Public Comment on National Academy of Sciences Study on Use of Toxic Methyl Isocyanate (MIC), Inherently Safer Technology Alternatives

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.

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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 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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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

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.

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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
mailto:karouna@earthlink.net
Sent: Tuesday, April 27, 2010 2:27 PM
Subject: MIC IMPORTANCE

April 27, 2010

Dr. Daniel Horowitz
Director of Congressional, Public, and Board Affairs
Chemical Safety and Hazard Investigation Board
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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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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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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.

Nguyen, Quang [mailto:Quang.Nguyen@us.rhodia.com]

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.

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,

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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)