained. OUTSTANDING!

So, at which level is your plant operating?

I think at this point it is very important to remember *why* we **really** do safety. It is the right thing to do for ourselves as ethical people, for our friends, for our colleagues, for our community and the environment, for quality productivity, and for the business as a whole. To paraphrase Sean Connery in the movie, *The Untouchables*, "You have just fulfilled the first rule of industrial workers (law enforcement); you are going home at the end of your shift." This having been said, there are three levels of safety processes that roughly match the injury frequency levels illustrated in Figure 2a. They are:

Dependent - I check my brain out at the door and wait for my supervisor to tell me what to do, how to do it, and when to do it. The rest of the time I try and look busy. My supervisor is responsible for my safety.
Independent - I am responsible for my own safety. I may listen when others discuss how they do work, but I am the ultimate check on whether I do something safely or not.
Interdependent - I am part of a team that willingly shares information about how we do jobs. We especially like to discuss the tough jobs because we care about each other in a professional way, and we are an important piece of the team and the business.

A PLANT MANAGER'S GUIDE TO LEVEL 3

There are a number of fairly complete books on safety, and we encourage managers to read and use these sources. However, they all seem to have one commonality that limits their usefulness: They have all been written by a supervisor who inherently wants to tell others how to "get there," i.e., give "the answer." The focus is usually on a specific safety goal and explains what needs to be done (at best). But, in reality, to truly get to ZERO PERIOD as a goal, there needs to be core or key processes operating. The first process step is that truly excellent safety is not something you tell people how to do. It's like pushing a rope because many first line supervisors have never been in the position where their subordinates (who, far and away, have the highest exposure to an injury) work, and, therefore much of their guidance **may not be very appropriate** Even when a supervisor has been promoted from the ranks, they can easily forget, or not want to be reminded, from whence they came. They can readily adopt their manager's style of telling others the answer. So, the first step is getting workers to pull on the rope, to ask for what they need to do their job better. But we are getting ahead of ourselves, so we'll continue this discussion later.

What is your current safety system? Can you explain how it works? Surprisingly, even in companies where good safety practices are one of the overriding objectives, supervisors and key managers can't explain what they do or why they do it! This comment is not meant to be judgmental. I ask the question to provoke thought on the matter, and, over the past few years, have often been assailed by angry answers. Which brings us to a second key process—*if you don't know the answer, say you don't know.* Don't get mad. Channel that energy into pursuing the answer. I would estimate 30 to 40% of the comments and statement about safety are either not correct, or they are made for reasons other than helping someone get better at safety management. Asking for help is not a sign of weakness. The person actually doing the job wants to know the facts and not be burdened by misinformation or extra safety equipment because someone in an office thinks they might be that much safer. In my experience adding **extra** safety equipment or procedures fosters all sorts of negative behavior, from not wearing the equipment in "off hours" to questioning the competency of the person who suggested it. And, after that person moves on, the equipment will still be

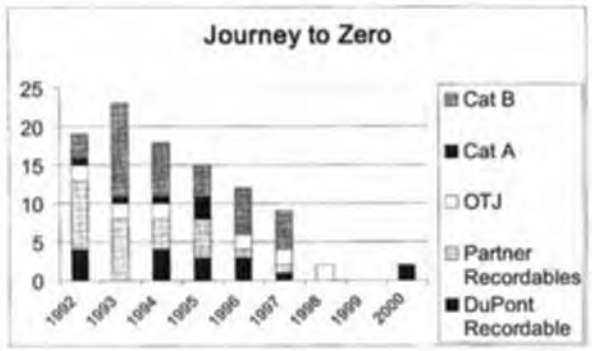

Figure 2c. Journey to zero.

Figure 2d. Injuries vs. behavior.

required because the actual reason for suggesting its use has become part of the mythology of the area.

Some of the question about safety systems can be answered by referring to a book by Bill Mottel, Joe Long, and David Morrison [1]. The book is valuable to get your safety program to Level 3. But, it becomes a barrier. For example, "You will achieve the level of safety that you demonstrate you want to achieve" still fosters a guilt complex in me because, for years, I have wanted to achieve zero. But just exhorting myself doesn't mean I know what to do or have a process to get there!

It should be your team's collective judgement as to where to start. For example, do you have safety principles? Do you measure your safety, environmental and health performance? Do you investigate all incidents and drive the investigation to root cause? Do you audit your operations for hazards and unsafe acts or behaviors? Do you periodically review the design basis of your facility and the operational, technical, and mechanical training needed to insure it is safe (IDPHR - in-depth process hazards review)? Do you have an emergency response team and do you practice against the more probable incidents included in your RMP (risk management plan)? Do you measure off-the-job safety performance? Is your line organization committed to safety? Do you practice PSM (process safety management) where incidents are thoroughly investigated and audits can be scrutinized to examine your safety systems for weaknesses and defects? Do you communicate this information to your organization in an understandable way?

Mottel, et. al.'s book discusses these topics, which are essential to establishing a fundamental basis for safety. Full utilization of these techniques takes your plant to Level 3. You can get to Level 4 by an exhaustive application, but in our experience we know of no management group that can sustain this intensity. The process, as we have found out, is incomplete (Note the years 1991 to 1996 in Figure 2b). The complete lack of incidents in Figure 2c is the result of the zero period process. It has carry-over into the environmental and contractor arenas.

WHAT IS THE ZERO PERIOD PROCESS?

What exactly is ZERO PERIOD? Ideally it is an **environment where safety is user-driven**, where instead of management pushing, the people actually doing the work recognizes the hazards because they have been trained to do so. Once this pull is established, the substantial demand for information needs to be met. So, when an engineer in an office writes a procedure, it has to be reviewed and revised after discussion with the people doing the job. This type of environment doesn't just happen. It takes place after a good deal of training and experience in putting the practice into place. Having recognized what it takes, we now feel we can get an organization to this level of performance much quicker than we previously did. The three key anchors this structure is built upon are:

(1) Dependent, independent, and interdependent model
(2) Understanding the safety pyramid (discussed below)
(3) The S.H.E. (Safety, Health and Environmental) core team

Used together, these three tools create a process all of us can use to help others keep safe. Understanding exactly how this works is not that hard, practicing it is because of all the misinformation we may have been taught. The remainder of the article is devoted to refining the discussion so that each of us finds the will to change how we manage safety on the job.

The Dependent, Independent, and Interdependent Model

Figure 2d illustrates levels of safety on the left axis, and mode of behavior on the bottom axis. Also along the bottom axis are several additional descriptive words. It is important to understand each of the three modes, since each may be appropriate at some point in time. For example, if there were a fire and someone yelled to you "run this way," you would be in the dependent mode and, hopefully, would run and not debate the matter. An example of independent behavior could be studying alone for an operator exam. There is some work you need to do for yourself, but studying as a group can be fruitful. Dependent behavior is sometimes called "victim behavior" because people who exhibit it have a helpless feeling as though things are just happening to them and they

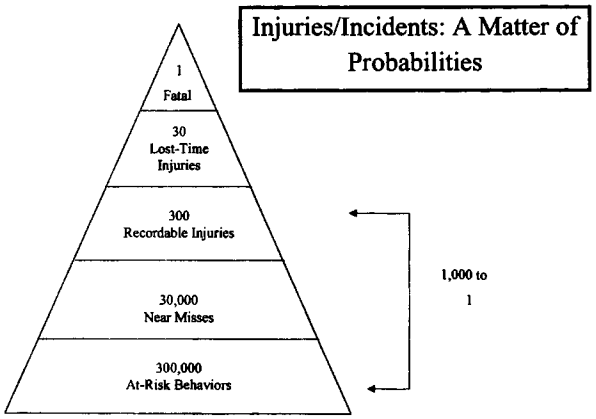

Figure 3. Safety pyramid.

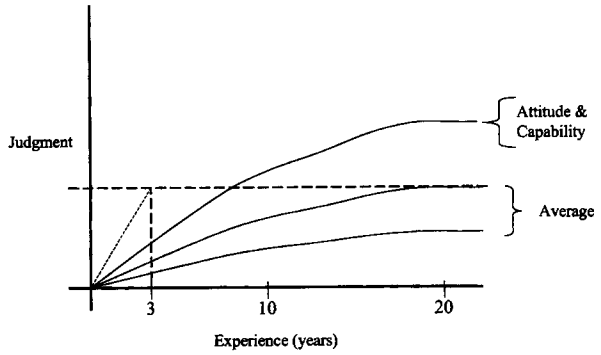

Figure 4. Judgment vs. experience.

don't know what to do. To get out of this mode, you do something to take control of the action. "I am responsible for my safety and therefore I need to know all there is about this job I am getting ready to perform." Many companies have a basic rule of employment, which states, "You are responsible to be safe." While this may help move people out of the dependent mode, it has been our experience that operating in this mode for a number of years severely limits people's ability to accept the interdependent, or teaming, mode. A very strong desire to control has been formed which must be overcome to reach the teaming mode.

Safety Pyramid

The safety pyramid shown in Figure 3 is a reflection of the fact that injuries have a hierarchical statistical nature. For each severe injury or fatality there are many less severe ones. As your safety practices get better and better, it is not statistically sound to focus on severe injuries, since they rarely occur. Actually, we have also found that, as we approached zero, all injuries inherently disappeared, so we needed a new measure. The focus shifted to a term called "at-risk behaviors," which means someone did something that you could designate an unsafe act or a "close call." **These not only apply to those doing daily work functions, but to those designing facilities, writing operating or maintenance procedures, etc.** Errors in these functions are just as serious as not correctly tightening bolts, but they are less frequently addressed. And, if we are in a teaming environment, no one is looking to punish the guilty. We want to work together to share information about what works, what works well, and what doesn't, be it an actual operation in the field or a design. This process enables the change from punishment by others to a self-imposed discipline. As more trust is built in the team, more examples are shared, and the process for continuously improvement is being developed.

S.H.E. Core Teams

It is easy to use the words "teams" and "teaming" so we draw a distinction. Many managers like to think their operations have teams because they have designated a group of people as such. But we have found that, for true teaming to take place, there are certain pieces which must be in place. For example, a typical area core team would have an electrical and instrument mechanic, a couple of general mechanics, an operator from each shift, a representative from supervision, and one from technical management.

For a S.H.E. core team to function properly, there must be a leader. We mean a true leader, not a manager, a person whom the team trusts, who helps people manage their behavior if they get too controlling, leads by example, and shares information because they care for all the team members in a professional manner. As the team gets more comfortable with each other, their skills, and the process, there will be frank discussions. This is a part of the teaming process: "forming, storming, norming, and performing." The first task the team needs to undertake should be something worth addressing, yet easy enough to complete, so the members experience success. As we often stated, we will not let you fail from lack of management support, and this support proved to be a potential stumbling blocks to successful teaming. If you choose not to participate in helping decide how things are run, then please don't complain about them. To date we have not had a single recommendation from a core team that was not carried out promptly. The visibility of core teamwork has a great impetus to its success.

In these days of lean spending many people think you cannot have an adequate safety program or make improvements. One of the premises of the core teams startup was to focus on procedure problems, training, confined space entry, etc — those areas to which resources were already available, and only a commitment of time was needed. Most teams responded immediately with some sort of "fix-it" list composed of tasks selected by people who worked in the area. The list was prioritized and ad hoc groups were selected to work on each item. This ranged from a group of supervisors working on behavior appropriate for the meetings (they wanted the task because they felt area meetings weren't smooth enough, and, in reality, some members of this group were responsible for the disruptions), to shift teams working on their "pet" pro-

ject. As items got accomplished, an air of success and trust began which compelled team members to explore the boundaries of the team's authority. To date a core team has not made a collective recommendation which has not ultimately been accomplished, including a complete revision of tag, lock and try for the most complex jobs, and recommendations for changing of protective equipment for unusual combinations of chemicals. These are the people who do the work. Their insights after 20 years on the job are valuable if they have an opportunity to influence the outcome. A key part of enabling team members to "come out of the box" and state real or perceived problems to work on is the sense of safety/trust brought about by the teaming process.

HAZARD RECOGNITION EDUCATION

During my first week in the chemical industry, HCN, one of the most hazardous chemicals in the industry, "got away from us" and the site where I was located had a major incident. As part of the clean-up, I was required to perform an analysis of large quantities of material. As I was analyzing the material, an experienced operator told me he "stayed away from HCN," but felt comfortable handling tons of oleum which made me uncomfortable. The point of this discussion is that each of us recognized different hazards, and so we had differing perspectives of certain materials. The operator has acquired his expertise from 25 years of industrial work with the material, and I from lab experiments. We shared our information, dispelled our myths and it helped both of us better understand the present situation and its hazards.

I believe hazardous recognition and judgement are traditionally two of the most underdeveloped skills in our zero period process. Whether in an incident investigation or writing new procedures, identifying a hazard and assessing its danger level can be very subjective. For example, I recently listened during a safety audit as a new supervisor told an operator with 25 years experience how he expected his unit to operate and what the operator needed to be concerned about in terms of safety. Many new, especially young, supervisors tend to be very possessive about "owning" their operation. During the audit we walked past a new piece of angle iron about eye height with a razor sharp burr on it. When it was over, the supervisor was "late for his meeting" so he had no time to talk; the operator was furious at being treated "like a rookie" and he stormed off. The supervisor was exhibiting the dominant role in dependent behavior; his "dictates" about what was important safety-wise were limited at best. The "subordinate" in the dependent behavior was being "pushed" into his role, and it is very likely that his safety performance will suffer. His focus is not on safety, and if I were critiquing this "incident," I would conclude that the supervisor committed an unsafe act. The maximum level of behavior that should be expected from the operator is independent. He needs to learn how to put the incident behind him quickly and regain his composure. Otherwise, he will allow himself to be driven into a dependent mode. The operator can still do better; he can still interact with others on his crew or shift and continue a cooperative focus on safety so he and those who work with him may benefit. Continued negative interactions will most likely erode the teamwork spirit.

There are two pieces of work left unfinished. I am not excusing the supervisor's behavior, but any unsafe act is very serious. Unfortunately, many don't see the discussion in the preceding paragraph as anything but a youthful, exuberant technical person turned supervisor or the right person "to really take control of the operation." Wrong on both counts if the person has had little or no training in "people skills" and doesn't understand the benefits of teaming (interdependence); a series of incidents can result while he/she learns this, which is so unnecessary. If the person is really "control-oriented," what do you think the chances are for creating a working core team or any team, for that matter, without a lot of effort? The behavior has limited how effective safety programs can be. We have come a long way from selecting first and second line supervisors based on the size of their boot. Neither poor safety nor poor people treatment is necessary with the proper introduction of new personnel into the workforce. Experienced help should be available to deal with these behaviors. Healthy competition is appropriate in the work place. However, some forms of competition can be extremely destructive to safety and business success. An excellent team safety program, like the one described below, can eliminate self-defeating internal competition, not only in safety, but also in the business.

The second piece of unfinished business is ensuring that, with all the personal interactions and distractions, the observed safety hazard gets fixed. Remember what it was? We report the burr on the angle iron and it gets removed, or a cushion gets placed on the exposed end, and we have corrected a deficiency. The point to be made here is that, if we truly believe it, **all injuries are preventable**.

We need to recognize that the reason most people don't believe the above statement is they imagine that they (independently) are responsible for preventing all injuries to themselves when in reality it is "we" (interdependent) who are responsible for all injuries for each other. Correcting the above condition may have prevented someone else from having an injury. At your site today if someone had gotten seriously cut on the angle iron, what would be the conclusions of the investigation?

Let's test this on a real live case. An engineer who worked for me was walking across an open area when a strong gust of wind blew a piece of 5/8 inch plywood off of a nearby roof and it hit him in the head. He was knocked unconscious. As the employee regained consciousness, the number of people that wanted to know what happened surprised me. The explanation was simple; a sheet of wood blew off a roof and hit him in the head. What I didn't realize at the time was many of the people wanted to find a reason to blame the employee for what had happened. If we are all responsible for our own safety, he should have done something.

If you agree with this conclusion, you need to move out of the independent mode and into the interdependent one. Securing a workspace, completely finishing a job, reporting other deficiencies, and cleaning up afterwards are crucial ingredients to excellent safety performance. Recognizing the hazard of loose boards on the top of a building, or bolts or a wrench left on the top of a vessel, general cleaning up of work areas so there is no debris to fall or fly in the wind are all part of the interdependence. There is also the recognition of the hazard associated with energy in the form of wind and gravity. I challenge you to internalize the next statement based on the context here: **There are no such things as accidents. They are all preventable.**

Hazards Education

I hope the above has started you on the path of recognition that if you can "see" the hazards after the event has occurred, the real learning is to think about how we might "see" hazards ahead of time and avoid them. Then we would have a "Zero Period Process" by definition. From the time we can comprehend as children, we learn about hazards, "hot," "uh oh," "NO!" And then we take this information in as we learn, and make judgements, "I'm going to do it anyway." Raising children does prepare us in some ways to help us teach others, despite the frustrations incurred. Children can go through the 3 levels—dependent, independent, and interdependent, but the last level can be very difficult, since our kids now become our peers in a manner of speaking.

So how much safety information, knowledge, and understanding do we pass on to them? Not much, unless we have had some education in safety processes ourselves, because excellent safety processes is an acquired trait. I maintain that when we enter the industrial workplace (or almost any new major task for that matter), we should really start "at the beginning" with few or no assumptions. We have to go through the 3 levels and if there is no one who is willing to mentor and, eventually, partner with us as peers, we may stay at the dependent level as a group, as indicated in Figure 2d. In fact, the safety processes discussed here may be very difficult to uncover if no one associated with the new job or task recognizes them as such.

There is a fundamentally important process that begins to emerge at the independent level, but really blossoms at the interdependent one. It is the ability of the interdependent group to continuously improve virtually all aspects of safety. Joining this group can be difficult because they may have such a high value for real expertise, as opposed to "wanna be" experts. It is our experience that sometimes supervisors have difficulty "dealing" with this group, since they may have an idea of "their outcome," which they perceive as threatened by the group process. Of course, management always has the final say, but if their outcome is at a high enough conceptual level where the expertise of the group is permitted to "do its thing," the results can be excellent. If it sounds like I think management inadvertently gets in the way of good safety, the answer is yes, especially if they do not understand the leadership process which is at work.

Moving Quickly Up the Learning Curve

In an ideal world, a new employee would reach the "expert" level as quickly as possible (Figure 4). In my experience this takes about 10 years for an employee off the street, or about 3 to 5 years for a skilled worker with 10 years in-house experience. The process is slow because we have failed to recognize how important interdependence is, and have not provided the time and resources necessary for a good base level understanding of the new task. This same experience occurs for new supervisors, although the timing may be a bit different since there are more resources available. However, there is no guarantee help will sought.

The best experience we have had in "ramping" a group quickly up to speed could serve as a prototype for rapid training. We were refurbishing a 20,000-ton ammonia tank [3]. The tank needed to be emptied, but kept cryogenic with residual ammonia, while replacing the main outlet valve. A group of skilled employees with an average 10 years of service was selected to perform the work. They were informed about the need to keep ammonia in the tank so the working conditions would always be in the presence of a hazardous material on the other side of some barrier. And there would be no leaks. The new fundamental skill required the insertion of a shaft with an uninflated balloon through existing valves. Then, the balloon would be inflated, the valve removed, and a new valve installed. The balloon would be collapsed and pulled through the new valve into a chamber with a seal for the shaft. This procedure was going to be performed on a number of small valves, with the grand finale being a 24-inch valve weighing 8,000 pounds. The overall plan was laid out with team input, and general roles that "somebody" had to fill.

You can read about the technical details in the Ammonia Symposium Proceedings of that year. I think the real accomplishment (which was only partially recognized at the time) was the intensive discussion between operators, pipe fitters, riggers, crane operators, back-ups, safety crew, etc. During a late afternoon meeting the day before the scheduled big valve replacement, "natural" leaders for the team said they were not ready and needed another day to make certain, mentally and physically, that there would be no mistakes. There was a team of 25 people (supervisors included) all on the same page—thinking the entire job through to eliminate defects—an inherently "zero process." The eventual execution was perfect.

WHY EFFECTIVE TEAMWORK IS IMPORTANT

Most of us feel pretty good if we can recall 80% of what we learn. (Here "learning" means not only job knowledge, but hazards recognition and judgment.) So, if a new hire assumes my job and I train them, on average, they will retain 64% (80% of my knowledge times 80%, the amount of my knowledge "passed on") of what they need to know. This is probably enough

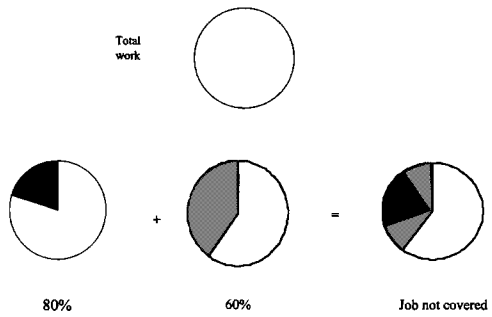

Figure 5. Job skill coverage.

Teach	Team Identity	Freedom
Focus	Leadership/ Interaction	Order

Figure 6. Attributes of a successful team.

to get them through an average day, but surely not enough to get them through a day of exceptions. To cover all the needed information, the two people in Figure 5 need to have no overlap of the person with 20% absence of knowledge with the one missing 40% of the information. But these workers may not realize what's missing. If I have two people skilled in a job and one is less experienced, the job will probably be 100% covered, including exceptional operations, provided the knowledge gap was not in the same area. If I have a team discussing missing information, I can bring all people up to the "80% knowledge bar." As people gain more knowledge, faster and more effective teamwork can take place. All team members will at the least be able to operate in the independent mode.

Next come three very important and interrelated quantities; (a) the will to want to improve; (b) the communication skills to discuss what should happen; and, (c) the leadership to make it happen. These three do not all have to reside in one individual. What usually happens first is (a) the will—a person sees that a procedure, a technique, etc. can be improved and they see how to do it better.

The idea generation process needs to be cultivated and nurtured. Not all ideas are great ones, so you need a very active idea generation process to get that one idea in 20 that is worthwhile. It is surprising how capable the organization can become at generating good ideas. Note that it takes very little to damage or stop the idea generation process. Without the opportunity for an individual to discuss their idea, considerable frustration is usually the result. If the "supervisory climate" is hostile, the idea can get buried. I have witnessed numerous situations where an idea is discussed with a supervisor, and the reply is, "the procedure is right, if you only knew how to use it." Oftentimes a supervisor does a task "because that is the only way to make sure it is done right!" Is that the real reason? I doubt it. It makes the supervisor feel good to accomplish something and to think, "Where would this place be without me?" This is ego-driven behavior that stresses the independent mode of behavior and is guaranteed to shutdown teamwork. But, if the climate is right, and an idea on how to improve is communicated so that everyone in the operation stands to benefit for the right reasons—it makes the business better, safer, and easier—and often someone else can further improve it. This is the first important key. If a group has a common focus, it usually improves. After all, these are the people who do the job nearly every day. If the focus is not common, quite often a compromise is made, which can become the "horse designed by committee"...not a pretty scenario.

The second key, which I think, captures an essential ingredient in the teaming process is: *People who are handed a creation tend to work towards owning it; people who are engaged in creating something tend to work towards improving it.*

The first part of this sentence is a static notion; if you are handed something, owning it is something you do for yourself. But, the second part captures the idea of continuous improvement. Why is that important? Because safety is a continuous process towards either getting better or getting worse. "*Making tomorrow safer than today*" is the Belle Plant motto, so we continuously think of improvements. And it's being done with the people who do the job, day after day, and have to live with the changes. Providing this group with the proper tools to continuously improve their safety practices seems like the ethical and logical thing to do.

Six Attributes of a Successful Team

After considerable work with teams, I have come to the conclusion that there are six important attributes for a successful team (Figure 6). I will share them with you, but if you have yet to work on a successful, high-performance team, they may just seem like words. Some teams are successful and don't know that these six things exist. But, if you want to be successful almost every time, you need to gain an understanding of each of the six concepts below.

The first is **team identity**. A team has to have or build a common denominator. It has to have a reason for being, or it might as well be a social club. Working in a common area is a reason; working in a common skill group is another.

The second is what I call interaction/leadership. How does the team process problems, ideas, questions, etc? Are there any principles that all team mem-

bers should adhere to, like only one person talking at a time, no cussing, having a meeting leader, and a project leader? Out of the interaction come priorities of things to work on.

The third is the ability to **focus** on subjects. If there is not an ability to prioritize items and then focus on completing those at the top, then the energy of the team is rapidly dissipated.

The fourth is to **teach** other team members and learn as you complete the top priority items. What you select to do is important, what you focus on is also, and in the doing, teaching and learning along the way, builds skills that can enable the team to take on even larger tasks.

The fifth and sixth items are a delicate balancing act. On the one hand the team needs some **freedom** to operate, to revise procedures, etc., but there is no "blank check." There is some **order** in the process and someone who may ultimately need to okay the change. There is a balance between improving safety, running into rigid rules, and having the energy to change those which need to be changed, and maximizing the benefits to team members, and other coworkers. I once had a manager say, "I will authorize anything that will significantly improve the business," then had an engineer come up with a brilliant idea, only to hear the manager say, "Not that much change." One of the biggest barriers you will face with a successful team is the "outside" (not inside!) perception that the team is moving "too fast" and those who have not put in the time and energy, or are not part of the team, will feel they are "losing control." Communication about the idea in progress is a useful tool for keeping "outsiders" informed so they are not "surprised" by the issue in point. But there are no guarantees that, at some point, a supervisor will just feel uncomfortable and begin the journey of asking thousands of questions to slow down or stop the work.

Out of the Box!

The six-step process outlined above needs to be exercised through several cycles, with an initial focus on "fixing" something. Frequently, teams pick the hardest, most difficult subject to begin work on, and then are surprised when they fail. Our recommendation is to pick readily achievable tasks, under the control of the area in which the team works. We're not trying to cheat the process by selecting an issue the team can surely accomplish, but are focusing on learning to work with each other, and establishing a process for success. There are two hidden messages to the team process. In past discussion, some employees have mentioned that restraints placed on operators, mechanics, etc, so they can't "step out of the box" are not real. But, if you have ever experienced the indignity of being less than articulate in public (to name one barrier), you realize there are real constraints. And if the improvement you have designed doesn't work perfectly, the supervisor can make you feel you are responsible for all its shortcomings. This is another way to maintain control. "See, being the boss isn't as much fun as you thought it would be," is nothing more than showing who's in charge. Helping make the change happen is far more productive for everyone, even if the idea is not important to you as an individual.

By using the six-part teaming process the idea has been reviewed by several people with different perspectives and it's probably pretty good. The task may have been an easy one, but if the problem solved was one of a chronic nature that had been on the table for years, other workers in the area will be grateful, and the team will gain considerable credibility. On the other hand, if criticized, the task was accomplished by the team and no one individual has to "bear all the heat" for it. So, stepping out of the box through a favorable team effort certainly makes the improvement process easier. You also capture a hidden benefit; many real or perceived barriers are broken between operators, mechanics, supervisors, etc. and it created a certain "freedom" to discuss other issues. To date, out of approximately 124 proposals, there has not been one core team proposal which had not been adopted by its area. And, I might add, that of the 12 S.H.E. core teams active, no two of them have an identical process. The process "fits" the area culture as defined by the team.

One of the very delicate items now being discussed in the most advanced teams is "gray" areas. These are those situations when an operator or mechanic can find themselves in when the procedure doesn't go far enough. For example, the evening instructions say to "prepare Tank 2 for entering the next day using the instructions from the sister tank, No. 1." On investigation, Tank 2 is not anything like Tank 1. But you know the fundamentals about what it takes for a vessel entry, and you know that the contractor who is coming to do the work charges a lot of money. So, do you write your own procedure, critique it, and go do the work, or discard the procedure as inadequate and wait until morning to go home? If the employee were used to a teaming environment, they would get an "ad hoc" team from members of their shift to review a procedure they had modified from Tank 1, and they would all sign off that this is the correct way to prepare the tank. The shift supervisor might authorize the procedure, but the operator would review the procedure in the morning and the work which followed. By having an extended review, safety has been maintained, if not improved (there now is a procedure for Tank 2), the business has been helped since the vendor will not charge for an extra day, and the shift members are truly team members in running the business.

There are all sorts of gray areas that skilled personnel can uncover. I do not want to diminish the trust that must be in place to open discussion of these areas, and solving them is truly achieving the **next level of safety.** Without the type of processes we have used to uncover "gray areas," many supervisors pretend they don't exist, or are oblivious to their existence.

Figure 7 illustrates three areas that compromise safety; the circle defines "work" practices and/or procedures. Let us say the safety standard requires three

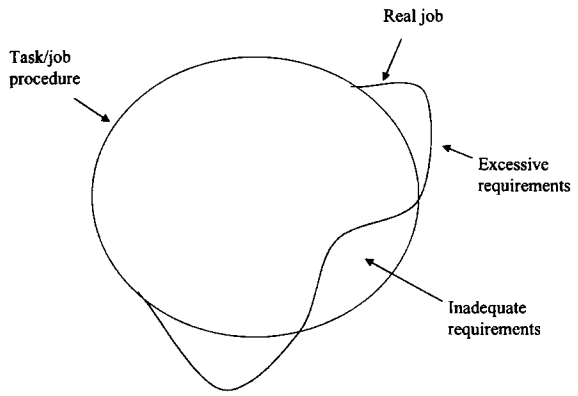

Figure 7. Procedures and job scope.

levels of protection (LOP). Note that many organizations do not define what LOPs they are striving for in standard work practices, which is the first compromise, so a **standard LOP** is needed. Some practices may have four or five LOPs so, "My people are absolutely safe." But, sometimes, people realize a task can't be performed with all that safety gear on, so an individual "compromises" his or her safety by taking off a glove to thread a nut on a bolt. Has safety been compromised? Are there still four levels of protection? Ask the team. Another example of compromise is a well-written procedure, which requires an operator to sample the repulper on a filter. But the only time you can do this is when the repulper is running, and the repulper has many shinny blades to remix solids and mother liquor. Has anyone really thought about what an operator may be required to do to get a proper sample, or has the inherent danger been ignored because it is "too difficult to deal with?"

Interacting Teams

At the Belle Plant, 12 safety, environmental, and health core teams are in operation. Each has been given the freedom to determine what works best in their particular area. And, believe me, they are different! Several of the teams have common problems. One team suggested that the site hold a cross-sectional meeting of interested teams to work together to resolve common issues. This idea was upgraded to have all the teams discuss what they were working on in a "core team day." We designed an event to do this and each team could display a poster explaining what they had accomplished, who their members were, and what important pieces of safety practice they were currently addressing. We actually had other teams—Process Safety Management (PSM), TERP (transportation emergency response), and the plant environmental team—also participate, since previous questions from core teams indicated an interest in their work. We opened the poster session to the plant, and, much to our surprise, there was a huge turnout for the two-hour event. Topics touched almost everyone on the plant, open discussions of difficult safety concerns and how they were being implemented. The end result is the formation of several cross-sectional teams to resolve some issues plant-wide. More importantly, some issues were identified that need to be **resolved on an area basis**.

Each core team also made a presentation to Central Safety, which is a legacy from the Mottel book. It's a very good forum for recognizing accomplishments, communication, and presentation of new ideas. However, it doesn't operate at the level of a core team and allow an interaction between members of high-exposure jobs.

PAY ATTENTION TO ATTENTION

After 25 years of experience we are still amazed at how many of our bright, well-trained colleagues fail to recognize hazards or choose to ignore them. Since the reason for their behavior is not clear, we will cover the "big four" items above and let you decide which is most important.

Hazards Recognition

How do we accelerate the capability of people to recognize hazards? One of the fundamental approaches is to have training sessions with people who can identify hazards For example, if you deal with flammable liquids, you can hold a course in the fundamentals of fire prevention and list basic elements in the "fire triangle" or the more modern version, the "fire pyramid." To get more sophisticated, you either go to a fire school, or bring in a consultant. After a number of discussions of this sort, people in your area can hold meetings with each other to share awareness of the types of hazards they have learned about, and are immediately faced with. Examples are usually graphic testimony as to the damage that a vapor cloud explosion can do, such as Flixborough in England or at the Phillips Plant in Houston, Texas. If you are unaware of these incidents, there is a great summary of these awful events [2], which you can read to help improve your hazard recognition skills. In addition, periodic hazards review of existing equipment (required by OSHA), or reviews of new equipment prior to start-up, are excellent methods of acquainting personnel with techniques of hazards recognition. There are two important points that help make the issue around fires, as an example of hazards recognition, serious:

1) You have to be willing to spend the time to explain the whys, which means that you must understand the facts thoroughly. This should not be viewed as an opportunity for someone to put you on the spot, but as an opportunity for the organization to learn and grow, and apply this information.

2) A personal example or testimony can "shock" a person into believing. A wise person once told me that their belief was that, to change a behavior, a person must suffer physical or emotional shock. I would hope that we all don't have to experience a tragedy to become safer. Accounts of a terrible experience someone else had should suffice, provided we are not so arrogant as to hold these people in contempt because their behavior looks deficient after the fact. One of the biggest barriers to

good safety is the foolish arrogance, "it can't happen here." We often think of young people as pretending they are immortal by taking huge risks, but, in reality, many of us also commit this same error if we fail to continue to exercise the learning process. Safety is an acquired trait. The team environment can be beneficial to everyone by expanding this trait.

Another bright person told me safety processes "are like holding up a 12-foot 2x4 with one hand, if you don't get some support (at the other end) it starts to sag pretty quickly. Early on we have trained new employees in hazards recognition. We continue to have training sessions and many operators learn just by watching and talking to others in an informal manner, or by incident investigations. A simple review of the hazards in various areas and a discussion of the levels of protection in the risk management plan (RMP) goes a long way as a first step in improving recognition and stimulating questions. After all, there are few emergencies where core team members are not going to be called on to help. Discussions in core teams, with the capability to call for expert assistance, can provide for continuous learning about hazards and improvement in the understanding around the RMP. We have established a principle that no legitimate safety question should go unanswered for more than three days.

"At-Risk" Behavior

This is a term that means an employee did some work in an unsafe way. At-risk behaviors are important since they anchor the bottom of the injury pyramid (Figure 3). This is a statistically developed model based on actual experience, that suggests that, for each 1,000 at-risk behaviors, there is an injury. Said another way, an at-risk behavior is an injury waiting to happen. If you performed an at-risk task three times a day, sometime in the next year you have a high probability of being injured. To recognize at-risk behavior, you need to recognize the hazard associated with the task. Many workers compensate for the dangers of an at-risk behavior by paying close attention, and they may not have an injury from the task for their entire career. But a younger, less experienced person, or someone who loses their focus, may have an injury the first time they perform the task.

There are many new "fashionable" programs that have been developed to focus on "at risk behavior." Most of these focus on static jobs an individual performs and are very time-consuming in their analysis. The most advanced of these programs believe that there are certain established procedures and the objective is to get every employee to follow every procedure every time so, by definition, you have a safe workforce. Despite some inflexibility and the cost, these programs can deliver short-term results. Our major objection is that they don't help the employee develop the judgment and understanding so the employee can better recognize hazards themselves. They are self-limiting. As a result, safety can be improved, but getting to zero injuries is just not going to happen.

Knowledge. Understanding. Skills. Attitude. Aptitude. Which attribute is most important?

It has to be attitude. If you don't think you can get hurt, if you don't keep trying to learn more and get better, if you don't care, then your chances of getting hurt are pretty good. Next in importance is aptitude—you have to be able to learn, and the quicker, the better. If you have the right attitude and aptitude, you can acquire the skills, knowledge, and understanding. But, even though you have worked with very good people and have gained skills and knowledge, if you find yourself in a new job, you may not have enough of the fundamentals to provide the judgment needed to recognize hazards quickly enough.

Can Attitude and Aptitude Be Influenced?

Both of these factors can be influenced in a positive or negative way. If you have had a tragedy in your family, upon returning to work your thoughts may continue to drift towards what happened in your personal life. You will be hard pressed to focus on your job. Distractions are a part of life. It we weren't influenced by them, we wouldn't be human. It's natural and normal. So, if you have a hazardous job to perform, you may need to be excused from it or think what it will take for you to regain your focus for the entire job. As we continue towards zero, part of our hope is that supervisors everywhere will recognize the opportunities they have to be more sensitive to their employees. Instead of requiring the job to be done immediately, they should recognize distraction, and give the work team the flexibility to complete the job while you mentally (and otherwise) deal with your personal concern. Supervisors are just as likely to have similar events in their lives. It is not a sign of weakness for us to be mentally distracted by these things. On the contrary, we find that people who fail to recognize the hazard they are to themselves during this period need to reevaluate their ability to recognize a hazard. Employee judgement errors are a weak link in many analyses of incidents and LOPs, and those who lose focus are more likely to get hurt.

Psychologists tell us that, by age three, our mental capabilities are pretty much formed. I maintain that while that may be true, by providing a good learning environment, a person and an organization can maximize the use of an employee's aptitude. It is the unused aptitude that is truly a waste. So, if an organization can teach hazards recognition, and provide a good work environment to encourage positive safety attitudes and teaming, skills and knowledge will grow and the organization will be well on its way to maintaining ZERO PERIOD.

PUTTING IT ALL TOGETHER AND GETTING RESULTS

Hints to Help You Keep Focused

The DuPont Belle Plant has gone more than three years without an OSHA recordable injury. Our safety achievements were mirrored in our environmental performance and our contractor performance (Figure

2c). People are communicating with each other about safety in supportive ways. There has been no hostile confrontations, and discussions have been helpful and non-threatening. We also sustained two reductions in the workforce during this period, which destroyed a long-standing DuPont paradigm: "You can't have good safety with low morale." We had excellent safety with almost no morale. The 12 core teams were meeting at least once a month, and more frequently on special topics. We averaged 100 people a month in very productive, direct safety discussions, and the rest of the plant was touched by core teams discussions which carried over after the meetings. The core teams processed some 800 ideas in three years, and 141 successes were fully implemented.

I think my favorite success involved a very complicated tag, lock, and try, a procedure that initially was done four different ways (by each shift). The core team leader got each shift's representative together and, after a three-hour meeting, they emerged with an outstanding procedure. All of the shift representatives returned to educate their shift with the knowledge that the entire area core team stood behind the practice. **This is the essence of operating discipline**.

Other noteworthy points raised in core team environments included a discussion of violence in the workplace, mental and physical hardships associated with shift work, and continuing discussion about substance abuse. These topics are extremely important to the core team members.

CONCLUSION

In conclusion this was an exciting time as tremendous self-directed energies accomplished a number of tasks. When some would show up at meetings unprepared, others were ahead of schedule and made their presentations, and useful work got accomplished. I have a sense that the success wasn't shared by all, including some supervisors/managers, because some time-honored safety practices were deemed ineffective. The real choice is between a process that is managed in a reactive manner, or one that is led in a proactive way. It seems to me that zero injuries for three years certainly should provide the motivation to accept the changes. We shall see.

ACKNOWLEDGMENTS

To those who have helped lead the way:
Jan Blanken DSM
Per Duus CB&I

LITERATURE CITED

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COMMENTS OF FRED MILLAR
FRIENDS OF THE EARTH
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WASHINGTON, DC
CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

[Docket No. CSB-10-01] MAY 9, 2010 Submitted by email

Friends of the Earth is pleased to comment on the Chemical Safety and Hazard Investigation Board (CSB) outline of the scope for the study by the National Academy of Sciences (NAS) to examine the use and storage of methyl isocyanate, including the feasibility of implementing alternative chemicals or processes and an examination of the cost of alternatives at the Bayer CropScience facility in Institute, West Virginia.

We suggest asking that as part of the scope, NAS also do a parallel new national study [which could be construed as a follow-up check of the adequacy and the real-world results of the previous Congressionally-ordered Hydrogen Flouride study in 1993 by US EPA

http://www.epa.gov/oem/docs/chem/hydro.pdf] on a similar toxic gas catastrophic risk chemical, Hydrogen Fluoride (HF) in US refineries. A parallel NAS study effort on HF, which already was the subject of a national study, could help focus NAS on the most useful directions and could have the added benefit of throwing more light on recent evidence on serious failures in overall US chemical industry safety culture. A new study of HF alternatives could also be very valuable, especially if it also includes some assessment of how less-than-adequate toxic chemical process alternatives get pitched to technically-challenged and easily manipulated communities (Modified HF in 2 CA cities, e.g.) and on what is needed to make alternatives a viable option (e.g., an assessment of the ongoing pilot studies using solid acid catalyst).

We suggest that both lines of a forthcoming NAS study include:

1. an assessment of risk communication and of the use of probabilistic risk analyses by the industry regarding both HF and MIC.
2. the potentials for realizing the risk reduction promise of alternative chemicals, e.g., solid acid catalysts as a substitute for HF
3. evaluation of at least a sample of the existing US urban HF refinery facilities, regarding their :
    a. Ongoing major hazard release risks – accidents or terrorism-caused
    b. Effectiveness of PSM and RMP in each facility
    c. Implementation of the corporate Best Industry Practices identified in the 1993 EPA study on HF facilities
    d. Effectiveness and level of communication of risks to the workers and the community – i.e., the effectiveness of RTK laws and practices (knowledge of the most serious vulnerable zones, etc.)

We suggest that the NAS study committee include knowledgeable union, community and public interest stakeholders who have been involved in chemical accident prevention work since Bhopal.

Respectfully,
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May 9, 2010

The Honorable John Bresland
Chairman
U.S. Chemical Safety and Hazard Investigation Board
2175 K. Street, NW, Suite 400
Washington, DC 20037-1809

RE: National Academy of Sciences Study [Docket No. CSB-10-01]

Dear Chairman Bresland-

On the behalf of my community and as the spokesperson for People Concerned About M.I.C. with the support of numerous national and international community and environmental organizations, I urge you to consider our comments regarding the National Academy of Sciences (NAS) Study [Docket No. CSB-10-01].

People Concerned About MIC (PCMIC) believes that the disaster at the Union Carbide plant in Bhopal, India on December 3, 1984 is enough reason to merit the elimination of the chemical methyl isocyanate (MIC), or at the very least merit eliminating the MIC stockpile at the Bayer CropScience facility in Institute, West Virginia. We are certain that the National Academy of Sciences (NAS) Study will follow our same conclusions and pave the way to make this necessity a reality.

A report produced by the Good Neighbor Project for Sustainable Industries in November of 1994 outlining a reduction of then Rhone-Poulenc's storage of methyl isocyanate was recently brought back to light. We trust this document will be thoroughly reviewed for the study. As Bayer's proposed MIC reduction transitions governmental authority from the state to the federal level as a result of the vaulted modification to the underground storage tanks, we hope potential regulatory gaps will be fully considered as well.

People Concerned About MIC recommends that a clear definition of inherently safer technologies shall:

- Adequately outline both process safety and risk management procedures;
- Take into consideration worse-case scenarios in the transportation of highly toxic chemicals;
- Weigh the human and environmental costs along with the potentials of catastrophic economic costs should worse case scenarios play out.

Whereas the 1984 methyl isocyanate (MIC) release at the Union Carbide facility in Bhopal, India is considered the worst industrial disaster in history;

Whereas the West Virginia Department of Environmental Protection recently cited Bayer CropScience for violation of their Underground Storage Tank permits with regards to the storage of MIC;

Whereas Bayer CropScience received numerous serious and repeat safety violations from OSHA as a result of the August 2008 explosion at the Institute facility which resulted in the death of two workers and injured countless other emergency responders and resident surrounding the area;

People Concerned About MIC recommends that the following additional topics be considered in the proposed task statement.

- Review and evaluate the human and environmental costs should worse case scenario play out.
- Review and evaluate the catastrophic economic effects it would have on the greater Kanawha Valley and West Virginia should a worse case scenario play out.
- Should the analysis of the NAS result in recommendation of maintaining current MIC storage and manufacturing practices, the NAS shall provide proof that the existing safety, storage, and manufacturing procedures, and government regulation will adequately protect residents surrounding the facility from another Bhopal-like disaster across the lines of changes in both management and facility ownership.

Whereas funds were appropriated specifically to examine the costs of alternatives at the Bayer CropScience facility in Institute, West Virginia;

Whereas phosgene, a nerve agent used as a chemical weapon in World War I, is stored in mass quantities at the Bayer CropScience- Institute facility in order to meet production demands of MIC;

Whereas exposure to phosgene at the DuPont chemical plant in Belle, West Virginia caused the death of one worker;

Whereas information available to the public on the dangers existing at the Bayer CropScience facility in Institute, West Virginia (and chemical facilities across the country) is not easily accessible to lay persons; and

Whereas the outcomes of the studies conducted utilizing the Kanawha Valley will translate to chemical facilities across the country;

People Concerned About MIC recommends that additional funding be directed in the following ways.

- Any appropriated funds not used in the feasibility study on MIC should be used towards reviewing the feasibility, costs, and benefits of inherently

safer alternatives to chemicals of greatest threat to the Kanawha Valley (including, but not limited to chlorine and ammonia).

- PCMIC believes that the use and storage of phosgene must go hand in hand with the studies of MIC and recommends that should additional funds exist, a feasibility study on inherently safer alternatives to this chemical also be conducted.
- A clear outline should be developed that eliminates both propinquity and language barriers and clearly communicates to fenceline communities the public dangers that exist at chemical facilities impacting them and how inherently safer technologies will better protect them.

For panel members, People Concerned About MIC recommends the following expertise be taken into consideration. The panelist representing community should:

- Have direct knowledge of the MIC storage history at the Institute facility as well as the transition of other companies across the world to safer technologies;
- Represent fenceline community concern and ensure a thorough analysis of environmental justice issues is considered within the panel recommendations;
- Represent concerns specific to Kanawha Valley residents as we are the only ones in the world who will have to live with the outcomes of the MIC-specific study of the Institute facility;
- Have functional knowledge of the chemical industry and the Bhopal disaster; and,
- Have a voice considered equal to that of the other panelists.

Whereas she serves as an expert in each of the above outlined roles, and is fully competent to perform the tasks outlined by the Chemical Safety Board, People Concerned About MIC unwaveringly recommends Pam Nixon to serve on the panel.

Pam Nixon is a Kanawha Valley resident who currently serves as the Environmental Advocate for the West Virginia Department of Environmental Protection. In her role, she serves as an outstanding liaison between communities and government, whereby in April 2009, she was asked to testified at the Congressional hearing on the August 2008 Bayer CropScience explosion. Ms. Nixon holds a Masters Degree in Environmental Science and has first-hand knowledge of the health effects of toxic chemical releases after having been injured as a result of the leak at the Institute facility eight months following the Bhopal disaster.

As the tasks are outlined in the docket, the proposed timetable for the proposed study seems appropriate. We are astutely aware that the Chemical Safety

Board's recommendations regarding the August 2008 Bayer CropScience explosion are pending the results of this study. Considering the major safety lapses that have occurred at the facility even since the explosion and the continued information shedding light on the seemingly negligent practices of the company, we eagerly await its conclusion.

Please feel free to contact me should you have any questions regarding our recommendations.

Sincerely-

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Via Electronic File (*nascomments@csb.gov*.)

May 10, 2010

U.S. Chemical Safety and Hazard Investigation Board
Office of Congressional, Public, and Board Affairs
Attention: D. Horowitz
2175 K Street NW, Suite 650
Washington, DC 20037

Re: Docket No. CSB-10-01
National Academy of Sciences Study
Comments Submitted by E.I. DuPont de Nemours, Inc.

Dear Sir or Madam:

The DuPont Company is pleased to provide comments to the U.S. Chemical Safety and Hazard Investigation Board on Docket No. CSB-10-01 as published in the Federal Register on April 23, 2010 involving a proposed study by the National Academy of Science (NAS) to evaluate the use and storage of methyl isocyanate (MIC) at the Bayer CropScience facility in Institute, West Virginia.

The DuPont Crop Protection business has been providing carbamate insect control solutions to growers for over 40 years, including our current methomyl manufacturing operations at LaPorte, Texas. We appreciate the opportunity to provide input on the proposed NAS study and the overarching issues associated with methyl isocyanate use as part of agrichemical production.

Please contact me if you have any follow -up questions or comments regarding the attached comments by email at david.e.cummings-1@usa.dupont.com or by phone 302-774-9558.

Sincerely.

David E. Cummings
Global Process Safety Management Leader
E.I. DuPont de Nemours, Inc.

Attachment

May 10, 2010

Comments from E.I. DuPont de Nemours, Inc on the U.S. Chemical Safety and Hazard Investigation Board - National Academy of Sciences (NAS) Study
Docket No. CSB-10-01

1) Does the proposed Task Statement include the appropriate topics for consideration by NAS? Are there any other additional general or specific topics the NAS panel will need to consider in order to reach a satisfactory answer on the feasibility and costs associated with reducing the use and storage of MIC?

DuPont Comments:

With respect to Task 1, we believe this broad based proposed scope with a focus on inherently safer technologies is a complex subject which is highly dependent on a number of factors such as unique technologies, product life cycles, product viability, and chemical specific characteristics. For these reasons, we believe the study should not seek to create new IST models and methods for the limited purpose of the MIC review, but should utilize the existing references and the body of work relative to IST such as information and guidance from the Center for Chemical Process Safety (CCPS) and other process safety organizations [reference CCPS Publication ISBN 978-0471-77892-9; Inherently Safer Chemical Processes – A Life Cycle Approach (2009)]

In reference to Task 2, our suggestion is that the proposed NAS study should be as focused as possible and not expanded beyond MIC use for the production of carbamate agrichemicals. Expanding the scope to include other uses for this technology we believe would add undue complexity to the proposed study.

In examining the inherent safety of MIC use in manufacturing, it is not appropriate to consider Life Cycle Analysis impacts or inherent safety of the end use product. The end use product is subject to extensive and rigorous risk assessment according to well established national and international regulations and norms such as the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the International Code of Conduct on the Distribution and Use of Pesticides.

Task 2 of the proposed task statement involves a detailed review of current and emerging technologies associated with carbamate agrichemical production. In any review of inherently safer technologies, it will be important to have an understanding of the complex national and international regulatory systems that are in place for the licensing of agrichemicals. These regulations impose requirements on registrants of agrichemicals to provide specific information to authorities on materials and manufacturing processes used to produce agrichemicals as part of the product registration approval process. In order to implement changes in materials and processes, regulatory authorities are required to review and approve these changes, often requiring long lead times before such changes may be implemented.

Further, adequate controls must be in place to protect proprietary and confidential materials and information belonging to individual companies that may be collected or reported as part of the NAS study, including technology information regarding manufacturing processes and practices, production costs, and other confidential

business information. U.S. Agrichemical companies compete globally in a highly competitive environment, and invest significant amounts of money in R&D, including investment in proprietary manufacturing technologies. In addition, it is important for the safety and security of facilities and neighboring communities, that details of facility manufacturing processes, their operations, and materials used at these facilities, not be generally available to the public, other than on a need to know basis by fire, safety and law enforcement authorities.

Task 2 of the proposed task statement includes a specific reference to fixed facility and transportation risks associated with alternative approaches. We suggest that the CSB delete any reference to transportation risk related to MIC or within any other proposed studies involving IST at fixed facility applications. Off-site transportation risk is a separate, complex, and distinct issue and function from that of safety technologies typically applied in a fixed manufacturing location which involves a substantially different group of stakeholders and risk assessment tools.

Task 2 of the proposed task statement includes an objective to identify the "best possible approaches for eliminating or reducing the use of MIC" at the Bayer facility including several examples. Any comprehensive evaluation by NAS should consider all potential and feasible IST-related improvements which can further reduce overall risk, including but not limited to simplification, moderation, passive engineering controls, and other means rather than a limited focus on only substitution or inventory reductions.

2) If funds are available, should the CSB initiate a second related study to consider the feasibility, costs, and benefits of inherently safer alternatives to other chemicals? For example, should a study consider alternatives to the use of hydrogen fluoride in refinery alkylation processes and/or to the use of chlorine in water treatment. What other chemicals or processes should be considered if a second study is undertaken?

DuPont Comments*:*

Congress appropriated funds for the study of MIC, in particular examining the storage and use of MIC at the Bayer CropScience facility in Institute, West Virginia. We do not believe it is appropriate to use these funds for other purposes since the appropriations legislation included specific language linking such funds to CSB's ongoing investigation of Bayer's incident and MIC.

Secondly, the proposed study of MIC by the National Academy of Sciences represents a new and unproven process which is likely to involve a diverse set of stakeholders, knowledge, and skills. We accordingly regard the congressionally authorized MIC study as a test case, and believe that it would unwise to expand the scope to other materials and technologies before gaining experience and evaluating its effectiveness and results.

Nonetheless, if funds are applied to any other areas of study, we suggest that any additional panel reviews include a clear and limited focus on the relevant hazard, industry sector, and technology as described in the response to question #1 above.

3) What kinds of backgrounds and expertise should be represented on the NAS panel?

DuPont Comments

Members of the MIC panel should include persons who have the requisite scientific and technical expertise and experience working with the chemistry, as well as appropriate practical knowledge and experience of having worked in the chemical manufacturing industry for a sufficient period of time to understand the issues that will be the focus of the NAS panel. This should include specifically, experts who have significant experience in the production and handling of carbamate agrichemicals. This expertise should include industry technical experts from companies that operate manufacturing facilities producing and handling carbamate pesticides today. DuPont would be willing to provide knowledgeable expertise provided appropriate safeguards are in place to protect our confidential proprietary technology and information. Panel membership should be objective and unbiased with respect to IST and also with respect to the need for safe and efficient production and use of agrichemicals. Agrichemicals, such as carbamate insecticides, provide important benefits for the security and sustainability of our global food supply. Our nation and the world face increasing demands for more and better quality food, renewable energy and material resources such as biofuels and materials made from biomass. Agrichemicals play an increasingly important role in delivering environmentally sustainable productivity. As a science based company, we encourage the search for better and safer technologies to produce these important and essential agrichemicals.

If additional studies on other hazards and technologies beyond MIC at Bayer are developed, consideration as to members of these respective panels should include technical personnel from all organizations who can offer proven alternative technologies which may provide additional benefits for inherently safer operations.

Task 2 refers to manufacturing approaches used worldwide for these (MIC) materials. We agree that technical expertise should be considered for the panel, including representatives outside the U.S. who have the requisite knowledge and experience with carbamate pesticide. It will be important, however, to provide for adequate protection of confidential and proprietary technology. As noted earlier, U.S. companies compete on a global scale and invest significant amounts of R&D dollars in developing safe and efficient manufacturing facilities. Loss of confidential and proprietary manufacturing information is a constant threat to the health and sustainability of our business which employs thousands of workers in the US and abroad.

4) Is the proposed timetable appropriate?

DuPont Comments

Twelve (12) months should be sufficient to conduct all study tasks. We support a formal goal and target date associated with this project to ensure timely completion of the contract and allocation of government funds.

Docket No. CSB-10-01
E.I. DuPont de Nemours, Inc
David E. Cummings
1007 Market Street
Wilmington DE 19898

May 10, 2010

Chemical Safety and Hazard Investigation Board
Office of Congressional, Public, and Board Affairs
Attn: Dr. Daniel Horowitz
2175 K Street, NW, Suite 650
Washington, DC 20037
Via electronic comments: *<nascomments@csb.gov>*

Re: ***Comments to CSB–10–01 on CSB funding for a Study by the National Academy of Sciences to examine the use and storage of methyl isocyanate***

Attention Chairman John S. Bresland:

The proposed study by the National Academy of Sciences (NAS) to examine the use and storage of methyl isocyanate should be expanded to include an evaluation of inherently safer technology alternatives to the deadly catalytic chemical hydrogen fluoride (HF) that is still being widely used in the U.S. oil refining sector in the alkylation units to produce high octane gasoline products. The catalyst HF may pose an even greater hazard to American communities than the use of methyl isocyanate.

The lives of millions of people are at risk living downwind of local refineries and in populated downwind neighborhoods several miles away, since so many large oil refineries continue to use the deadly catalyst HF. Recent accidents at refineries (Citgo's East Corpus Christi refinery on July 19, 2009) in the last two years where HF was released and workers injured highlight the critical need for the Chemical Safety and Hazard Investigation Board to add HF to the upcoming NAS study.

The expanded NAS study is needed because of serious risk concerns about the potential for an airborne release of the HF chemical, which is highly toxic by inhalation and could adversely impact the health and safety of workers and the public in 51 refinery communities located in 20 states. These HF refineries are located in several large urban areas like Los Angeles, Houston, Chicago, Philadelphia, Salt Lake City, Corpus Christi.

In an August 2005 report Needless Risk: Oil Refineries and Hazard Reduction, U.S. PIRG identified 51 U.S. oil refineries that are still using the deadly catalyst hydrofluoric acid or HF--about 1/3 of existing refineries. The good news is that two thirds of U.S. refineries are using processes that do not include HF, reducing risk to the surrounding communities.

Please consider expanding and adding the deadly catalytic chemical hydrogen fluoride to the proposed study by the National Academy of Sciences examining the use and storage of methyl isocyanate. The NAS study must include an evaluation of safer alternatives to the deadly catalytic chemical hydrogen fluoride.

Sincerely yours,

Elizabeth Hitchcock
Public Health Advocate
U.S. Public Interest Research Group
218 D Street SE
Washington DC 20003
202-461-3826
Elizabeth@pirg.org

VIA ELECTRONIC FILE

May 10, 2010

U.S. Chemical Safety and Hazard Investigation Board
Office of Congressional, Public and Board Affairs
Attn: D. Horowitz
2175 K Street, NW
Suite 650
Washington, DC 20037

RE: CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD Docket No. CSB–10–01

Dear Sir or Madam:

The American Chemistry Council's Hydrogen Fluoride Panel (Panel) is pleased to provide comments to the U.S. Chemical Safety & Hazard Investigation Board (CSB) on the Board's proposed approach for the National Academy of Science (NAS) Study of the use and storage of methylisocyanate (MIC) at the Bayer Crop Science (BCS) facility in Institute, West Virginia (ref.).[1] Specifically, the Panel is commenting on the following questions, posed by the CSB:

> *If funds are available, should the CSB initiate a second, related study to consider the feasibility, costs, and benefits of inherently safer alternatives to other chemicals? For example, should a study consider alternatives to the use of hydrogen fluoride in refinery alkylation processes and/or to the use of chlorine in water treatment? What other chemicals or processes should be considered if a second study is undertaken?*

The Hydrogen Fluoride Panel[2] represents major North American manufacturers of hydrofluoric acid. The Panel was chartered in 1988 to address issues relating to the use, transportation, emergency response, health effects, environmental impacts and regulation of Anhydrous Hydrogen Fluoride and Hydrofluoric Acid (collectively referred to as HF). Members of the Panel are committed to the responsible use and handling of hydrogen fluoride, improvement of tank car safety and the prevention of incidents resulting in releases.

[1] 75 Fed. Reg. 21223 *et seq*
[2] The following companies are members of the Hydrogen Fluoride Panel: Arkema, Inc.; Daikin America, Inc.; DuPont; Honeywell; Mexichem Fluor Sa. de CV.; and Solvay Fluorides.

HF is essential to everyday life. In many cases, HF is the only known raw material that can provide the chemistry which is needed in many applications relevant to quality of life. It is the source for producing fluorine-containing materials such as refrigerant gases for industrial and mobile air conditioning units, blowing agents for insulating foam, fluoropolymers, pharmaceutical and agricultural chemicals. Additional uses include the production of alkylate (octane) for gasoline, stainless steel pickling, semi-conductor preparation, uranium refining, and glass etching.

As responsible product stewards, members of the HF Panel are aware that many factors and site specific characteristics should be considered when evaluating the use of HF. These include risks, hazards, processes, staff resources, feasibility, location, transportation issues and surrounding population among others. As mentioned in the overall comments of the American Chemistry Council, the use of alternative chemicals will depend on many of these site-specific factors. A broad, generalized study on one or more chemical processes would have little practical value for decisions regarding individual facilities. Additionally, study recommendations made without addressing site specific factors and characteristics may actually increase risk to individual facilities.

The Panel appreciates the opportunity to submit these comments. If you require additional information or have questions concerning these comments, please contact me at (703) 741-5614, or by e-mail at Kristy_morrison@americanchemistry.com

Sincerely yours,

Kristy L. Morrison

Kristy L. Morrison, Manager
Hydrogen Fluoride Panel
Chemical Products & Technology Division

americanchemistry.com®
1300 Wilson Boulevard, Arlington, VA 22209 | (703) 741.5000

May 10, 2010

Via electronic file

Docket No. CSB-10-01
Chemical Safety and Hazard Investigation Board
Office of Congressional, Public and Board Affairs
Attn: D. Horowitz
2175 K Street, NW
Suite 650
Washington, DC 20037

Subject: Comments of NPRA, the National Petrochemical & Refiners Association, and the American Petroleum Institute on the Proposed National Academy of Sciences Study Scope Published in the Federal Register on April 23, 2010 (75 Fed. Reg. 21223 *et seq.*)

The American Petroleum Institute (API) and the National Petrochemical and Refiners Association (NPRA) submit the following comments on the Chemical Safety Board's (CSB's) "**Proposed National Academy of Sciences Study Scope**" published in the Federal Register on April 23, 2010 (75 FR 21224).

API is a national trade association with nearly 400 member companies that are involved with all aspects of the oil and natural gas industry. NPRA members include more than 450 companies, including virtually all U.S. refiners and petrochemical manufacturers.

API and NPRA submit these comments to provide context to issues found within the Proposed National Academy of Sciences Study Scope**.** Specifically, we believe that the scope of the study is not consistent with the original appropriations language and that Task #1 is not suitable or appropriate because it is too broad in nature to make definitive conclusions on inherently safer chemical processes.

Scope of the Study is not Consistent with the Original Appropriations Language

The scope of the National Academy of Sciences (NAS) proposed study goes beyond the language in Public Law 111-88, 123 Stat. 2949 which states "[t]hat of the funds appropriated under this heading, $600,000 shall be for a study by the National Academy of Sciences to examine the use and storage of methyl isocyanate including the feasibility of implementing alternative chemicals or process and the examination of the costs of alternatives at the Bayer CropScience facility in Institute, WV." This Congressional appropriation does not call for a study to "review and evaluate the state of the art in

inherently safer process assessments and implementation" as specified under Task #1 of the Proposed Study. Based on both House and Senate Appropriations Committee reports, the language approved in conference specifically requests an investigation of methyl isocyanate (MIC) and its use at the Bayer Institute, West Virginia site. The conference language did not expand the study to include alternatives to chemicals other than MIC. Studies for alternatives such as chlorine are simply outside of the scope intended by Congress. In order for NAS to expand the study, the Chemical Safety Board (CSB) is required to notify the Appropriations Committee to approve reprogramming of the original appropriations language (See House Appropriations Committee report (111-180) on the general matter of "reprogramming). There is no record that the CSB notified the Appropriations Committee.

Topics covered under the first four bullet points of Task 2 are appropriate and within the scope of the study called for by Congress. The fifth bullet point is neither appropriate to the scope of the study nor needed to reach a satisfactory answer on the feasibility and costs of reducing the use and storage of MIC.

The Study is Infeasible and Inappropriate as Currently Written

Task 1 and bullet point 5 of Task 2 in the National Academy of Science ("NAS") proposal are neither suitable nor appropriate. These tasks attempt to make a comparison that is too broad in nature to provide definitive conclusions on inherently safer chemical processes.

The refining and petrochemical industries continue to develop advanced technologies and processes that reduce risks associated with handling hazardous chemicals. It is not appropriate to describe certain technologies or chemicals as inherently safer than an alternate with no further description and consideration of site specific attributes. In fact, no valid methods have been developed in the chemical engineering discipline to even make such a comparison.

Inherently safer technology ("IST") and design are operation and site specific evaluations and decisions. A technology or chemical can only be described as inherently safer than a different technology or chemical when all hazards and exposures associated with a specific site operation are considered including logistics, location and the potentially affected population. In addition to hazards, location, surrounding population, and both technical and economic feasibility must be considered. These elements are operation specific. Public Law 111-88, 123 Stat. 2949 provides that for the NAS study to be appropriate, it must focus solely on options to eliminate or reduce the risks associated with the storage and use of MIC at the Bayer CropScience Institute Site.

Task 1 of the study is not feasible if extended beyond the evaluation of the Bayer Crop Science Institute site. IST assessments, life-cycle benefits, and risks from the adoption of inherently safer technologies can only be done on a per site and per process basis. Broad generalization is not applicable in an individual IST decision because there are no valid methods with which to quantify or compare different processes in such a wide-ranging manner. Economic evaluation methods vary for each industry, company, locations, and site and therefore cannot be calculated with a generic equation. The original language in the congressional appropriations public law reflects the true intent of the study and the only feasible study the NAS can realistically perform given that IST is a conceptual and philosophical approach to engineering. The scope states that the NAS will examine the use and storage of MIC to include the feasibility of alternative chemicals use or processes and an examination of the cost of these alternatives specifically at

the Bayer CropScience facility. The NAS does not have the information required to develop comprehensive conclusions for a chemical or a process beyond the Institute site.

Specific IST standards and metrics cannot be adopted industry wide, since there is no valid way to determine whether one process at a particular site is inherently safer than a process at a different site. NPRA and API recommend that the NAS scope of work remain focused on the Congressional mandate of the MIC use and storage at the Bayer CropScience facility in Institute, West Virginia.

The NAS Should Make Better Use of Current and Previous Work on IST

Inherently Safer Technology is not a new concept. Use of the term IST began in the process industries in the 1970s. There has been extensive work and research conducted by several organizations and academia on the best practices approach to IST. Most recently the Department of Homeland Security's Chemical Security Analysis Center ("CSAC") engaged the Center for Chemical Process Safety (CCPS) to create a definition of IST for use by the agency. The CSAC requested CCPS participate in its process due to the Center's extensive experience with IST. For example, in 2009, CCPS published the second edition of its book, *Inherently Safer Chemical Processes: A Life Cycle Approach.* This publication is based on more than 40 years of research and examination of the IST concept. Accordingly, NPRA and API recommend that CSB utilize the definition of IST in development by CSAC and that Task #1 associated with the development of an alternate definition of IST be excluded from the NAS scope of work.

A Study of Chemical Alternatives will be Problematic

This same logic applies to the CSB statement proposing to examine potential alternatives to other chemicals used in industry, specifically hydrogen fluoride and chlorine. Risk reduction decisions must consider all hazards and potential exposures as well as potentially conflicting goals and impacts. Other factors that must be considered are economics, resource allocation (including capital, research and development resources, operating costs), feasibility, reliability, and the effectiveness of other process risk management features (passive, active, procedural). These considerations may result in different options for specific situations for a given technology or chemical. In unique environments, hazards and other factors may be different which would lead to alternate choices about the appropriate technology or chemical. Therefore, any conclusions for specific chemical alternatives in terms of IST are unattainable considering the study's limitations of specific site characteristics. This may result in the transfer of risk to other locations and an overall increase of risk.

NPRA and API members are concerned that broad generalized statements on IST could have a detrimental impact if applied generically to industry. IST specialists, scientists and academia all agree that IST can only be performed with consideration of all hazards and risks, both of which vary significantly site by site.

Suggested Panelists and Expertise
The following individuals are suggested for their technical expertise on the issue of IST:

- Iclal Atay, Bureau Chief, NJDEP/BRP at NJ Dept of Environmental Protection, iclal.atay@dep.state.nj.us, (609) 633-6187

- Dennis Hendershot, Staff Consultant, AIChE, Center for Chemical Process Safety, Allentown, PA,dennis.hendershot@gmail.com, (610) 419-4780

- All appropriate technical and economic experts with understanding of the Bayer CropScience manufacturing process.

Suggested Changes Will Result in a Feasible Study Scope

NPRA and API support the CSB recommendation to study the use and storage of MIC and potential alternative processes or chemicals at the Bayer CropScience facility. The expanded scope proposed by the National Academy of Science goes beyond the Congressional mandate, and is not feasible if the analysis goes beyond the recommendation to study MIC use and storage at the Bayer CropScience facility in Institute, West Virginia.

We appreciate the opportunity to provide comments on the Proposed National Academy of Sciences Study Scope**.** If you have any questions please contact Lara Swett, NPRA Safety & Health Director, at 202-457-0480 or Ron Chittim, API Senior Policy Advisor at 202-682-8176 (Chittim@api.org).

Sincerely,

Lara Swett
Director, Health and Safety
NPRA

VIA ELECTRONIC FILE

May 10, 2010

Chemical Safety and Hazard Investigation Board
Office of Congressional, Public and Board Affairs
Attn: D. Horowitz
2175 K Street, NW
Suite 650
Washington, DC 20037

RE: Docket No. CSB-10-01
National Academy of Sciences Study
Comments of the American Chemistry Council

Dear Sir or Madam:

The American Chemistry Council (ACC) is pleased to provide comments to the Chemical Safety & Hazard Investigation Board (CSB) on the Board's proposed approach for the National Academy of Sciences (NAS) Study of the use and storage of methylisocyanate (MIC) at the Bayer Crop Science (BCS) facility in Institute, West Virginia.[1] ACC believes that no further work is required for completion of Task 1 and that the final deliverable under this task – a best practices guidance document - is unnecessary. Rather, NAS should study and use existing information related to Task 1 to complete Task 2 so that their focus remains solely on the mandated scope of the Study.[2] The basis for this recommendation is provided in our comments below.

ACC represents the leading companies engaged in the business of chemistry. ACC members apply the science of chemistry to make innovative products and services that make people's lives better, healthier and safer. ACC is committed to improved environmental, health and safety performance through Responsible Care®, common sense advocacy designed to address major public policy issues, and health and environmental research and product testing. The business of chemistry is a $689 billion enterprise and a key element of the nation's economy. It

[1] 75 Fed. Reg. 21223 *et seq.*
[2] Public Law 111-88: The Department of the Interior, Environment and Related Agencies Appropriations Act, 2010.

is one of the nation's largest exporters, accounting for ten cents out of every dollar in U.S. exports.

Safety and security have always been primary concerns of ACC members, and they have intensified their efforts, working closely with government agencies to improve security and to defend against any threat to the nation's critical infrastructure. These efforts have included stakeholder collaboration on defining inherently safer chemical processes, which CSB has identified as the first study task.

ACC appreciates the opportunity to comment on this proposed NAS Study. We look forward to future dialogue with CSB on the important IST issues discussed therein. Please contact me if you have any questions about our comments. I can be reached by phone at (703) 741-5247 or by e-mail at laurie_miller@americanchemistry.com.

Sincerely,

Laurie A. Miller

Director
Regulatory and Technical Affairs

Attachment

May 10, 2010
Comments of the
American Chemistry Council
On the Chemical Safety & Hazard Investigation Board
National Academy of Sciences Study

1. *Does the proposed Task Statement include the appropriate topics for consideration by the NAS? Are there any additional general or specific topics the NAS panel will need to consider in order to reach a satisfactory answer on the feasibility and costs of reducing the use and storage of MIC?*

ACC believes that no further work is required for completion of Task 1 and that the final deliverable under this task – a best practices guidance document - is unnecessary regardless. CSB should use the body of work that already exists or is underway about the definition of inherently safer technology (IST) and methods to evaluate IST alternatives. Rather, NAS should study and use the existing body of available work on IST to complete Task 2 so that their focus remains solely on the mandated scope of the Study. A complete risk analysis that includes IST as well as other risk reduction options should be included in the scope of work for NAS. The risk analysis should focus on the risk to the BCS operations and the potentially affected citizens and environment of the Kanawha Valley.

The objective of Task 1 appears to be to generalize the technical and cost aspects of IST assessments and translate these generalizations into a best practices guidance document to carry out Task 2 and possibly other chemical-specific IST evaluations. We believe that this goal is inappropriate. IST decisions are highly dependent upon extrinsic factors, such as location relative to population centers, end-user requirements such as ISO standards, GMP and FDA requirements, among others. To make recommendations based on the type of guidance that appears to be the objective of Task 1 could have unintended consequences regarding important factors such as product viability and whether risk is actually reduced or simply shifted elsewhere by implementing a particular IST alternative. Thus, we do not believe the development of the deliverables identified in Task 1 is either necessary or useful.

Should NAS identify gaps in the existing information or methodologies discussed in Task 1, we believe that the CSB should consult with process safety experts with relevant experience in assessment and implementation of IST concepts in order to develop recommendations on how to fill these gaps. Additionally, whether additional tasks are needed to conduct the Study would at this point be speculation, due to the myriad factors that must be considered in IST evaluations. NAS may find through their research of existing information on IST that additional tasks may be necessary to specifically address MIC.

Regarding the definition of IST, ACC recommends that CSB leverage the extensive work already completed or underway to define IST to achieve its mission. Process safety experts and other stakeholders have worked through the Center for Chemical Process Safety (CCPS),

academia and other credible organizations to define IST.[3] Additionally, work is currently being done by CCPS at the Federal Government's request to define IST more broadly to span the full lifecycle of the chemical manufacturing process including manufacturing and use, storage and transportation.[4] We have been made aware through the Chemical Sector Coordinating Council that related research is also being done by the Federal Government to develop metrics to quantify the potential impact of IST changes on process safety and security throughout the chemical manufacturing supply chain. CSB should wait until the metrics generated from this research are completed to determine if they will be useful.

Finally, we believe the charge under Task 1 to examine the impact of existing state and local regulatory programs which seek to promote inherently safer processes, would be ineffective in helping CSB carry out Congress' request. Such programs out of necessity attempt to simplify the complex nature of IST evaluations, have limited scope when it comes to analysis of site-specific conditions, and are more general overall; therefore they are not an effective tool in this context.

2. *If funds are available, should the CSB initiate a second, related study to consider the feasibility, costs, and benefits of inherently safer alternatives to other chemicals? For example, should a study consider alternatives to the use of hydrogen fluoride in refinery alkylation processes and/or to the use of chlorine in water treatment? What other chemicals or processes should be considered if a second study is undertaken?*

Based on our comments on question 1 above, we believe that funds that Congress provided to CSB are intended only to address Task 2. While Task 2 addresses specific processes at a single facility, the discussion of a potential "second, related study" suggests CSB is interested in evaluating chemicals and processes across a range of facilities. For example, chlorine gas is used by tens of thousands of water treatment facilities in the U.S. For any type of process, the feasibility, costs and benefits of using alternative chemicals depend on many site-specific factors. A broad, generalized study on one or more chemical processes would have little practical value for decisions regarding individual facilities.

3. *What kinds of backgrounds and expertise should be represented on the NAS panel?*

   The NAS panel should consist of chemical manufacturing experts that have extensive background in both evaluating and implementing IST concepts and approaches.

[3] CCPS Publication ISBN 978-0471-77892-9; Inherently Safer Chemical Processes – A Life Cycle Approach (2009).
[4] (Source: http://www.aiche.org/Conferences/Specialty/GCPS/IST.aspx).

4. *Is the proposed timetable appropriate?*

   We believe that one year would be sufficient for conducting Task 2. This work would involve studying and using the existing definition, and technical and cost feasibility aspects of Task 1, but without Task 1 deliverables.

Comments of the
United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union
AFL-CIO.CLC
on the
Proposed National Academy of Sciences Study
U.S. Chemical Safety and Hazard Investigation Board
Docket CSB-10-1
May 10, 2010

The United Steelworkers Union strongly supports the study proposed by the CSB in its April 23 *Federal Register* notice. However, as we explain below, we believe the scope of the study should be expanded beyond an examination of the use and storage of methyl isocyanate to a more general examination of inherently safer technologies, centered on a number of case studies.

The USW represents 850,000 North American workers in a large variety of industries, many of whom make or use large quantities of hazardous chemicals on the job. Specifically, the USW is the predominant union in oil refining, chemicals, metals, paper and rubber. USW members have been killed and injured in many of the catastrophic accidents investigated by the CSB, most recently the April 2 explosion and fire which killed seven workers at the Tesoro refinery in Anacortes, Washington. Our members and their families are exposed to the risk of such accidents, both as employees of potentially dangerous enterprises and as residents of the surrounding communities. And as a union with a strong environmental program, we are deeply concerned with risks to the public in general. We believe that many of those risks could be eliminated or greatly mitigated through the wider adoption of inherently safer technology (IST). We therefore welcome the proposed National Academy of Sciences study.

The proposal as written is limited to a general study of inherently safer technology, and a specific study of the storage and use of methyl isocyanate. The author of these comments has seen first hand the impact of a major release of MIC. I was part of an international team which traveled to Bhopal, India after the December 2-3, 1984 release of MIC from a Union Carbide pesticides plant, which killed thousands and continues to kill from the long-term effects of the respiratory injuries suffered that night. We interviewed hundreds of workers and residents who survived the release, and published our findings in *The Trade Union Report on Bhopal* (International Confederation of Free Trade Unions and International Chemical, Energy and General Workers Federation, Geneva, 1985).

The tragedy was compounded by the fact that large scale storage of MIC is unnecessary. MIC is a chemical intermediate, primarily used to make carbamate pesticides. It could have been synthesized in small quantities for immediate use. Instead, Union Carbide chose to make and store it in large quantities to be used at the company's convenience. In fact, DuPont currently uses a process which largely eliminates storage of MIC in its LaPorte, Texas plant (*http://www.scienceblog.com/community/older/2003/C/2003411.html*).

Unfortunately, Bayer Crop Science chose the high storage route for its Institute, West Virginia plant. As a result – and as the CSB has documented – the August 28, 2008 explosion and fire in that facility could have released almost 14,000 pounds of MIC. Bayer has announced plans to eliminate aboveground storage of MIC, but intends to continue to store up to 40,000 pounds underground. This reduces the risk of an airborne release due to a breached tank, but not the risk of a runaway reaction in the tank or a release from an aboveground unit connected to the tank. Underground storage would not have prevented the Bhopal release.

For those reasons, the USW supports the proposed study. The review of IST specified as the first Task in the *Federal Register* notice is entirely appropriate. The examination of MIC use and storage that is the subject of the second Task is also appropriate, but it should be slightly expanded. According to several online documents (most notably the Wikipedia article on MIC) the chemical has been used in the formulation of some rubber and adhesive products. It is not clear whether these uses are current, or whether MIC has been replaced by safer substitutes in all such processes. Either way, an investigation of other uses would be useful.

In the questions for public comment, the *Federal Register* notice asks whether a second case study is warrented. The USW urges the CSB to include at least one additional study and, if possible, several. A single case study is simply not sufficient to adequately explore the issue of IST. The additional studies should be included even if they cannot be completed to the same level of detail as the MIC study.

Three studies in particular should be considered. Perhaps the single most dangerous operation in all of American industry is the use of hydrogen fluoride in oil refinery alkylation. There are two alternatives currently in use – sulfuric acid and hydrogen fluoride modified by an agent that raises its boiling point. Both have their hazards. Solid acid catalysis appears to be a much safer alternative (Mukherjee et. al., *Oil and Gas Journal*, November 9, 2009, pp. 1-9). However, no refinery in the United States has installed a solid acid catalyst alkylation unit. Far more people are at risk from hydrogen fluoride than from methyl isocyanate. Although the CSB's appropriation includes language specifying the MIC study, a hydrogen fluoride study could be even more important.

Two additional studies would also be instructive. Both involve the use of chlorine and chlorine compounds. Chlorine gas is widely used as a disinfectant in municipal water systems. Chlorine is typically stored in large quantities on site. Liquified chlorine also presents a threat in transport, typically by railcar. Chlorine and chlorine dioxide are also used in the paper industry as bleaching agents. A study by the USW of 78 unionized paper mills (scheduled for publication later this year) found that 19 use elemental chlorine and 38 use chlorine dioxide in large enough quantities that their storage exceeds the OSHA Process Safety Management thresholds of 1500 lbs and 1000 lbs respectively. A 2007 study of worst-case scenarios in 74 paper industry Risk Management Plans submitted to EPA found an average of 77,000 people in each vulnerability zone (Fidis, *Pulp Fiction: Chemical Hazard Reduction at Pulp and Paper Mills*, U.S. PIRG Education Fund, Washington, 2007). Safer alternatives exist, both for municipal water systems and for pulp and paper bleaching. The NAS study could be critical in determining why they have not been more widely adopted.

Of course other case studies could also be included. Possibilities include the use of phosgene and boron trifluoride in manufacturing a variety of products.

To summarize, the USW strongly supports the proposed study of inherently safer technologies with the methyl isocyanate case study. We believe that at least one, and preferably several case studies should be included. As the representative of workers in many of the relevant industries, we would be happy to cooperate in any way we can.

Respectfully submitted,

Michael J. Wright
Director of Health, Safety and Environment
United Steelworkers

May 10, 2010

Chemical Safety and Hazard Investigation Board
Office of Congressional, Public, and Board Affairs
Attn: Dr. Daniel Horowitz
2175 K Street, NW., Suite 650
Washington, DC 20037
Via electronic comments: <*nascomments@csb.gov*>

Re: Comments to CSB–10–01 on CSB funding for a Study by the National Academy of Sciences to examine the use and storage of methyl isocyanate

Attention Chairman John S. Bresland:

The proposed study by the National Academy of Sciences (NAS) to examine the use and storage of methyl isocyanate needs to be expanded to include an evaluation of inherently safer technology alternatives to the deadly catalytic chemical hydrogen fluoride (HF) that is still being widely used in the U.S. oil refining sector in the alkylation units to produce high octane gasoline products. The catalyst HF may pose an even greater hazard to American communities than the use of methyl isocyanate.

The lives of millions of people are at risk who are living in downwind kill zones near local refineries and populated downwind neighborhoods several miles away, since so many large oil refineries continue to use the deadly catalyst HF. Recent accidents at refineries (Citgo's East Corpus Christi refinery on July 19, 2009) in the last two years where HF was released and workers injured highlight the critical need for the Chemical Safety and Hazard Investigation Board to add HF to the upcoming NAS study.

The expanded NAS study is needed because of serious risk concerns about the potential for an airborne release of the HF chemical, which is highly toxic by inhalation and could adversely impact the health and safety of workers and the public in 51 refinery communities located in 20 states. These HF refineries are located in several large urban areas like Los Angeles, Houston, Chicago, Philadelphia, Salt Lake City, Corpus Christi, and others.

At least 51 U.S. oil refineries or about 1/3 of existing refineries are still using the deadly catalyst hydrofluoric acid or HF.

List below has been compiled from the U.S. EPA's 2007 TRI data where HF is reported by oil refineries, and one plant was added, the Citgo Oil's Corpus Christi East refinery,

since it does not file HF release reports most years with the U.S. EPA.

Company Facility - Plant - County or Parish or County Equivalent - State

1. EXXONMOBIL OIL CORP - TORRANCE REFINERY, LOS ANGELES, CA.
2. ULTRAMAR INC. WILMINGTON REFINERY, LOS ANGELES, CA.
3. EXXONMOBIL OIL CORP JOLIET REFINERY, WILL, IL.
4. PDV MIDWEST REFINING L.L.C. LEMONT REFINERY, WILL, IL.
5. MARATHON ASHLAND PETROLEUM LLC, ILLINOIS REFINING DIV, CRAWFORD, IL.
6. COUNTRYMARK REFINERY, POSEY, IN.
7. FRONTIER EL DORADO REFINING CO, BUTLER, KS.
8. COFFEYVILLE RESOURCES REFINING & MARKETING, MONTGOMERY, KS.
9. NATIONAL CO-OP REFINERY ASSOC., MCPHERSON, KS.
10. CATLETTSBURG REFINING LLC, BOYD, KY.
11. MURPHY OIL USA INC MERAUX REFINERY, ST BERNARD, LA.
12. MARATHON PETROLEUM CORP, GARYVILLE, ST JOHN THE BAPTIST, LA.
13. PLACID REFINING CO L.L.C., WEST BATON ROUGE, LA.
14. CHALMETTE REFINING LLC, ST BERNARD, LA.
15. CONOCOPHILLIPS CO - ALLIANCE REFINERY, PLAQUEMINES, LA.
16. MARATHON PETROLEUM CO LLC SAINT PAUL PARK REFINERY, WASHINGTON, MN.
17. EXXONMOBIL BILLINGS REFINERY, YELLOWSTONE, MT.
18. CHS INC. LAUREL REFINERY, YELLOWSTONE, MT.
19. CONOCOPHILLIPS CO BILLINGS REFINERY, YELLOWSTONE, MT.
20. MONTANA REFINING CO INC., CASCADE, MT.
21. TESORO REFINING & MARKETING CO - MANDAN REFINERY, MORTON, ND.
22. VALERO REFINING CO - NEW JERSEY, GLOUCESTER, NJ.
23. NAVAJO REFINING CO, EDDY, NM.
24. WESTERN REFINING SOUTHWEST INC - GALLUP REFINERY, MCKINLEY, NM.
25. MARATHON PETROLEUM CO LLC OHIO REFINING DIV, STARK, OH.
26. CONOCOPHILLIPS PONCA CITY REFINERY, KAY, OK.
27. VALERO REFINING CO - OKLAHOMA VALERO, ARDMORE REFINERY, CARTER, OK.
28. WYNNEWOOD REFINING CO, GARVIN, OK.
29. SUNOCO, INC. (R&M) PHILADELPHIA REFINERY, PHILADELPHIA, PA.
30. CONOCOPHILLIPS CO. - TRAINER REFINERY, DELAWARE, PA.
31. VALERO REFINING CO TENNESSEE LLC, SHELBY, TN.
32. CONOCOPHILLLIPS CO BORGER REFINERY, HUTCHINSON, TX.
33. VALERO THREE RIVERS REFINERY, LIVE OAK, TX.
34. BP PRODUCTS NORTH AMERICA INC, TEXAS CITY REFINERY, GALVESTON, TX.
35. VALERO REFINING - TEXAS L.P., GALVESTON, TX.

36. VALERO REFINING - TEXAS LP, CORPUS CHRISTI WEST PLANT, NUECES, TX.
37. FLINT HILLS RESOURCES LP - WEST PLANT, NUECES, TX
38. PASADENA REFINING SYSTEM,INC, HARRIS, TX.
39. ALON USA - BIG SPRING REFINERY, HOWARD, TX.
40. MARATHON PETROLEUM CO LLC, GALVESTON, TX.
41. VALERO REFINING TEXAS LP CORPUS CHRISTI EAST PLANT, NUECES, TX.
42. CONOCOPHILLIPS CO, SWEENY REFINERY COMPLEX, BRAZORIA, TX.
43. PREMCOR REFINING GROUP INC PORT ARTHUR, JEFFERSON, TX.
44. CITGO, CORPUS CHRISTI EAST REFINERY, NUECES, TX.
45. CHEVRON PRODUCTS CO, SALT LAKE REFINERY, SALT LAKE, UT.
46. BIG WEST OIL LLC, DAVIS, UT.
47. HOLLY REFINING & MARKETING CO, WOODS CROSS REFINERY, DAVIS, UT.
48. CONOCOPHILLIPS, FERNDALE REFINERY, WHATCOM, WA.
49. MURPHY OIL USA INC, DOUGLAS, WI.
50. WYOMING REFINING CO, WESTON, WY.
51. FRONTIER REFINING, CHEYENNE REFINERY, LARAMIE, WY.

States with oil refineries using HF include the following twenty states with 51major oil refineries.

13 - TEXAS
5 - LOUISIANA
4 - MONTANA
3 - UTAH
3 - OKLAHOMA
3 - ILLINOIS
3 - KANSAS
2 - WYOMING
2 - CALIFORNIA
2 - NEW MEXICO
2 - PENNSYLVANIA
1 - INDIANA
1 - KENTUCKY
1 - NEW JERSEY
1 - MINNESOTA
1 - OHIO
1 - NORTH DAKOTA
1 - WASHINGTON
1 - WISCONSIN
1 - TENNESSEE

Please consider expanding and adding the deadly catalytic chemical hydrogen fluoride to the proposed study by the National Academy of Sciences to examine the use and storage of methyl isocyanate. The NAS study needs to include an evaluation of safer alternatives to the deadly catalytic chemical hydrogen fluoride that is widely used in the U.S. oil refining sector in urban areas where millions of people live.

Sincerely yours,

Neil J. Carman, Ph.D.
Clean air program director
Sierra Club Lone Star Chapter
1202 San Antonio
Austin, Texas 78701
512-472-1767

.

May 10, 2010

Attn: Daniel Horowitz
Chemical Safety and Hazard Investigation Board
Office of Congressional, Public, and Board Affairs
2175 K Street, NW, Suite 650
Washington, DC 20037

Re: Docket Number CSB-10-01

The U.S. Chemical Safety and Hazard Investigation Board is requesting comments on a report by the National Academy of Sciences (NAS) to examine the use and storage of methyl isocyanate (MIC), including the feasibility of implementing alternative chemicals or processes and the cost of alternatives at the Bayer CropScience facility in Institute, West Virginia.

More than 25 years after the preventable tragedy at Bayer's sister facility in Bhopal, India, systematic study of specific options is still needed and overdue. By proposing to reduce MIC storage 80 percent, Bayer already demonstrates that safer and more secure alternatives are feasible. However, an 80 percent reduction would still leave a Bhopal-scale hazard amount of MIC stored on-site.

The NAS study should seek to identify alternatives that further substantially reduce or eliminate the possibility of an off-site MIC release. In addition, the task statement for the report should specifically direct NAS to also address the following:

- Economic valuation methods should include not only costs, but also savings and avoided costs (including both actual and potential liabilities).
- Economic valuation methods should include not only safety but also security costs, savings, and avoided costs, which are undeniably part of today's operating environment.
- Economic valuation methods should include the potential consequences of a worst-case chemical release scenario.
- The study should address the completeness and availability of relevant information about practices already in use at other facilities.

Additional studies of safer and more secure alternatives for other chemicals and processes are warranted in certain circumstances. For example, Bayer CropScience stores large amounts of phosgene and chlorine gas in addition to MIC at its West Virginia facility. However, such additional studies should focus on chemicals and processes for which alternatives are not already in use or fully developed.

CSB should initiate a review of hydrofluoric acid used at petroleum refineries. A refinery study should assess the potential to commercialize solid acid catalyst methods of alkylation, and should take into account the potential harm of a worst-case release, including from modified hydrofluoric acid (which remain quite dangerous to employees and surrounding communities).

The following survey reports identify safer and more secure chemicals and processes that are in at U.S. chemical facilities across more than 20 industries:

Preventing Toxic Terrorism: How Some Chemical Facilities Are Removing Danger to American Communities identifies 284 facilities that switched to safer and more secure technologies – while frequently saving money.

Toxic Trains and the Terrorist Threat: How Water Utilities Can Get Chlorine Gas Off the Rails and Out of American Communities identifies two-dozen large water utilities that eliminated chlorine gas railcars for less than the cost of a bag of potato chips per customer per year.

Chemical Security 101: What You Don't Have Can't Leak, Or Be Blown Up by Terrorists identifies options to eliminate a catastrophic chemical release danger from most of the nation's 101 highest hazard chemical sites.

These industries include:

- Bleach manufacturers eliminate bulk chlorine gas by generating chlorine "just in time" on-site as needed without storage.
- Petroleum refineries eliminate hydrofluoric acid alkylation by using less hazardous sulfuric acid or by developing solid acid catalysts.
- Water utilities eliminate bulk chlorine gas by using liquid bleach, ozone without storage, and ultraviolet light as appropriate.
- Paper mills eliminate bulk chlorine gas by using hydrogen peroxide, ozone, or chlorine dioxide without bulk storage.
- Pool service companies eliminate chlorine gas by using chlorine tabs or liquid bleach.
- Manufacturers of polyurethane foams eliminate bulk ethylene oxide by substituting vegetable-based polyols.
- Soap and detergent manufacturers eliminate bulk oleum and sulfur trioxide by using sulfur burning equipment on-site.
- Manufacturers of ferric chloride eliminate bulk chlorine gas by processing scrap steel with less concentrated liquid hydrochloric acid (less than 37 percent) and oxygen.

- Titanium dioxide producers eliminate bulk chlorine gas by generating chlorine on-site as needed without storage or using the sulfate process.
- Secondary aluminum smelters eliminate bulk chlorine gas by removing impurities with nitrogen gas injected with magnesium salts.
- Manufacturers of semiconductors, silicon wafers, and metal products eliminate concentrated hydrofluoric acid by using less concentrated forms (less than 50 percent).
- Power plants eliminate bulk anhydrous ammonia gas by using cleaner combustion or by using aqueous ammonia or urea in pollution control equipment; they also remove chlorine gas by using liquid bleach to treat cooling water.
- Wholesale chemical distributors eliminate most bulk chlorine gas and sulfur dioxide gas by distributing alternatives such as liquid bleach and sodium bisulfite.
- Pulp mills, food processors, wastewater plants, and hazardous waste recovery operations eliminate bulk sulfur dioxide gas by, as appropriate, generating sulfur compounds on-site or purchasing sodium bisulfite, metabisulfite, hydrosulfite, or other alternatives.
- Diverse manufacturers eliminate bulk chlorine gas by generating chlorine on-site as needed, such as for fuel additives, water treatment chemicals, and aramid polymers used to make bulletproof vests.

Respectfully submitted,

Paul Orum
PO Box 15465
Washington, DC 20003

Bibliography and Quotations

Amnesty International:

Clouds of Injustice: Bhopal Disaster 20 Years On
November 29, 2004
http://www.amnesty.org/en/library/asset/ASA20/015/2004/en/dom-ASA200152004en.html

"Ensuring public participation and transparency in decisions relating to the location, operational safety and waste disposal of industries using hazardous materials and technology is an essential step to heighten risk awareness and responsible behavior as well as to ensure better preparedness to prevent and deal with disasters like Bhopal."
p.6

In the Bhopal disaster "At least half a million people had been exposed to the toxic fumes."
p.10

Argonne National Laboratory

A National Risk Assessment for Selected Hazardous Materials Transportation
December 2000
http://projects.battelle.org/trbhazmat/Presentations/TRB2001-002217.doc

"…Releases of toxic chemicals can kill and injure people located relatively far from the accident…As a result, failure to identify and evaluate opportunities to reduce the risks from these types of relatively rare accidents could ultimately lead to thousands of fatalities, injuries, and evacuations."

Association of American Railroads
February 27, 2008

"It's time for the big chemical companies to do their part to help protect America. They should stop manufacturing dangerous chemicals when safer substitutes are available. And if they won't do it, Congress should do it for them in the Chemical Facility Anti-Terrorism Act of 2008."

The Brookings Institute:

Protecting the American Homeland; A Preliminary Analysis
2003
http://www.brookings.edu/press/Books/2003/protectingtheamericanhomelandoneyearon.aspx

Brookings estimate that a "successful attack on [a]… chemical plant [could result in] 10,000 fatalities." This estimate is modest.
p.6

"Prevention must be the highest priority (since it stops all attacks, large and small)."
p.8

"In most cases, government intervention should take the form of mandates on the private sector rather than through direct subsidies or tax incentives."
p.10

"…Preventive measures are likely to be particularly effective because they tend to reduce overall levels of risk, rather than just shifting it from one target to another."
p.35-6

"Shipping by rail poses certain concerns… Chlorine, for example, a toxic chemical that can enhance the combustion of other substances, is often stored and shipped in 90-ton rail tank cars. A release of 90 tons of chlorine could affect populations up to 14 miles away"
p.46

"Security at many chemical facilities has not been sufficient, as demonstrated even before September 11 by environmentalists from Greenpeace."
p.47

Center for American Progress:

Chemical Security 101
November 2008
http://www.americanprogress.org/issues/2008/11/chemical_security.html

"The only certain way to protect our communities is to remove the possibility of a toxic gas release by converting facilities to safer, more secure alternative technologies. This report identifies opportunities for conversions at the 101 most dangerous facilities, each of which threaten roughly 1 million people or more in surrounding areas. The chemicals most often posing the greatest danger at the top 101 facilities are chlorine—almost always in railcars—followed by hydrofluoric acid and sulfur chemicals.
p.1

"One insurance study found that a major chlorine rail spill in an urban area could cause 10,200 fatalities and over $7 billion in damages."
p.6

Toxic Trains and the Terrorist Threat
April 2, 2007
http://www.americanprogress.org/issues/2007/04/chemical_security_report.html

"Cost was a frequently cited reason for not converting. But the survey found such conversions are affordable even at large facilities, costing no more than $1.50 per person served each year--or the price of a bag of potato chips."
p.2

"Put another way, a single day's expenditures on the war in Iraq could cover construction costs of converting the remaining U.S. water utilities off chlorine gas railcars."
p.2

"A comprehensive solution can only come from the federal level. In fact, judges in the ongoing litigation over rerouting in Washington, D.C., have encouraged the Bush administration to develop a national strategy to address the security and safety dangers involved in the manufacture, use, and transportation of chlorine gas and other hazardous chemicals."
p.2

"A RAND Corp. database of worldwide terrorist incidents recorded over 250 attacks against rail targets from 1995 to 2005. Insurgents in Iraq have recently targeted trucks carrying chlorine gas with several deliberate attacks."
p.5

"Some facilities, however, identified important savings in preventative maintenance, emergency planning, employee training, regulatory compliance, future site security, and other factors.
p.10

"After all, there is little reason to believe that current security practices would be able to withstand a well-executed attack by an armed intruder. Nor does enhanced physical security do anything to protect railcars in transit to the facility."
p.10

"...Recently enacted interim chemical security legislation exempts water utilities, neglects transportation hazards, and ignores safer technologies. Millions of Americans remain unnecessarily at risk from a catastrophic chemical release."
p.14

"To address this threat, Congress, the administration, and industry must make chemical security an urgent national priority, with the goal of transitioning to safer, more secure technologies."
p.14

Preventing Toxic Terrorism: How Some Chemical Facilities are Removing Danger to American Communities
April 2006
http://www.crtk.org/library_files/ChemicalSurvey.pdf

Of the 238 chemical facilities that have already transitioned to safer chemicals or technologies, "of respondents that provided cost estimates, roughly half reported spending less than $100,000 to switch to safer alternatives and few spend over $1 million."
p.3

"Facilities cut a variety of costs and regulatory burdens by switching to less hazardous chemicals or processes. These facilities need fewer physical security and safety measures and can better focus on producing valuable products and services"
p.3

"Unfortunately, more than four years after the 9/11 terrorist attacks, the White House and Congress have failed to act. Currently, no federal law or regulation requires hazardous chemical facilities to review or use readily available alternatives. "
p.4

"Many chemical facilities have already taken this step thereby protecting millions of Americans. Millions more could be taken out of harm's way within a concerted national effort to convert other high-risk facilities to safer chemicals and processes."
p.4

"Numerous federal agencies and other observers have warned that terrorists could turn hazardous chemical facilities into improvised weapons of mass destruction. These agencies include the Department of Homeland Security, Department of Justice, Government Accountability Office, Environmental Protection Agency, Agency for Toxic Substances and Disease Registry, Army Surgeon General, and Naval Research Laboratory, among others."
p.6

"Some 284 respondents in 47 states reported they had switched to less acutely hazardous chemicals or processes or moved to safer locations. As a result, more than 38 million Americans no longer live under the threat of a harmful toxic gas release from these facilities."
p.7

"...Approximately 1,150 wastewater facilities and 1,700 drinking water plants remain in the RMP program for extremely hazardous chemicals, primarily chlorine gas."
p.10

"Ultraviolet light and other options such as ozone are more effective than chlorine against certain biological agents such as anthrax that could contaminate drinking water."
p.11

"Some 18 manufacturing facilities reported process changes that reduced the danger of an off-site gas release...These manufactures represent diverse industries and made an array of changes... Notably, the majority of these facilities reported neutral costs or anticipated cost savings from their changes."
p.12

"A catastrophic chemical release at just one of the nation's most dangerous facilities could kill, injure or sicken tens of thousands. Adopting less acutely hazardous chemicals or processes is the only *certain* way to protect the public from a toxic gas cloud."
p.20

"Many facilities achieved significant safety and security improvements... Nonetheless, many other facilities that could make similar improvements remain potential terrorist targets. Accordingly, the chemical industry and government should make conversion of high-hazard facilities to safer available technologies a national strategic priority."
p.20

Charles River Associates

"Assessment of the Economic Benefits of Chlor-Alkali Chemicals to the United States and Canadian Economies"
April 1993
http://yosemite.epa.gov/ee/epalib/eelib.nsf/73bc8d7fb6d3644385256a290076d16f/56978f7fc30046d3852566b70051f917!OpenDocument

"…Any situation where chlorine-dependent processes or chlorine-containing compounds create unacceptable health and environmental risks should be corrected."
p.1

"At some cost, alternatives exist for *all* uses of chlorine and chlorine-derived compounds."
p.5

Chemical and Engineering News

"Simply Safer," by Jeff Johnson
February 3, 2003
http://pubs.acs.org/cen/government/8105/8105gov1.html

"Coined 'inherently safer design' by British chemical engineer Trevor Kletz in the late 1970s, the concept seems simple: It is better to design processes that eliminate chemical plant hazards at the beginning than to engineer 'add-on' technologies later to try to control them."
p.1/9

“Kletz, who is retired after 38 years with ICI [Imperial Chemical Industries], puts it like this, ‘The very best way to prevent an explosion is to simply replace the material that explodes with one that does not or at least keep the stock down so low that it hardly matters if it all leaks out.’”
p.1/9

The concept was seized upon during the terrorism debate as a hazard reduction solution with safety benefits…”
p.1/9

“In the end, the result [of ISTs] could be a new world of smaller and highly efficient chemical plants.”
p. 4/9

“[Trevor] Kletz, [Dennis C.] Hendershot, and others with long time chemical industry experience say industry, academia, and government should do much more to encourage the spread of what may ultimately be the safest, cheapest way to make chemicals.”
p. 4-5/9

“’In many companies, the gut reaction to an accident is to reroute procedures,’ he [Kletz] says. ‘They are starting at the wrong end of the hierarchy.’”
p. 9/9

“’There are far, far more opportunities for inherently safer designs than we are making use of today,’” Kletz adds.”
p. 9/9

The Chlorine Institute:

Estimating the Area Affected by a Chlorine Release—Pamphlet 74
February 2006
http://www.chlorineinstitute.org/Bookstore/ProductDetail.cfm?ItemNumber=2303

"90-Ton Rail Tank Car

- Total mass release = 180,000 pounds
- 10 minute release
- 300 pounds/second steady rate release
- Release occurs on concrete surface
- Maximum downwind distance to 3ppm = 41.5 miles
- Maximum crosswind distance to 3ppm = 2.3 miles
- Maximum downwind distance to 20ppm = 14.8 miles
- Maximum crosswind distance to 20ppm =1.9 miles" “Even a 150 lb cylinder could be catastrophic for over 1.5 miles.”

p.20

“Even a 150 lb cylinder could be catastrophic for over 1.5 miles”
p.20

Recommended Practices for Handling Chlorine Tank Cars—Pamphlet 66
December 4, 2007
http://www.chlorineinstitute.org/Bookstore/ProductDetail.cfm?ItemNumber=2247

"Tank cars for chlorine use are permitted by regulation to have a maximum capacity of 90 tons (81648 kg) of chlorine. Chlorine tank cars have 55, 85 or 90 ton capacities. Tanks may not be loaded with chlorine in excess of the load limit stenciled on the side of the car."
p.8

"The weight of chlorine must not exceed 90 tons... Gross rail load must not exceed 263,000 pounds."
p.21

Congressional Budget Office:

Homeland Security and the Private Sector
December 2004
https://www.cbo.gov/doc.cfm?index=6042

"The security of the chemical industry--which includes oil and gas production, processing, and transportation--was a concern before September 11, but after that date, the increased national threat... amplified the expected losses...that many people already deemed vulnerable...."
p.21

"...September 11 indicated that the scope of potential attacks is now larger."
p.21

"EPA reported in 2000 that nearly 15,000 facilities were handling at least one hazardous substance in a quantity greater than threshold limits..., a subset of a much larger number of businesses handling a 'significant' quantity."
p.22

"Much of the overall government effort for chemical safety occurs at the state and local level and is oriented toward emergency preparedness. The federal effort (as of Dec. 2004) includes worker-safety, environmental, and information programs that are intended to support local activities."
p.27

The CBO recommends: "Better informing the public on where dangerous chemicals are, either by regulation or through public/private partnerships to disseminate information."
p.27

Congressional Research Service

Chemical Facility Security
August 2, 2006
http://www.fas.org/sgp/crs/homesec/RL31530.pdf

“Facilities handling large amounts of potentially hazardous chemicals (i.e., chemical facilities) might be of interest to terrorists… [and] the risks may be increasing—with potentially severe consequences for human health and the environment. Available evidence indicates that many chemical facilities may lack adequate safeguards.”
Summary Page (first page)

“Congress might enact legislation to reduce risks, either by ‘hardening’ defenses against terrorists… or by requiring industries to consider use of safer chemicals, procedures, or processes.”
Summary Page (first page)

Council on Foreign Relations

America the Vulnerable: How Our Government is Failing to Protect Us from Terrorism
Stephen Flynn, Senior Fellow in National Security Studies
2004
http://www.foreignaffairs.org/20020101faessay6557/stephen-e-flynn/america-the-vulnerable.html

"Congress should reconsider Senator Corzine's proposed provision to end the use of some especially deadly chemicals at plants near high population areas."
p.121

CRO Corporate Responsibility Office

"Complex Chemistry"
by Abby Schultz
June/July 2007
http://www.thecro.com/node/510

"Heather Langsner, Director of Research at Innovest Strategic Value Advisors… says Dow is right to develop green chemistries, which she notes Dow's competitors have been doing. However, Langsner is concerned with Dow's reliance on chlorine based products, such as polyvinyl chloride (PVC)."
p.20

"Observers of the company question whether Dow will ever overcome its legacy as a maker of Dursban and Agent Orange, as well as the legacy it inherited when it bought Union Carbide Corp. in 2001 On Dec. 3, 1984 a leak of methyl isocyanate (MIC) from an agricultural pesticide plant in Bhopal, India—a company in which Union Carbide held just more than half the stock—killed several thousand people. It is estimated that another 15,000 to 20,000 more people have died of complications since then, and the region is still contaminated 23 years later."
p.18

Dupont Chairman Charles Holliday

Security tops DuPont chief's concerns
News Journal Washington Bureau
By Nicole Gaudiano
June 26, 2007 and July 25, 2007
http://seclists.org/isn/2007/Jun/0120.html

In a presentation on industry risks, Mr. Holliday told the National Press Club: "I feel very comfortable that we've taken all the reasonable steps, but obviously if someone wants to fly an airplane into a plant, it's very hard to guard against it."

Falkenrath, Richard, Deputy Homeland Security Adviser to President Bush

Statement before US Senate Committee on Homeland Security and Governmental Affairs,
January 26, 2005
http://www.brookings.edu/testimony/2005/0126defense_falkenrath.aspx

"Of all the various remaining civilian vulnerabilities in America today, one stands alone as uniquely deadly, pervasive and susceptible to terrorist attack: toxic- inhalation-hazard industrial chemicals."

Federal Register
December 28, 2006

Proposed Rules

"The key difference is that they may involve effects that are more severe than expected with accidental risk."
Vol. 71, No. 249, p.78317

The Gardian

"Chemical Infrastructure Security: Good News and Bad News"
By P. J. Crowley
2006
http://www.infragardconferences.com/thegardian/ChemicaclInfra.html

"But the security dilemma is that… facilities that manufacture or use the most hazardous chemicals… are not moving fast enough to adopt safer alternatives that have been proven to be effective and economical."
p.4

"Entities that use specific chemicals should be required to study inherently safer technology or other alternatives. This analysis should be conducted annually and made available to the public and investors through annual reports or corporate filings with the Securities and Exchange Commission."
p.8

International Joint Commission:

Seventh Biennial Report
February 7, 1997
http://www.ijc.org/php/publications/html/7bre.html

"Recommendations:
....7) the Parties, in consultation with industry and other affected interests, develop timetables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks and that the means of reducing or eliminating other uses be examined."
p.54

Sixth Biennial Report
February 10, 1997
http://www.ijc.org/php/publications/html/6bre.html

"...In many cases, alternative production processes do exist... We know that when chlorine is used as a feedstock in a manufacturing process, one cannot necessarily predict or control which chlorinated organics will result, and in what quantity. Accordingly, the Commission concludes that the use of chlorine and its compounds should be avoided in the manufacturing process. We recognize that socio-economic and other consequences of banning the use of chlorine--and subsequent use of alternative chemicals or processes--must be considered in determining the timetable."
p.29

"The Commission also recognizes that certain other uses of chlorine are of special concern because of the overwhelming public health benefits from their use. Disinfection of drinking water and sewage (as well as production of certain pharmaceuticals) are uses for which public health has been protected and for which, it is claimed, there are limited or no alternatives. Yet, there is evidence that chlorinated organics are created in water treatment processes and that, in other parts of the world, alternative processes have long been in use. Again, the issue seems to be cost rather than technology."
p.29-30

K2 Pure Solutions
2007-2009
http://www.k2pure.com/

"Utilizing our new, Inherently Safe Technology (IST), K2 Pure produces exceptionally pure, high-quality bleach with nothing but water, inert salt and electricity in a vertically integrated process that eliminates the need to transport chlorine."

Ketchum/Clorox

"Crisis Management Plan for the Clorox Company"
1991
http://www.sourcewatch.org/index.php?title=Clorox

"Defining a 'crisis' is less important than knowing one when you see one."
p.33

National Research Council:

Terrorism and the Chemical Infrastructure; Protecting People and Reducing Vulnerabilities
2006
http://www.nap.edu/catalog.php?record_id=11597

"According to a 2004 U.S. Fire Administration survey, fewer than 16 percent of fire departments in this country have hazmat units."
p.53

National Journal

"Security Leak"
August 2, 2003
by Margaret Kriz

"'These chemical plants have a vulnerability which has a catastrophic characteristic… that could approximate the World Trade Center,' Rand Beers, a White House counter-terrorism adviser for 30 years, told *National Journal.*"
p.2477

"'EPA initially said that one of the things facilities ought to at least look at as part of a comprehensive vulnerability assessment is whether there are steps they can take to reduce hazards that are present at the site,' recalls a former EPA official."
p.2478

"'Chemical companies make dangerous things,' added Greg Lebedev, president of the American Chemistry Council, which represents 180 giants of the chemical manufacturing industry. 'Getting into the technology of what you make and how you make it is a subject for an environmental or technology context, not security. I don't want us to wander down an exotic path here.'"
p.2479

"Corzine describes that defeat and industry's continuing effort to water down his bill as 'a classic case of the special interest trumping the public interest.'"
p.2480

"But the battle continues over Corzine's desire to encourage industry to use inherently safer technology at the chemical facilities."
p.2480

"'The problem you have in an open society is that it's physically impossible to make any large industrial site terrorist-proof,' Barton said in an interview. 'If there are enough terrorists who are dedicated enough and equipped well enough, they're going to overwhelm everything that you put up short of some sort of Fort Knox—which doesn't make much sense, given the cost and the relatively remote possibility that any specific site is going to be targeted.'"
p.2481

National Security Advisor to the President

Richard Clarke *UPI*
August 31, 2005

"Clarke criticized the administration and the Republican-controlled Congress for not giving priority to pushing through legislation yet. 'Congress has diddled for three years on a Chemical Security Act.'"

New Jersey Work Environment Council

Safety and Security First: Protecting Our Jobs, Families, and Hometowns from Toxic Chemical Disasters
May 2006
http://inquirer.philly.com/pdfs/2006/safety.pdf

In the likely case of a terrorist attack, not to mention the "far more frequent and continuing 'routine' accidents, spills, fires, and explosions
p.16

New York City Comptroller

One Year Later: The Fiscal Impact of 9/11 On New York City
September 4, 2002
http://www.comptroller.nyc.gov/bureaus/bud/reports/impact-9-11-year-later.pdf

Palm Beach Post

"Hijacking Suspect Cased Targets, Experts Say Mohammed Atta Called a 'Little Bomb Walking Around"
by Joel Engelhardt

October, 2001
http://www.greenpeace.org/usa/assets/binaries/falkenrath-testimony

"On October 28, 2001, Danny Whitener reported Mohammed Atta's (terrorist involved in 9/11 attacks) interest in the status of a chemical storage facility—the Palm Beach Post: "According to Whitener the man asked 'So tell me about this factory I just flew over,' referring to a former copper processing plant nearby, with dozens of round steel tanks and flanked by towering smokestacks. At the time, hundreds of rail tanker cars were parked near the plant, Whitener said… 'He was just persistent about the chemical company,' Whitener said. 'I told him the tanks were empty. He came back and said 'Don't tell me that. What about all the… [rail] tanker cars?'"

Paper, Allied-Industrial, Chemical and Energy Workers International Union (PACE):

PACE International Union Survey: Workplace Incident Prevention and Response Since 9/11
October 2004
http://www.google.com/search?hl=en&client=firefox-a&rls=org.mozilla%3Aen-US%3Aofficial&hs=8f7&q=PACE+International+Union+Survey%3A+Workplace+Incident+Prevention+and+Response+Since+9%2F11+PACE&btnG=Search

"PACE-represented industries… [namely] chemical manufacturing… facilities may be targets. The communities surrounding these facilities are also at-risk."
p.ii

Of PACE workers surveyed at 133 high-risk chemical facilities…

"Less than half (44%) of the respondents indicated that their company's preventative actions, including security efforts, were effective (…*very effective, moderately effective, …[or] slightly effective)* in reducing the vulnerabilities of their site to a catastrophic event caused by a **terrorist attack.** Over one-third (36%) were *neutral* about the effectiveness, and one-fifth (21%) said the actions were ineffective."
p.*v*

"When considering responding to an event caused by a **terrorist attack**, 44% of respondents who characterized their sites as *high* risk found their company's actions ineffective."
p.*vi*

"A strong majority of respondents reported no action had been initiated by the companies at their sites to involve the local union or hourly workers in company plans or actions to *prevent* or *respond* to a catastrophic event caused by a possible **terrorist attack**…. Involvement of the community regarding company plans or actions was even lower.
p.*vi*

"It is especially sobering for those who work at or live near refineries… chemical plants.

"On February 12, [2003, the DHS sounded] another alert… warning of possible 'conventional attacks against the U.S. nuclear/chemical-industrial infrastructure… Based on information, …industrial chemical plants remain viable targets."
p.3

"This adds up to nearly 4,000 sites and tens of millions of people at risk.
p.4

Pittsburgh Tribune-Review

"Chemicals pose risks nationwide"
June 11, 2002
By Carl Prine
http://www.pittsburghlive.com/x/pittsburghtrib/news/specialreports/potentialfordisaster/s_69664.html

"A month-long probe by the Pittsburgh Tribune-Review into chemical plant security in Baltimore, Chicago and Houston found safeguards so lax that a potential terrorist can easily reach massive tanks of toxins that endanger millions of residents."

Risk Management Solutions, Inc.

http://www.rms.com/NewsPress/PR_042904_CasualtyStudy.asp

"The chlorine spill scenario results in 42,600 total casualties, over 10,000 of which are fatal. Insurance claims covering these casualties would exceed $7 billion."
p.56

"Explosions, transportation accidents, and chemical releases all pose a threat to people living, working, or traveling in the vicinity of the accident."
p.54

"Chlorine is one of many industrial agents that are harmful, yet used extensively in processing and transported in bulk. Chlorine gas is so deadly that it was used as a chemical weapon in the trenches of World War I."
p.56

Securities Exchange Commission

10K Report submitted by The Dow Chemical Company December 31, 2008
http://ccbn.tenkwizard.com/filing.php?repo=tenk&ipage=5477624&doc=1&total=&attach=ON&TK=DOW&CK=0000029915&FG=0&CK2=29915&FC=000000&BK=FFFFFF&SC=ON&TC=FFFFFF&TC1=FFFFFF&TC2=FFFFFF&LK=0000FF&AL=FF0000&VL=800080

"Local, state and federal governments have begun a regulatory process that could lead to new regulations impacting the security of chemical plant locations and the transportation of hazardous chemicals.

"Growing public and political attention has been placed on protecting critical infrastructure, including the chemical industry, from security threats. Terrorist attacks and natural disasters have increased concern regarding the security of chemical production and distribution. In addition, local, state and federal governments have begun a regulatory process that could lead to new regulations impacting the security of chemical plant locations and the transportation of hazardous chemicals, which could result in higher operating costs and interruptions in normal business operations."

p. 10

Teamsters Rail Conference:

High Alert: Workers Warn of Security Gaps on Nation's Railroads
September 2005
http://www.ble.org/pr/news/newsflash.asp?id=4185

"Engineers report that there's no distress code or signal... to alert authorities of a crisis, even as they pass through or work in rail yards close to schools, government buildings and densely populated areas."
p1

"In short, workers say, America's rail lines appear one step shy of disaster."
p1

"As Americans debate and examine the nation's post-9/11security... serious questions regarding the safety and security of the U.S. rail system remain unanswered and serious flaws go uncorrected--leaving the American public vulnerable."
p1

"...Hazardous materials, says the Department of Transportation, are potentially weapons of mass destruction, and as such, are likely targets for terrorism."
p1

"Fatigue was the focus of the NTSB investigation into the deadly June 28, 2004 train crash in Macdona... in which three people including a train conductor, died from a chlorine gas release."
p.6

"More than half the workers surveyed who saw running, unattended locomotives... said the trains were hauling hazardous materials--deadly agents like chlorine that, if released, could kill people as far as 15 miles away, according to the pamphlet 'Estimating the Area Affected by a Chlorine Release,' issued by the Chlorine Institute."
p.8

"The FBI's words were chilling: al Qaeda cells could be targeting trains carrying hazardous materials. The Bureau had captured al Qaeda photographs of railroad engines, cars and crossings, and officials said that terrorists could choose a number of strategies, 'such as destroying key rail bridges and sections of track to cause derailments or targeting hazardous material containers.'"
p.15

"Weapons of mass destruction, the workers knew, had become part of their daily lives."
p.16

"Nearly 85% of the world's chlorine… is shipped by rail, according to the International Labour Organization (ILO)."
p.16

"By the time the green, gaseous cloud had passed over Graniteville on January 6, 2005, nine people were dead… Thousands of people were evacuated from their homes. Hundreds were injured. The full extent of environmental damage is still unknown."
p.16-17

"…Since 9/11, the nation's rail carriers have, by virtually all accounts, failed to provide significant, measurable safety and security improvements to deter or respond to a terrorist attack on the U.S. rail network."
p.18

"Restrict remote control use to non-hazmat shipments."

p.18

U.S. Army

Draft Medical NBC Hazard Analysis of Chemical-Biological-Radiological-Nuclear-High Explosive Threat, Possible Scenarios & Planning Requirements
By, **Army Office of the Surgeon General**
October 2006
http://www.fas.org/irp/doddir/dod/jp3_41.pdf

As summarized by the Washington Post (http://www.washingtonpost.com/ac2/wp-dyn/A10616-2002Mar11):

“A previously undisclosed study by the Army surgeon general concludes that as many as 2.4 million people could be killed or injured in a terrorist attack against a U.S. toxic chemical plant in a densely populated area.”

U.S. Chemical Safety and Hazard Investigation Board

CSB Board Member John Bresland
February 28, 2007
http://www.chemsafety.gov/index.cfm?folder=news_releases&page=news&NEWS_ID=343

"Chlorine is a highly toxic substance that needs appropriate safeguards to prevent releases and protect the public, facility personnel, and emergency responders."

U.S. Environmental Protection Agency

Lessons Learned in the Aftermath of September 11, 2001
February 1, 2002

“General authority exists under the Safe Drinking Water Act (SDWA)/Clean Water Act (CWA) to perform vulnerability assessments, but EPA has only limited Authority to require corrective actions.”
p.2-1

“Two specific incidents where security was a specific concern were identified: (1)railroads did not want to ship chlorine in tankers after attacks, but chlorine is needed to guarantee the safety of water supplies, and (2) EPA received requests to reroute chemical tankers and trucks away from the population centers.”
p.D-14

Chemical Accident Risks in U.S. Industry
By James C. Belke
September 25, 2000
http://www.epa.gov/ceppo/pubs/stockholmpaper.pdf

“A chemical plant could effectively be converted into a weapon of mass destruction (WMD) relatively easily.”
p.5
“Toxic chemicals… particularly ammonia and chlorine… account for the majority of RMP processes.”

(with table)
p.13

“The median [negatively impacted] population for… toxic worst case scenarios is 1500 people.”
p.25

“The high number of facilities in both class intervals is primarily due to the prevalent use of 90-ton rail tank cars for chlorine storage in the United States.”
p.26

Letter from William H. Sanders III, Dr., P.H., P.E., Director, Office of Pollution Prevention and Toxics, to Rick Hind, Legislative Director of Greenpeace USA

“All chemical companies have a fundamental responsibility and a general duty to design, operate, and maintain a safe plant, prevent accidents, and to mitigate the consequences of those releases that do occur under section 112(r) of the Clean Air Act Amendments of 1990."

President Clinton’s Clean Water Initiative
February 1994

“…The Administration will develop a national strategy for substituting, reducing, or prohibiting the use of chlorine and chlorinated compounds:
Within 6 months following enactment, the Administrator should convene a task force… to comprehensively assess the use, environmental and health impacts of chlorine and chlorinated compounds, and availability and relative efficacy and safety of substitutes for these substances as used in… solvents, PVC and other plastics…”
p.22

U.S. Government Accountability Office

Protection of Chemical and Water Infrastructure
March 2005
http://www.gao.gov/new.items/d05327.pdf

"In March, 2003, we recommended that Secretary of Homeland Security and the Administrator of EPA jointly develop, in consultation with the Office of Homeland Security a comprehensive national chemical security strategy to include... legislative proposal to require chemical facilities to expeditiously assess their vulnerabilities... and... require these facilities to take corrective action."
p.6

"The nation's drinking water systems are not required to implement any risk reduction actions based on their vulnerability assessments.”
p.7

"The majority of officials at the community water systems we visited reported that the federal government should provide technical support and guidance to help the water sector in developing and implementing security enhancements."
p.7

"The majority of officials we interviewed also supported the need for the federal government to expand financial support for the security enhancements in the water sector by providing funding designated for community water systems."
p.7

“According to a 1999 study by the Agency for Toxic Substances and Disease Registry (ATSDR), security at chemical plants in two communities was fair to poor.” – ***General Accounting Office (GAO-03-439)***, March 2003

Homeland Security: DHS Is Taking Steps to Enhance Security at Chemical Facilities but Additional Authority Is Needed
January 27, 2006
http://www.gao.gov/products/GAO-06-150

"...Industry officials told us that they face a number of challenges in preparing facilities against a terrorist attack. They reported that the cost of security improvements can be a burden, particularly for smaller companies that may lack the resources larger chemical companies have to devote to security."
p.6

"Because chemical facilities pose significant risks to millions of Americans, additional legislation is needed to give DHS the authority to require security improvements at these facilities."
p.6

"...Stakeholders had mixed views, however, on the specific contents of any legislation, such as requirements that facilities substitute safer chemicals and processes--referred to as "inherently safer technologies"--that could lessen the potential consequences of an attack by reducing the risks present at these facilities, but could be costly or infeasible for some plants."
p.6

"We are also recommending that DHS... work with EPA to study the advantages and disadvantages of substituting safer chemicals and processes at some chemical facilities.”
p.7

Homeland Security: Voluntary Initiatives Are Under Way at Chemical Facilities, but the Extent of Security Preparedness is Unknown
March 2003
http://www.gao.gov/new.items/d03439.pdf

“Chemical facilities may be attractive targets for terrorists intent on causing massive damage. The risk of an attack varies among facilities, depending upon several factors, including their location and the types of chemicals they use, store, or manufacture.”
p.3

“Many facilities are located in populated areas, where a chemical release could result in injuries or death as well as economic harm.”
p.3-4

“Furthermore, both the Secretary of Homeland Security and the Administrator of EPA have stated that voluntary efforts alone are not sufficient to assure the public of the industry’s preparedness.”
p.5

“The Army has also estimated high potential damage to the population from a toxic chemical release… The Army Office of The Surgeon General propose, based on generic estimates, that it was conceivable that as many as 2.4 million people could request medical treatment if a terrorist caused a release of a toxic chemical.” p.11

“ACC’s security code generally requires that third parties… verify that [stated] improvements were implemented. The code does not require, however, that third parties verify that the vulnerability

assessment is conducted appropriately or that the actions taken by the facility adequately address security risks." p.26

"While industry recognizes the contribution that inherently safer technologies can make to reducing the risk of a terrorist attack, industry officials noted that decisions about inherently safer technologies require thorough analysis." p.29

"Chemical facilities may be attractive targets for terrorists intent on causing economic harm and loss of life. Many facilities exist in populated areas where a chemical release could threaten thousands. EPA reports that 123 chemical facilities located throughout the nation have toxic 'worst-case' scenarios where more than a million people in the surrounding area could be at risk of exposure to a cloud of toxic gas if a release occurred."

U.S. Homeland Security Council:

Planning Scenarios: *Executive Summaries*
Scenario 8: Chemical Attack—Chlorine Tank Explosion
Copyright valid through 2009
http://www.globalsecurity.org/security/ops/hsc-scen-8.htm

"Assuming a high-density area, as many as 700,000 people may be in the actual downwind area, which could extend as far as 25 miles. Of these, 5% (35,000) will receive potentially lethal exposures… An additional 15% (105,000 people) will require hospitalization… However, approximately 450,000 "worried well" will seek treatment at local medical facilities…. Most of the injured will recover in 7 to 14 days, except for those with severe lung damage. These individuals will require long-term monitoring and treatment."
Section 8, p.2

"There will be significant damage to the plant as a direct result of the attack. Decontamination of waterways may present a significant challenge as well. Environmental impacts especially public safety concerns, are likely to significantly delay rebuilding efforts.
Section p.8-3

Casualties	17,500 fatalities; 10,000 sever injuries; 100,000 hospitalizations
Infrastructure Damage	In immediate explosions areas, and metal corrosion in areas of heavy exposure
Evacuations/Displaced Persons	Up to 70,000 (self evacuate)
Contamination	Primarily at explosion site, and if waterways are impacted
Economic Impact	Millions of dollars
Potential for Multiple Events	Yes
Recovery Timeline	Weeks

Section 8, p.1'

U.S. Justice Department: Federal Bureau of Investigation
Troy Morgan FBI Agent and expert on weapons of mass destruction
June 2003

"You've heard about sarin and other chemical weapons in the news. But it's far easier to attack a rail car full of toxic industrial chemicals than it is to compromise the security of a military base and obtain these materials."

U.S. Nuclear Regulatory Commission

Edward McGaffigan, Commissioner
November 2001

"There is no chemical regulatory commission that looks at the petrochemical plants and has requirements for security that are inspected by chemical regulatory agency staff, and there are no on-force exercises, and none of the apparatus that we have in place is in place for much of the rest of the infrastructure. It is quite clear that you can get catastrophic consequences in industries other than the nuclear industry…"

U.S. Naval Research Laboratory

Dr. Jay Boris, Testimony before the Committee on Pubic Works and the Environment of the Council of the District of Columbia
January 23, 2004
http://www.greenpeace.org/usa/assets/binaries/analysis-by-us-naval-research

"Terrorist attacks in an urban environment can put 100,000 people or more at risk in a 15 to 30-minute time span…lethally exposed people can die at the rate of 100 per second."

U.S. Public Interest Group Education Fund

Protecting Our Hometowns; Preventing Chemical Terrorism in America
2002
http://www.environmentillinois.org/uploads/vX/q5/vXq5bctEDlM08AzFaZHlxg/Protecting_our_Hometowns.pdf

"The threat of terrorism require eliminating or reducing hazards through the use of inherently safer technologies wherever feasible."
p.1

"The use of airplanes on September 11th and the use of truck bombs in previous attacks show that terrorists need not penetrate a site's perimeter to cause destruction, and security alone is inadequate to prevent a terrorist attack."
p.5

"While some attention has focused on the potential for terrorists to use chemicals to build chemical weapons, national security experts have asserted that the enormous complexity of creating a chemical weapon makes such a scenario less likely than an intentionally triggered chemical release from an industrial facility. Industrial facilities provide relatively easy access to chemicals at locations from which a significant chemical release could harm large numbers of people. Amy Smithson, director of the Chemical and Biological Weapons Non-Proliferation Project at the Henry L. Stimson Center, testified in a House of Representatives committee hearing:

'Although assembling from scratch an unconventional weapons capability that could cause mass casualties is not that elementary, there are tangible routes whereby terrorists could inflict considerable harm with chemical and biological substances. One shortcut involves foul play with industrial chemicals…. Logic dictates that if the same result [mass casualties from a chemical release] can be achieved through a less arduous route, terrorists intent on causing mass casualties with chemicals would probably engineer the intentional release of industrial chemicals

rather than wrestle with the complexities of making large quantities of the classic chemical warfare agents.'"
p.6

U.S. Senator (former), Garry Hart, D-CO

Washington Post, op-ed
August 11, 2003
http://www.washingtonpost.com/ac2/wp-dyn/A42185-2003Aug10?language=printer

"As hard as it is to believe, the chemical industry has refused to take adequate precautions to safeguard its facilities and surrounding communities. Some plants have strengthened on-site security by adding guards, building fences or installing surveillance cameras. Others have committed to reducing or phasing out their use of highly hazardous processes or chemicals in favor of safer ones. Unfortunately, however, it is still business as usual at most plants. They continue to deal with high volumes of dangerous chemicals -- even when safer materials or processes are readily available. That is why the government must require industry cooperation in homeland security."

U.S. Senator (former) Barack Obama, D-IL

Senate Floor Statement
March 30, 2006
http://frwebgate.access.gpo.gov/cgi-bin/getpage.cgi?position=all&page=S2611&dbname=2006_record

"These plants are basically stationary weapons of mass destruction."
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

"While plant owners would not be able to substitute their own security standards, they would be able to come up with security plans that are tailored to each facility."
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

"The Lautenberg-Obama bill also protects state and local rights to establish security standards that match their local needs."
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

"The legislation also gives employees a seat at the table…"
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

"But there are other ways to reduce risk that need to be part of the equation. Specifically, by employing safer technologies, we can reduce the attractiveness of chemical plants as a target. This concept, known as Inherently Safer Technology, involves methods such as changing the flow of chemical processes to avoid dangerous chemical byproducts, reducing the pressures or temperatures of chemical reactions to minimize the risk of explosions, reducing inventories of dangerous chemicals and replacing dangerous chemicals with benign ones. Each of these methods reduces the danger that chemical plants pose to our communities and make them less appealing targets for terrorists."
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

"Even the chemical industry itself has embraced IST, and many facilities across the country have already employed safer technologies."
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

“So far, because the industry wields so much influence in Washington, it’s been getting its way.”
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

“We cannot allow our security to be hijacked by corporate interests.”
pS2612, CONGRESSIONAL RECORD—SENATE, *March 30, 2006*

Statement at Senate Environment and Public Works Committee hearing
June 21, 2006

“For instance, we've heard that IST is in "the early stages of development," even though it's been used in the chemical industry for nearly 30 years. Saying IST is in its infancy is a little like saying the personal computer is in its infancy.”

“We've heard that IST is an environmental issue, not a security one, even though the Departments of Justice and Homeland Security, and even the American Chemistry Council have embraced IST as part of chemical plant security in the past. And most recently, a National Academy of Sciences study, commissioned by DHS, endorsed the adoption of IST as "the most desirable solution to preventing chemical releases" from terrorist attack. Time and again, experts have agreed that IST is the most effective approach to eliminating terrorist threats at chemical facilities.”

“…But there is one thing we can all agree on: any chemical plant security legislation must be comprehensive and rational. It should balance the need to keep us safe with the need to continue producing chemical products that are essential to our economy. I believe the IST approach needs to be a part of rational comprehensive security legislation.”

U.S. Senator (former), Warren Rudman, R-NH

CBS 60 Minutes
November 16, 2003
http://www.cbsnews.com/stories/2003/11/13/60minutes/main583528.shtml

"You know, the threat is just staring us in the face. I mean, all you'd have to do is to have a major chemical facility in a major metropolitan area go up and there'd be hell to pay politically," says Rudman. "People will say, 'Well, didn't we know that this existed?' Of course, we knew."

Washington Post

Study Assesses Risk of Attack on Chemical Plant
By Eric Pianin
March 12, 2002
http://www.highbeam.com/doc/1P2-326046.html

“A previously undisclosed study by the Army surgeon general concludes that as many as 2.4 million people could be killed or injured in a terrorist attack against a U.S. toxic chemical plant in a densely populated area.”

Toxic Chemicals' Security Worries Officials
By Eric Pianin
November 12, 2001
http://www.mapcruzin.com/news/rtk111201a.htm

"'No one needed to convince us that we could be-and indeed would be-a target at some future date,' said Frederick L. Webber, president of the American Chemistry Council, an industry group representing 180 major companies including Dupont, Dow, and BP Chemical."

Working Group on Community Right-to-Know:

Unnecessary Dangers: Emergency Chemical Release Hazards at Power Plants
July 2004
http://www.crtk.org/library_files/PowerPlantsReport.pdf

"The data in this report also show that… just two-dozen power plants account for two-thirds of the people in danger. By using readily available safer chemicals these two-dozen plants could all but eliminate the danger to 2.4 million people."
p.3

"Some 166 power plants report using anhydrous ammonia, endangering an average of 21,506 people around each facility."
p.3

"Forty power plants report chlorine gas as their greatest emergency release hazard, endangering an average of 4,618 nearby residents."
p.3

"National data show frequent ammonia and chlorine spills at industrial facilities. The National Response Center received reports of… 2,200 releases involving chlorine gas. Spills reported… range from minor to very large."
p.6

"By switching to readily available and inherently safer pollution control options these power plants could eliminate or significantly reduce dangers that accidents or acts of terrorism pose to surrounding communities."
p.7

"Agencies that have issued such warnings include the Department of Homeland Security, Department of Justice, Environmental Protection Agency, General Accounting Office, Congressional Research Service, Agency for Toxic Substances an Disease Registry, Naval Research Laboratory, and Army Surgeon General." … (list continues)
p.12

"The power industry should curtail unnecessary dangers by: converting high hazard power plants in populated areas to readily available safer alternatives to anhydrous ammonia and chlorine gas."
p.15

May 10, 2010

Attn: Daniel Horowitz
Chemical Safety and Hazard Investigation Board
Office of Congressional, Public, and Board Affairs
2175 K Street, NW, Suite 650
Washington, DC 20037

Re: Docket Number CSB-10-01

Questions for Public Comment

1. Does the proposed Task Statement include the appropriate topics for consideration by the NAS? Are there any additional general or specific topics the NAS panel will need to consider in order to reach a satisfactory answer on the feasibility and costs of reducing the use and storage of MIC?

Answer: Given the near miss of another Bhopal magnitude disaster at Bayer's Institute West Virginia facility, it is reasonable that Congress would be interested to know if this kind of risk is preventable. On April 21, 2009 The Energy and Commerce Committee issued a memo:
http://energycommerce.house.gov/Press_111/20090421/supplementalmemo.pdf
The Committee raised serious questions about why the Bayer facility is the only U.S. facility that continues to store and use methyl isocyanate (MIC) to make an obsolete pesticide more than 25 years after the Bhopal tragedy and after all other U.S. chemical facilities have adopted safer processes.

Given the widespread availability of commercially operating facilities using safer processes across a wide range of facilities that once used, stored or made substances such as MIC or similar toxic-by-inhalation (TIH) substances that pose catastrophic risks up to twenty-five miles from their point of release, the NAS should focus on three areas:

A) The relatively few exotic processes still in use that pose inherently dangerous risks to employees and surrounding communities.
B) Advice to the Chemical Safety and Hazard Investigation Board on ways to incorporate safer process recommendations into each of their accident investigations.
C) Conduct a literature search (see attached) that documents the hundreds of applications of safer chemical processes now in use and the benefits in terms of costs savings, reduced liability and fewer regulatory obligations as a result of their conversion to safer processes.

2. If funds are available, should the CSB initiate a second, related study to consider the feasibility, costs, and benefits of inherently safer alternatives to other chemicals? For example, should a study consider alternatives to the use of hydrogen fluoride in refinery alkylation processes and/or to the use of chlorine in water treatment? What other chemicals or processes should be considered if a second study is undertaken?

Answer: Most U.S. refineries already use safer alternatives to the most hazardous hydrogen fluoride (HF) process. The NAS should now focus on the most promising safer alternative, the solid acid process. This process appears to have the greatest potential to eliminate catastrophic risks to refinery employees and surrounding communities.

A study of the use of chlorine gas in water treatment, however, may not be the best use of NAS time and resources given the many operating alternatives, all of which eliminate these catastrophic risks to employees and surrounding communities. A literature search (see attached) of these alternatives should prove invaluable for the remaining water facilities still using chlorine gas as they pursue safer alternatives best suited for their facility.

3. What kinds of backgrounds and expertise should be represented on the NAS panel?

Answer: We strongly recommend that the panel be composed of experts who are free of conflicts of interest, represent a range of stakeholders including non-management employees, community representatives, academic and environmental experts.

4. Is the proposed timetable appropriate?

Answer: Yes, one year should be more than enough time to assemble the wealth of data, literature and commercially operating safer alternatives in use in facilities across the U.S. We caution against any study that postpones the implementation of common sense, widely available alternatives that can eliminate catastrophic risks to millions of Americans.

Additional Considerations and Background:

The Urgency of the Post 9/11 Era:
The September 11th terrorist attacks successfully used our own infrastructure against us with tragic results. They also demonstrated that tight perimeter security, such as in the case of the Pentagon, is incapable of preventing such attacks. Should a chemical plant be targeted, a truck bomb, a small plane, helicopter or a high powered rifle would easily render the industry's current reliance on fence-line security totally useless. In fact, U.S. chemical facilities have been referred to by then Senator Obama on the Senate floor as ***"stationary weapons of mass destruction."***

The recent attempted terrorist attack in New York City's Times Square is a sobering reminder of the nearly nine years of neglect following the 9/11 attacks. The vulnerability of U.S. chemical plants to terrorism and serious accidents such as the 1984 disaster in Bhopal, India and in the fatal 2008 accident in Institute, West Virginia have been widely recognized. The potential magnitude of these risks far surpasses the 9/11 attacks. Once released these chemicals and gases can remain dangerous for up to 14 miles in an urban area (20 miles in a rural area) and put the lives of millions of Americans at risk. **A December 2009 Congressional Research Service analysis of Environmental Protection Agency (EPA) data identified 91 chemical facilities that each put 1,000,000 or more Americans at risk.**

The nature of these risks meets any definition of a weapon of mass destruction. The manner in which people would be killed and injured is terrifying. Poison gases such as chlorine will literally melt the lungs of its victims causing them to drown in their own lung fluid (pulmonary edema). Survivors could be left with life long disorders.

Following the 9/11 attacks it was reported that 9/11 ringleader, Mohamed Atta, visited a Tennessee chemical plant asking lots of questions (December 16, 2001 Washington Post). In the first six months of 2007 at least five successful terrorist attacks in Iraq used relatively small (150 to 250 pound) cylinders of chlorine gas to kill dozens of people. As a result the Department of Homeland Security (DHS) began briefing local bomb squads and chemical plants across the country. (April 24, 2007 USA Today) In February and April of 2007 thefts of 150 pound cylinders of chlorine gas occurred in California prompting questions by members of this Committee to the DHS about their response to these thefts, any other thefts and plans to eliminate these vulnerabilities by using inherently safer technologies.

U.S. chemical facilities were not built or designed to defend against terrorist attacks. And predicting where an attack will take place is a fool's errand. No one predicted that Timothy McVeigh would attack the Federal Building in Oklahoma City in 1995, killing 168 innocent people.

On June 25, 2007, duPont Chairman Charles O. Holliday Jr. told the media that he worries most about a computer system failure or a security breach at one of the company's chemical plants around the world. "I feel very comfortable that we've taken all the reasonable steps, but obviously if someone wants to fly an airplane into a plant, it's very hard to guard against it," said Holliday.

Stephen Flynn, Senior Fellow in National Security Studies at the Council on Foreign Relations warned in his 2007 book, The Edge of Disaster, " "...While attacks on the electric grid, oil and gas facilities, major ports, and the food-supply system have the potential to create the greatest cascading economic effects, it is chemical facilities near urban population centers that have the potential to inflict the greatest casualties. Placing them at the top of the list of priorities is obvious...In most cases, chemical plants that threaten nearby populations can switch to less dangerous substances. This practice is known as "inherently safer technology," or IST…Without a strong mandate from the federal government, it's unrealistic to think they ever will. Yet voluntary compliance is the premise of the legislation Congress passed last fall [2006]; the new rules rest on the assumption that companies will now suddenly begin taking steps they have so far refused to contemplate."

A Terrorist Attack or Accident Would be Catastrophic:
--- In July, 2004, the Homeland Security Council estimated that an attack on a single chlorine facility could kill 17,500 people, severely injure an additional 10,000 and result in 100,000 hospitalizations and 70,000 evacuations.

--- In January, 2004, the U.S. Naval Research Laboratory testified before the Washington, D.C. City Council warning that 100,000 people could be killed or injured in the first 30 minutes of a catastrophic release of a tank car of chlorine or similar chemical within blocks of Capitol Hill. They further estimated that people could "die at rate of 100 per second."

--- In June, 2003 FBI specialist on weapons of mass destruction, Troy Morgan, in a speech at a chemical industry conference warned, "You've heard about sarin and other chemical weapons in the news. But it's far easier to attack a rail car full of toxic industrial chemicals than it is to compromise the security of a military base and obtain these materials."

Commercially Available Safer Processes Prevent Disasters:
In February 2008, the CEO of Association of American Railroads said, ***"It's time for the big chemical companies to do their part to help protect America. They should stop manufacturing dangerous chemicals when safer substitutes are available. And if they won't do it, Congress should do it for them…."***

There are commercially available safer alternatives for virtually all of the poison gas or toxic-by-inhalation (TIH) substances that pose the greatest risks to hundreds of urban areas. The Center for American Progress (CAP) conducted an analysis of EPA's Risk Management Program data and identified 284 facilities that have converted since 1999. See full report at: http://www.americanprogress.org/issues/2006/04/b681085_ct2556757.html

Examples of conversions from TIH chemicals and continuing threats include:

--- More than 550 water treatment facilities (including Washington, D.C.) converted to safer alternatives such as ultraviolet light, eliminating the use of **chlorine** and **sulfur dioxide** gas. At least 73 water treatment plants still threaten more than 100,000 people.

--- Ninety-eight petroleum refineries use safer alternatives to **hydrogen fluoride (HF)**. But 50 refineries still threaten millions of people with the use of HF.

--- At least 36 electric power plants use safer alternatives to **anhydrous ammonia** gas such as dry urea. But 166 power plants still use anhydrous ammonia gas each threatening an average of 21,506 people.

--- The Blue Plains sewage treatment plant (like more than 550 other water treatment plants all over the US) in Washington, D.C. halted its use of chlorine and switched to safer chemicals just eight weeks after the 9/11 attacks due to fears of another attack. The plant had seven rail cars of chlorine on sight following the 9/11 attacks. The conversion only cost approximately $0.50 per year for each water customer. In other words, by using safer technologies we can neutralize and eliminate targeting by terrorists and prevent catastrophic accidents as well at negligible costs.

--- In November 2009, the Clorox Company announced plans to convert all seven of its U.S. facilities. This conversion will eliminate Clorox's bulk use of chlorine gas and risks to more than 13 million people in nearby communities.

--- In December 2008 Dow Chemical and K2 Pure Solutions announced an agreement in which K2 Pure would supply Dow's Pittsburgh, California facility with small quantities of chlorine gas produced in just-in-time batches by K2 Pure, thus eliminating the risks associated with bulk on-site storage and transport of chlorine gas.

This CAP analysis shows that 87% of the converted facilities spent less than $1 million and one third expected to save money, particularly from reduced liability costs and reduced regulation compliance costs. Clearly these conversion costs pale in comparison to the cost of disaster response, relocating communities, defending against personal injury law suits or resolving environmental clean up liability or even conventional security costs.

While the CAP analysis also proves the feasibility of safer alternatives, CAP estimates that at this rate of conversion, without any new regulatory requirements, it will take 45 years to eliminate hazards that pose the highest risk to America's hometowns. A 2008 CAP analysis

identified 300 chemical facilities that together put 110 Million Americans at risk. The DHS needs the authority to prioritize the conversion of the highest risk plants first.

A 2006 GAO report (GAO-06-150), Homeland Security DHS Is Taking Steps to Enhance Security at Chemical Facilities, But Additional Authority Is Needed, concluded, “Implementing inherently safer technologies potentially could lessen the consequences of a terrorist attack by reducing the chemical risks present at facilities, thereby making facilities less attractive targets.”

A 2006 report by the National Academy of Sciences issued a report called “Terrorism and the Chemical Infrastructure: Protecting people and Reducing Vulnerabilities” which said, “The most desirable solution to preventing chemical releases is to reduce or eliminate the hazard where possible, not to control it. This can be achieved by modifying processes where possible to minimize the amount of hazardous material used, lower the temperatures and pressures required, replace a hazardous substance with a less hazardous substitute, or minimize the complexity of a chemical process.”

A Government Accountability Office report (GAO-05-165) identified chlorine gas and 90-ton chlorine rail cars as "among the top five terrorist-related wastewater system vulnerabilities." Among the top three recommendations: "Replacing gaseous chemicals used in wastewater treatment with less hazardous alternatives." In addition, the largest majority of experts gave replacing these chlorine facilities the highest priority for federal funding.

The Benefits of Safer Technologies:
The use of safer technologies offers a more competitive and stable business plan with fewer regulations, potentially zero liability, sustainable profitability, better relationships with workers and neighboring communities and no threat of a catastrophic attack or accident. Specifically, the use of safer technologies will likely result in a facility no longer being subject to federal safety and security regulations.

Chemical facilities located on site at nuclear power plants, water treatment works, iconic facilities such as Disney World, Camp David, etc. also need to be considered for priority protection. However, using safer technologies as a countermeasure at these facilities will lessen the lethality that an attack on them would pose. Given the finite nature of government and industry resources it is urgent that we use safer technologies to reduce the consequence of an accident or attack. By doing so we eliminate risks, safeguard communities and save scarce money and resources to protect targets that cannot be so neutralized (airports, U.S. Capitol, etc.).

Sincerely,

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Comments on the Design of the Study "Inherently Safer Chemical Processes: The Use of Methyl Isocyanate at Bayer Cropscience" by the National Academy of Sciences
[Docket No. CSB-10-01]

Mary Kay O'Connor Process Safety Center

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May 10, 2010

Comments on the Design of the Study "Inherently Safer Chemical Processes: The Use of Methyl Isocyanate at Bayer Cropscience" by the National Academy of Sciences
United States Chemical Safety and Hazard Investigation Board
[Docket No. CSB-10-01]

This statement was prepared by the Mary Kay O'Connor Process Safety Center (MKOPSC) at Texas A&M University. Founded in 1995, the Center conducts programs and research activities that enhance safety in the chemical process industries. Educational activities of the Center promote safety as second nature to everyone in the industry. In addition, the Center develops safer processes, equipment, procedures, and management strategies to minimize losses within the processing industry. The Center supports the U.S. Chemical Safety and Hazard Investigation Board (CSB) and welcomes opportunities to assist the CSB in its mission to improve safety in the process industry.

ANSWERS TO QUESTIONS FOR PUBLIC COMMENT ON THE DESIGN OF THE STUDY "INHERENTLY SAFER CHEMICAL PROCESSES: THE USE OF METHYL ISOCYANATE AT BAYER CROPSCIENCE" BY THE NATIONAL ACADEMY OF SCIENCES

1. **Q: Does the proposed Task Statement include the appropriate topics for consideration by the NAS? Are there any additional general or specific topics the NAS panel will need to consider in order to reach a satisfactory answer on the feasibility and costs of reducing the use and storage of MIC?**

   A: The proposed task statement in fact, includes adequate topics. Additionally, previous worldwide incidents involving MIC should be examined in order to extract the lessons learned and recommendations from each incident, which may be useful in the development of alternatives for the process. Although in the second task, the risk of incidents and transportation associated with alternatives is reviewed, it should be noted that a quantitative risk assessment may be needed in addition to a qualitative risk assessment. Also, risk transference should be part of the risk analysis, since some alternatives may reduce or eliminate one hazard, but create another hazard.

2. **Q: If funds are available, should the CSB initiate a second, related study to consider the feasibility, costs and benefits of inherently safer alternatives to other chemicals? For example, should a study consider alternatives to the use of hydrogen fluoride in refinery alkylation processes and/or to the use of chlorine in water treatment? What other chemicals or processes should be considered if a second study is undertaken?**

   A: If possible CSB should definitely initiate another study to consider alternatives to other chemicals, specially, toxic inhalant hazard chemicals mentioned in Appendix A of 6 CFR Part 27. The scope of this effort would need to be realistic in terms of time and resources, balanced with the expectation of original work vs. a compilation of existing studies for various chemicals.

3. **Q: What kinds of backgrounds and expertise should be represented on the NAS panel?**

   A: As it was stated, the panel should be of diverse backgrounds. Process safety experts in risk assessment and individuals with experience in inherently safer design, optimization and process integration should definitely be on the team. Expertise and experience in both academic and industrial backgrounds is key to the development of a robust study. Since alternatives certainly need to include the environmental impact of alternatives to air, water, soil, it is necessary that the panel include an expert in this area. The team should also include perspectives representing impacts to the work force and local community.

4. **Q: Is the proposed timetable appropriate?**

   A: The project could be finished most likely in 18 months, rather than 12 months. We would recommend quarterly reports rather than monthly work on the project vs. report writing. Instead, CSB could hold teleconferences with the panel every month.

Hon. John Bresland
Chairman and CEO
US Chemical Safety and Hazard Investigation Board
Washington, DC

May 10, 2010

Dear Mr. Bresland,

The American Institute of Chemical Engineers (AIChE), and its Center for Chemical Process Safety (CCPS) are pleased to have the opportunity to present comments regarding the subject study.

In regard to task #1, "Review and evaluate the state of the art in inherently safer process assessments and implementation", we encourage the National Academies to bear in mind the following work which has previously addressed these tasks:

- Definition of Inherently Safer Technologies: AIChE/CCPS has developed a scientifically-based definition of Inherently Safer Technologies under contract to the US Department of Homeland Security. The final report is due to be issued later in May, 2010, but the definition may be viewed now at http://www.aiche.org/Conferences/Specialty/GCPS/IST.aspx
- Current practices of IST: In 2009, AIChE/CCPS published the second edition of "Inherently Safer Technologies: A Lifecycle Approach", which explores this subject in depth
- Metrics: In 2007, AIChE/CCPS published leading and lagging process safety metrics, and elaborated considerably on this topic in "Guidelines for Process Safety Metrics." This work has become formalized in the American Petroleum Institute's Recommended Practice 754

AIChE/CCPS has access to considerable expertise and literature pertaining to process technology, process safety, and inherently safer technologies. If AIChE/CCPS can be of further assistance as the National Academies pursue this study, please feel welcome to contact either AIChE Executive Director June Wispelwey or me.

Thank you for the opportunity to comment on this subject.

Scott Berger
Executive Director
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The Global Community Committed to Process Safety
http://www.ccpsonline.org

The Honorable John Bresland, Chairman
U.S. Safety and Hazard Investigation Board2175 K Street, N.W., Suite 400
Washington, D.C. 20037-1809

Dear Chairman Bresland:
The response by People Concern's spokeswoman, Ms. Maya Nye to your Board's resquest for public comment pertaining to the National Academy of Science's Study is very eloquently stated and very much inclusive of community concerns about the stated issue. It is my personal opinion, however that the "feasibility study" will prove to be time consuming, allowing more time for our lives to be at risk; too much time when added to the years that MIC has been located in our community, and the years since the Bhopal disaster of 1984, and the almost two years since the explosion at the Bayer Plant in August of 2008 when apparently it first became obvious to some Government officials that we have lived with great potential for tragedy due to the storage and use of MIC at Bayer, and that we continue to do so.

In your comments you refer to the "thousands of public fatalities" resulting from the Bhopal, India tragedy. Reference should also be made regarding the numerous ongoing illnesses and mutations in children born since the Bhopal incident, and for the potential for it to continue for years that nobody can number, and the travesty that yet surrounds the accident's mystery. Reference should also be given with great scrutiny to the conditions that the Guilty chemical company left in Bhopal as they vacated, and that the current owner yet allows to remain, including soil and drinking water contamination. It's a scenario that could also happen here. Inconceivable was an article I read in the Washington Post indicating that their governmental environmental leader, who may unknowingly add to the suffering and shame of that travesty, plans to use the locale and unchanged plant area of tragedy as a museum piece for tours. He very obviously is lacking in truth and knowledge regarding the dangers of such chemicals as is the case of many of our local and federal representatives. The point in case, is what more could be necessary to prove that MIC has no place in our community, or in any other American community, or indeed in any community in the World?

In your comments you also mention that following the Bhopal incident of 1984, many chemical companies largely phased out the use and bulk storage of MIC due to safety concerns. If I had said to my class of kindergarteners that the persons making those decisions obviously had good reasons for doing so, I am sure that my young students in their own words would have reasoned that if those persons of expertise who dealt with such a dangerous chemical on a daily basis felt it necessary to eliminate its storage and use in order to protect their workers and surrounding neighbors, then it would probably be good for everyone else to do the same. That is close to how a kindergartener would reason..IF they were privy to such information. Perhaps the surviving siblings and parents of the young children involved in the Bayer and Peruvian Children "accident," and the remaining students in that Peruvian school would reason likewise, that "if it's not around it can't harm."

A provision of $600,000 or even "healthy" remnants of that amount would probably be enough to at least initiate a study of our health and health concerns, centered around exposure to the deadly and debilitating chemicals stored at the Bayer Cropscience plant in Institute; since it seems impossible to get honest and adequate evaluation of our health from the medical profession when it involves chemicals even if our healthcare plans are excellent. It could also be used for a study of past and disproportionate illnesses and premature deaths in our community and those of close proximity, or for a feasibilty study on the need for a useful toxicologist in our locale. It could also be utilized in assessing how much danger and harm has and is being caused by the presence of chemicals buried beneath and piped around our homes, school facilities, children play areas, parks and golf courses, or to educate the citizens including children, how to make the best of "the hand they've been dealt."

Finally, it would appear to me that your Chemical Safety Board and quite possibly the National Academy of Sciences, with all of your competence, accomplishments and past investigations are probably already familiar enough with the dangers and "past sins" of Methyl Isocyanate to support its complete removal from around our homes, and from around the young students at West Virginia State University whose lives are endangered everyday. Those students work and study within a "stone's throw" of some of the deadliest chemicals known to man and some of them, potentially, because of a foreseeable and

preventable accident, may never live to see their dreams and goals fulfilled; trusting students like the young WVSU freshman who died after a breathing attack a few days following the August 2008 explosion. That youngster left his dorimitory for help from the local hospital, and he was told he was all right and sent back to his dormitory. A day or so later he tried again to get help from the local hospital but this time was sent back to his parents in a box. It is said that a young female student also suffered a breathing attack that week, but some students were informed by their teachers that it was thought to be "probably" food poisoning from a restaurant connected to their dorm. The young lady lived and the restaurant to our knowledge was never investigated. It is our understanding that she was asked to go home but refused. It is quite possible and probable that neither the death of the young man nor the illness of the young lady was investigated in regards to the explosion and it's quite possible that had it been investigated the occurrances may have been found totally unrelated. We may never know.

These are points respectfully submitted for your thought and consideration. I appreciate your interest and your work.

Sue F. Davis
Box 24
Institute, WV 25112
tutemom@hotmail.com

May 10, 2010

National Association of SARA Title III Program Officials
Concerned with the Emergency Planning and Community Right-to-Know Act

May 10, 2010 *Electronically Submitted – via e-mail.*

Chemical Safety and Hazard Investigation Board
Attn: D. Horowitz
2175 K St NW, Ste 650
Washington, DC 20037

Re: Comments to Docket No. CSB-10-01

Dear CSB:

The National Association of SARA Title III Program Officials (NASTTPO) is made up of members and staff of State Emergency Response Commissions (SERCs), Tribal Emergency Response Commissions (TERCs), Local Emergency Planning Committees (LEPCs), various federal agencies, and private industry. Members include state, tribal, or local government employees as well as private sector representatives with Emergency Planning and Community Right to Know (EPCRA) program responsibilities, such as health, occupational safety, first response, environmental, and emergency management. The membership is dedicated to working together to prepare for possible emergencies and disasters involving hazardous materials, whether they are accidental releases or a result of terrorist attacks. Thank you for the opportunity to comment on this proposal.

NASTTPO strongly supports this effort. There is a tremendous need for a systematic analysis of inherently safer process assessment and implementation. CSB is correct to take this approach in setting the tasks for the NAS study authorized by Congress. We believe CSB has correctly interpreted the intention and objectives of Congress with this project and, specifically, that Task 1 is critical to the proper completion of Task 2.

With the understanding that we broadly support and endorse the approach being taken by CSB, we have some suggestions:

1. We agree that NAS should convene an expert panel. Our suggestion is that the expert panel explicitly includes individuals with community-based emergency planning and emergency response backgrounds. This would be in addition to people with experience in community organization and work with disadvantaged individuals.

   Our thinking on this topic is based upon several fundamental beliefs. First, that inherently safer processes or technology does not equate with the absence of accidents. We anticipate that the potential impacts on a community and the need for community-based emergency planning and response will need to be more sophisticated than the current approach. Now we are typically focused on evaluating the impacts of an accident based on the quantity of stored hazardous chemicals. It is possible that the analysis of accident scenarios at facilities practicing inherently safer processes may change to looking at releases of in-process materials and a response scenario where the reaction by-products involved present greater hazards that stored precursor chemicals and products.

   Second, that there is a fundamental difference between planning and response, especially with regard to the standards and metrics that might relate to inherently safer processes and technology. Inherently safer processes no doubt involve changes in traditional delivery, storage and handling procedures. All of these potentially change the way communities evaluate and plan for chemical accidents.

2. When we look at inherently safer processes and technology it occurs to us there is some aspect of the analysis that needs to include the community context of the facility involved. What might be inherently safer in one place may actually increase risks in another due to changes in transportation or risks presented by the unique conditions of a facility and where it sits in a community. A focus solely

on the engineering aspects of inherently safer processes is too limited in our view. It is quite possible that the Task 1 activities described in the proposal are broad enough to encompass these issues, but it would be useful to articulate that the analysis conducted under Task 1 not be solely focused on life-cycle benefits and risks to the facility.

Thank you.

Timothy R. Gablehouse
President
410 17th St, Ste 1375
Denver CO 80202
(303) 572-0050

Bayer CropScience

May 10, 2010

William B. Buckner

Chemical Safety and Hazard Investigation Board
Office of Congressional, Public, and Board Affairs
Attn: D. Horowitz
2175 K Street, NW
Suite 650
Washington, DC 20037

Re: Docket Number CSB-10-01, National Academy of Sciences Study

Bayer CropScience appreciates the opportunity to provide written comments with regard to the proposed National Academy of Sciences study of methyl isocyanate (MIC) storage and use at our Institute facility in West Virginia, as directed by the Chemical Safety and Hazard Investigation Board, and funded by Congressional appropriation legislation for fiscal year 2010.

Bayer CropScience fully supports measures that enhance the safe storage and use of MIC in our production facility. The processes used in the manufacture, storage and use of MIC have been examined and refined over the long use history of this intermediate. As previously announced we believe the process currently used to produce MIC, coupled with our proposed $25 million investment plan to further reduce MIC inventories by 80% and to eliminate all above-ground storage, properly address safety concerns related to MIC production for a manufacturing facility of our scope and size.

Also, following the incident on 28 August 2008, Bayer CropScience has implemented numerous important changes in our manufacturing operations. These include the hiring of new safety personnel, improved communication and safety equipment, extensive training and compliance programs, improved employee/community communications and more frequent drills to test emergency preparedness response capabilities.

In summary, Bayer CropScience understands and appreciates the concerns of others over the production and use of MIC at the Institute Industrial Park. The tragic accident on 28 August that took the lives of two of our employees is a constant reminder of the highest need for vigilance in our

focus on safety. We welcome any additional insights that may come from the National Academy of Sciences study and will strive to cooperate fully with the panel as the study progresses.

Sincerely,

William B. Buckner
President and CEO
Bayer CropScience LP